Über dieses Buch

Dies ist ein digitales Exemplar eines Buches, das seit Generationen in den Regalen der Bibliotheken aufbewahrt wurde, bevor es von Google im Rahmen eines Projekts, mit dem die Bücher dieser Welt online verfügbar gemacht werden sollen, sorgfältig gescannt wurde.

Das Buch hat das Urheberrecht überdauert und kann nun öffentlich zugänglich gemacht werden. Ein öffentlich zugängliches Buch ist ein Buch, das niemals Urheberrechten unterlag oder bei dem die Schutzfrist des Urheberrechts abgelaufen ist. Ob ein Buch öffentlich zugänglich ist, kann von Land zu Land unterschiedlich sein. Öffentlich zugängliche Bücher sind unser Tor zur Vergangenheit und stellen ein geschichtliches, kulturelles und wissenschaftliches Vermögen dar, das häufig nur schwierig zu entdecken ist.

Gebrauchsspuren, Anmerkungen und andere Randbemerkungen, die im Originalband enthalten sind, finden sich auch in dieser Datei – eine Erinnerung an die lange Reise, die das Buch vom Verleger zu einer Bibliothek und weiter zu Ihnen hinter sich gebracht hat.

Nutzungsrichtlinien

Google ist stolz, mit Bibliotheken in partnerschaftlicher Zusammenarbeit öffentlich zugängliches Material zu digitalisieren und einer breiten Masse zugänglich zu machen. Öffentlich zugängliche Bücher gehören der Öffentlichkeit, und wir sind nur ihre Hüter. Nichtsdestotrotz ist diese Arbeit kostspielig. Um diese Ressource weiterhin zur Verfügung stellen zu können, haben wir Schritte unternommen, um den Missbrauch durch kommerzielle Parteien zu verhindern. Dazu gehören technische Einschränkungen für automatisierte Abfragen.

Wir bitten Sie um Einhaltung folgender Richtlinien:

+ *Nutzung der Dateien zu nichtkommerziellen Zwecken* Wir haben Google Buchsuche für Endanwender konzipiert und möchten, dass Sie diese Dateien nur für persönliche, nichtkommerzielle Zwecke verwenden.

+ *Keine automatisierten Abfragen* Senden Sie keine automatisierten Abfragen irgendwelcher Art an das Google-System. Wenn Sie Recherchen über maschinelle Übersetzung, optische Zeichenerkennung oder andere Bereiche durchführen, in denen der Zugang zu Text in großen Mengen nützlich ist, wenden Sie sich bitte an uns. Wir fördern die Nutzung des öffentlich zugänglichen Materials für diese Zwecke und können Ihnen unter Umständen helfen.

+ *Beibehaltung von Google-Markenelementen* Das "Wasserzeichen" von Google, das Sie in jeder Datei finden, ist wichtig zur Information über dieses Projekt und hilft den Anwendern weiteres Material über Google Buchsuche zu finden. Bitte entfernen Sie das Wasserzeichen nicht.

+ *Bewegen Sie sich innerhalb der Legalität* Unabhängig von Ihrem Verwendungszweck müssen Sie sich Ihrer Verantwortung bewusst sein, sicherzustellen, dass Ihre Nutzung legal ist. Gehen Sie nicht davon aus, dass ein Buch, das nach unserem Dafürhalten für Nutzer in den USA öffentlich zugänglich ist, auch für Nutzer in anderen Ländern öffentlich zugänglich ist. Ob ein Buch noch dem Urheberrecht unterliegt, ist von Land zu Land verschieden. Wir können keine Beratung leisten, ob eine bestimmte Nutzung eines bestimmten Buches gesetzlich zulässig ist. Gehen Sie nicht davon aus, dass das Erscheinen eines Buchs in Google Buchsuche bedeutet, dass es in jeder Form und überall auf der Welt verwendet werden kann. Eine Urheberrechtsverletzung kann schwerwiegende Folgen haben.

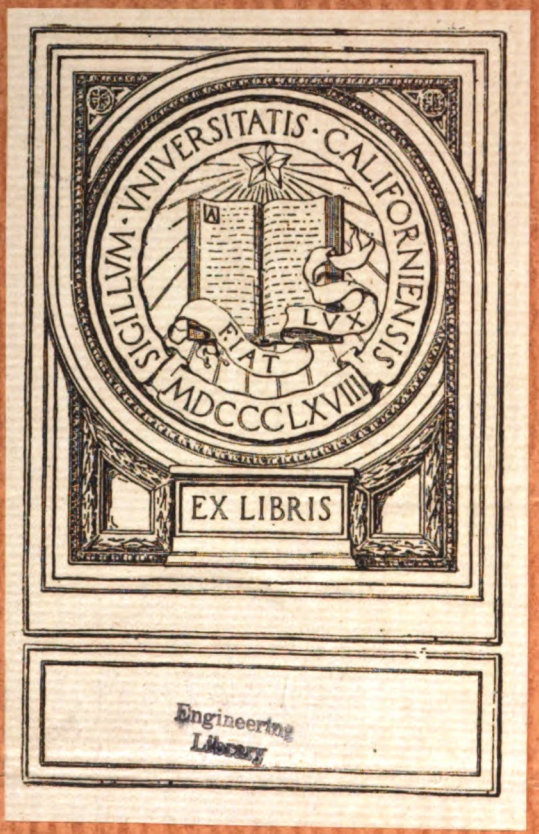
Über Google Buchsuche

Das Ziel von Google besteht darin, die weltweiten Informationen zu organisieren und allgemein nutzbar und zugänglich zu machen. Google Buchsuche hilft Lesern dabei, die Bücher dieser Welt zu entdecken, und unterstützt Autoren und Verleger dabei, neue Zielgruppen zu erreichen. Den gesamten Buchtext können Sie im Internet unter `http://books.google.com` durchsuchen.

This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com



Engineering
Library

Digitized by Google

Digitized by Google

Digitized by Google

INDEX TO VOL. XLVI

Electrical Review

NEW YORK

JANUARY 7 TO JUNE 24, 1905

Univ. of California

Digitized by Google

TK1
E4-8
Engineering
Library

INDEX TO VOLUME XLVI

ELECTRICAL REVIEW

JANUARY 7 TO JUNE 24, 1905

Articles marked * are illustrated; (E) indicates "Editorial;" (P) indicates notes under "Recent Electrical Patents;" (R) indicates "Reviews of Current Engineering Literature."

A

Abrasive materials, method of fastening to metal bodies (P)..... 208
Absorption dynamometer..... 326
Acetylene gas lighting in France (E). 139
Accuracy checks of switchboard instruments, by Clayton H. Sharp..... 242
Acyclic dynamo, the (E)..... 182
Acyclic (homopolar) dynamos, by J. E. Noeggeratt*..... 188
Acetylene, precautions in the use of (E) 446
Adjustable vapor discharge (P)*..... 464
African telegraph line, the great..... 653
Agriculture, electricity in (E)..... 397
Agriculture, electricity in, by C. L. Durand* 422
Air-insulated cables, the manufacture of, by Emile Guarini..... 104
Alliance of Massachusetts Institute of Technology with Harvard, the proposed 840
Alternating-current machine (P)*..... 945
Alternating-current motor (P)*..... 428
Alternator, a high-frequency..... 107
Alternator for 120,000 cycles per second, an..... 562
Aluminum electrolytic condenser, the (E) 800
Aluminum electrolytic condenser, the, by C. I. Zimmerman*..... 813
American Electrochemical Society, the meeting of the (E)..... 717
American Institute of Electrical Engineers 25
34, 118, 162, 197, 297, 376, 472, 501
544, 665, 737, 766, 804, 852, 882
American railway appliance exhibition, 562, 718, 762
American Telephone and Telegraph Company, annual report of the.... 535
American Trade Press Association, meeting of the.....251, 318
American machine exports to Germany, review of..... 25
Ampere-meter for high-potential circuits, an (R)..... 546
Amsterdam-Haarlem tramway system, the 196
Amusement telephones..... 374
And still the wonder grows (E)..... 561
Animas Canal, Reservoir, Water, Power and Investment Company..... 534
Annual dinner of the American Institute of Electrical Engineers, the, 25, 161, 184, 226
Annual meeting of the American Institute of Electrical Engineers..... 802
Annual meeting of the Technical Publicity Association..... 783
Annual report of the Cuyahoga Telephone Company, the..... 367
Annual report of the Mackay Companies, the..... 358
Annunciator (P)*..... 886
Anthracite coal mines, electricity in the, by Robert Thurston Kent*.563, 613
Apparatus for mechanically checking recording wattmeters, new..... 683
Apparatus for nickel-plating (P)*..... 382
Apparatus for producing high vacua (P)* 120
Apparatus for testing the insulation of coils (P)*..... 336
Apparatus for transforming electrical energy (P)* 337
Application of electricity to steam roads, by S. Cass..... 283
Application of electric power at mines in Germany, notes on the, by E. O. F. Brown..... 901
Application of the cymometer to the measurements of coefficiencies of coupling of oscillation transformers 611
Application of electricity to heavy freight and trunk line railways.. 691
Application of the differential galvanometer to exact measurement of resistance, by W. Jaeger, translated by M. G. Lloyd*..... 981
Application of wireless telegraphy for domestic purposes, by W. J. Hammer 340
Arc in a magnetic field, the (R)..... 381
Arc, the electric (E)..... 44
Arkansas Valley Electric Company, the, by J. E. Johnston*..... 881
Armature coils and ozone (R)..... 426
Atmospheric electricity, influence of the sun on meteorology and..... 15
Australian tramway systems, by John Plummer 379
Automatic appliances, the use of (E).. 1001
Automatic block system, an (R)..... 628
Automatic fire-alarm..... 103
Automatic telephone exchange at Battle Creek, Mich.*..... 250
Automatic telephone exchange at Columbus, Ohio, new*..... 975
Automobile Club of America, new clubhouse and garage for the..... 882
Automobile displace the tramway? will the (E)..... 399
Automobile freight line between Lima and Callao 379
Automobile parade, the..... 664
Automobiles and electric cars for Lima, Peru 932
Automobiles, electric (R)..... 252
Automobile show, Chicago, fourth annual 103
Automobile shows in New York city 118
Automobile shows, the (E)..... 99
Auxiliary dynamo for controlling an accumulator installation, the use of an (R)..... 628

B

Battery (P)*..... 782
Belfast, Ireland, railways, electrification of the..... 25
Berlin private telegraph exchange, the (R) 426
Best economy of the piston steam engine at the advent of the steam turbine, the, by James E. Denton.... 574
Bimetallic rheostats (R)..... 699
Blake-Morscher electrical ore-separator, the (R)..... 1023
Bone fractures treated by electricity.. 21
Book Reviews.
American Telephone Practice. Miller 774
A Treatise of the Theory of Alternating Currents. Russell..... 424
Cyclopædia of Applied Electricity.. 460
Diseases of Electrical Machinery. Schulz 424
Dry Batteries..... 460
Electrical Circuits and Diagrams, illustrated and explained. Schneider 460
Elements of Mechanics. Merriman 661
Electricity in Everyday Life. Houston 278
Electric Lighting for the Inexperienced. Walter..... 424
Electric Furnaces and Their Industrial Applications. Wright..... 116
Experimental Researches on the Flow of Steam Through Nozzles and Orifices. Rateau..... 622
Ferric and Heliographic Processes. Brown 460
Gas-Engines and Producer-Gas Plants 839
How to Install Electric Bells, Annunciators and Fire-alarms. Schneider 460
La Bobine d'Induction. Armagnat. 424
Laboratory and Factory Tests in Electrical Engineering. Sever and Townsend..... 424
Letters of Petrus Perigrinus on the Magnet, The. Brother Arnold and Brother Potamin..... 14
Maxwell's Theory and Wireless Telegraphy. Poincaré, Vreeland. 116
Mechanical Engineer's Reference Book. Supplee..... 661
Modern Electrical Construction. Horstman and Tousley..... 973
Practical Electric Light Fitting. Allsop 774
Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes. Paulding. 15
Producer Gas for Power Purposes. Tookey 424
Producer Gas. Sexton..... 425
Self-Propelled Vehicles. Homans. 278
Short Course in Alternating Currents. Townsend..... 460
Steam Turbines. Stodola..... 578
Suction Gas. Haenssgen..... 460
Telephone Principles and Practice. Wilder 278
Telephone Service. Webb..... 278
Telephone Troubles and How to Find Them..... 460

Digitized by Google

BOOK REVIEWS—*Continued.*
The Art of Generating Gear Teeth.. 460
The Beginner's Guide to the Lathe. 460
The Berlin-Zossen Electric Railway Tests of 1903. Welz..... 774
The Insulation of Electric Machines. Turner and Hobart..... 622
The Mechanical Engineer's Pocketbook. Kent..... 424
The Pocketbook of Refrigeration and Ice-Making. Wallis-Tayler.. 774
The Steam Engine. Heck..... 1004
The Study of Electricity for Beginners. Schneider..... 460
The Telegraphist's Guide to the Departmental and City and Guilds Examinations in Telegraphy. Bell and Wilson..... 774
Bolometer for the absolute measurement of radiation, a..... 984
Bouvier speed governor, the (P)..... 338
Bradford, England, breakdown, the.... 71
Branding apparatus, an electrical (P)*. 208
British railways, electric motor cars for 585
Breakdown of the Bradford, England, municipal light and power station.. 6
Breaks in overland telegraphic communication due to storms (R).... 299
British Royal Commission on coal supplies 335
Buenos Ayres, electric cabs in..... 845
Burning out of electric street-car controllers (R)..... 785

C

Cable-laying (R)..... 123
Cable, the choice of an insulated, by Wallace S. Clark*..... 933
Cables, the manufacture of air-insulated, by Emile Guarini*..... 104
Cable work, early..... 65
Cadmium amalgam lamps, the (R).... 380
Calcium metal (R)..... 78
Canadian Niagara district, power plant in the (R)..... 253
Canadian Niagara Power Company's turbines, test of the..... 4
Canal telephone exchange at Cincinnati, Ohio, the new, by J. E. Peavey* 185
Can a steam turbine be started in an emergency quicker than a reciprocating engine of the same power? by A. S. Mann..... 1005
Candle-power of searchlights and flashlights, the (E)..... 99
Carborundum for meter bearings, by M. Van Every..... 840
Car equipment of the single-phase railway system..... 290
Caronia, the new Cunard liner..... 423
Caronia, the Cunard twin-screw steamship 465
Caustic alkalies in the nickel-iron accumulator, the use of (R)..... 823
Celebes-Guam cable, the..... 1023
Central station development (E)..... 223
Central station protection..... 897
Century's "Great Inventions" series, the 693
Charge carried by the X-rays from radium 490
Charging station for electrically operated vehicles (P)*..... 857
Chattanooga Electric Company, the power plant of the*..... 319
Chicago automobile show, fourth annual 103
Church Stretton, England, gas-driven electricity works (R)..... 784
Circuit-making and breaking relay (P)* 209
City noises (E)..... 489
Coal, the world's production of..... 466
Coal-cutting machines, the advantages of electric (E)..... 45
Colorado Springs Electric Company, by E. P. Dillon*..... 927
Columbus, Ohio, new automatic telephone exchange at*..... 975
Combination of dust destructors and electricity works economically considered, by W. P. Adams*....16,110, 156
Combined single-phase and continuous-current traction..... 885
Commercial aspect of engineering, the, by C. A. S. Howlett..... 448
Commercial electrical engineering..... 621
Communicative elephant, a*..... 944
Commutator, the difficulty with the, by Stanley S. Seyfert*..... 492
Comparison of New York and London transit systems..... 562
Compensated single-phase shunt motor, notes on the (R)..... 1022
Compounding of alternators (E)..... 140
Compound dynamo brush..... 781
Condensed specifications and forms of proposals for the construction of Chicago municipal street railways 970
Condensers for high vacuum..... 362
Conductivity of very dilute hydrochloric and nitric acid solutions, electrical (R)..... 78
Conical wind motor, the (R)..... 26
Conneaut, Ohio, the electric ore unloaders at*..... 721
Considerations relating to the design of the armature slot insulation in high-voltage, alternating-current generators (R)..... 858
Control for prime movers driving alternators in parallel (P)*..... 337
Control of electric locomotives, by William Cooper..... 568
Convenience of the small motor, the (E) 525
CONVENTIONS.
American Electrochemical Society.. 297, 402, 619, 731
American Institute of Electrical Engineers 804, 882, 940, 971, 1002
American Railway Master Mechanics 926, 973, 1020
American Society of Mechanical Engineers 838, 972
Bell Telephone Managers..... 423
Electrical Contractors' Association of New York State..... 248
Electrical Contractors' Association of Ohio, the..... 145
Independent Telephone Association of Wisconsin.....118, 199
Independent Telephone Association of Nebraska, the..... 161
International Association of Municipal Electricians.....326, 685, 970
International Railway Congress... 663, 682, 718, 761, 818
Iowa Telephone Association....469, 509
Iowa Electrical Association....682, 739
Kansas Independent Telephone Association 335
Master Car Builders' Association.. 926, 973
CONVENTIONS—*Continued.*
National Electric Light Association 453, 534, 663, 766, 804, 838, 883, 922, 962
National Electrical Trades' Association 974
National-Interstate Independent Telephone Association.....974, 1003
National Machine Tool Builders.. 655
New York State Independent Telephone Association..... 852
Northwestern Electrical Association 25, 150
Ohio Electric Light Association.. 4
Ohio Independent Telephone Association 508, 562
Street Railway Association of the State of New York..... 945
South Dakota Telephone Association 161
Texas Independent Telephone Association 146
Copper, a big chunk of..... 804
Copper in Honduras..... 838
Copper production, world's..... 851
Corrosion of condenser tubes (R)..... 164
Cost of lighting, the..... 306
Cost of electric lighting in various cities 987
Cotton machinery, the driving of, by electricity (R)..... 122
Counterweights on large engines, by D. S. Jacobus* 1011
Curious comments (E)..... 715
Current, a pertinacious (E)..... 607

D

Dallas, Tex..... 534
Death of Mr. Edward H. Mullin..... 161
De Cew Falls, Ontario, power station, the 169
Denver Gas and Electric Company, the electrical properties of the, by C. W. Humphrey*..... 874
Designing of fixtures for modern lighting, the, by A. H. Patterson..... 59
Detector for Hertzian waves, a (R)... 338
Determination of the commercial efficiency of continuous-current machines 326
Development in electric traction, by W. B. Potter..... 142
Diamond dies (E)..... 559
Diesel engine at Rothesay, England (R) 26
Diesel engines in electricity generating stations, the (R) 299
Dinner of the Indianapolis Telephone Company 766
Dinner to the Swedish delegates to the International Railway Congress... 783
Direct-current dynamos, the separation and analysis of losses in (R)..... 165
Direct-reading resistance thermometers 612
Direct Wheatstone working between England and Teheran (R)..... 206
Discharge of electrically charged electrolytic surfaces by light (R)..... 946
Disruptive distance in air (E)..... 225
Distribution and dollars, by C. H. Williams 232
District heating, report of committee on, 1018
Dominion of Canada, the wire situation in..... 72
Driving two alternators in parallel, by R. E. Spencer Geare..... 621
Doubling the capacity of a street (E). 753
Dynamo-electric machine (P)*..... 588

356156

Digitized by Google

E

Economy in recharging..... 586
Eddy-current brake for testing motors, the, by D. K. Morris and G. A. Lister*..... 892
Eddy-current losses in massive pole-shoes (R)..... 462
Effect of load-factor on cost of power, by E. M. Archibald*..... 358
Efficiency of electric hauling gears, the (R)..... 338
Efficiency of steam engines, the..... 8
Efficiency of steam plant, some notes on the (R)..... 822
Efficiency of the incandescent lamp, the (E)..... 560
Efficiency of the incandescent lamp, the, by William Kent..... 648
Efficiency of the incandescent lamp, the, by George H. Gibson..... 683
Electrical absorption brakes (E)..... 723
Electrical apparatus for measuring speed..... 656
Electrical driving of shops, the (E)... 835
Electrical distribution in Paris in the future..... 501
Electrical equipment of a London hospital, the (R)..... 252
Electrical equipment of the New York *Times* building, the..... 147
Electrical equipment of Messrs. Harland & Wolff's shipbuilding works, the (R)..... 628
Electrical equipment of suburban lines of the Great Western Railway, England..... 340
Electrical exhibition..... 720
Electrical industry and its relation to the mineral industry (E)..... 140
Electrical manufacture of light and the lamp of the future (R)..... 666
Electrical manufactures in England... 340
Electrical measuring instruments (E). 716
Electrical men enjoy planked shad.... 854
Electrical methods of measuring temperature (E)..... 357
Electrical mining machinery in South Africa..... 847
Electrical mining notes, by Sydney F. Walker.....684, 775
Electrical notes from Europe, by C. L. Durand.....114, 414, 776, 941
Electrical power in mines (E)..... 3
Electrical repairs at sea (R)..... 822
Electrical speed indicator, an..... 783
Electrical standards and units..... 809
Electrical system (P)*..... 382
Electrical theories, by Dr. John Trowbridge..... 55
Electrical transfusion, by James Edmondson, M. D..... 413
Electrical transmission in Europe (E) 3
Electrical transmission of power..... 49
Electrically propelled fire engines (R). 986
Electrically driven Semet-Solvay coke plant of the Wigan Coal and Iron Company, Limited, near Wigan, England (R)..... 805
Electric conductor support (P)*..... 590
Electric crane at St. Triphon Quarries, Switzerland, by C. L. Durand*.... 529
Electric elevator control (P)*..... 588
Electric elevators (E)..... 999
Electric generator (P)*..... 590
Electric hoisting at a French colliery.. 284
Electricity and bread..... 192
Electricity as a means to an end (E).. 313
Electricity for Rio..... 472
Electricity for city work (E)..... 2
Electricity from the cold combustion of hydrocarbons (R)..... 123
Electricity from water power *versus* gas (R)..... 666
Electricity in mines..... 7
Electricity in 1904, a review of the year 46
Electricity in the "City of the Holy Cross," Cal. (R)..... 859
Electricity in the anthracite coal mines, by Robert Thurston Kent*.....563, 613
Electricity on steam roads, by C. F. Street..... 723
Electric lighting during fogs (E)..... 44
Electric lighting in New England, by C. L. Edgar..... 49
Electric lighting of railway trains (R) 592
Electric lighting of trains in Belgium.. 253
Electric locomotive (P)*..... 120
Electric locomotive for the Valtellina line*..... 1008
Electric motor (P)*..... 121
Electric plant for the Nilgiri, India, cordite factory (R)..... 427
Electric plants for the supplying of electricity to London..... 704
Electric porch lights (E)..... 679
Electric power for spinning mills..... 706
Electric power in an office building (E) 2
Electric power in New Zealand..... 172
Electric radiography (R)..... 252
Electric railroads in Connecticut in 1904..... 4
Electric railway operation in a great city, by H. H. Vreeland..... 334
Electric railway problems (E)..... 679
Electric railway situation, the, by Dr. Louis Bell..... 51
Electric railways—the art and the men, by Frank J. Sprague..... 324
Electric recording instrument (P)*.... 665
Electric service during storms (E).... 271
Electric snap switch (P)..... 857
Electric state railway experiments in Sweden..... 149
Electric stove (P)*..... 209
Electric supply in the Gate City, by Alton D. Adams*..... 73
Electric traction on the North Eastern Railway*..... 754
Electric tramways and light railways in England..... 654
Electric tramways in Lima..... 1004
Electric trucks in Cologne, Germany... 337
Electric water power from the Great Lakes (E)..... 1
Electrification of an important English railway (E)..... 224
Electrification of the Metropolitan Railway, the..... 8
Electrification of the London, Brighton & South Coast Railway, England.. 251
Electrification of railroads (E)..... 183
Electrification of trunk lines, the, by W. Caryl Ely..... 48
Electrochemical and Electrometallurgical industries in 1904, progress in the, by J. B. C. Kershaw..... 52
Electrodes, improvement in (P)..... 208
Electrogasoline vehicle (P)*..... 623
Electrolysis of platinum (E)..... 607
Electrolytic corrosion in underground pipes, by Aloc A. Beadle..... 19
Electrolytic detectors of electric waves. 667
Electrolytic preparation of tin plate, by F. Gelstharp..... 66
Electrolytic preparation and production of calcium, strontium and barium (R)..... 785
Electrolytic rectifier, the theory of the (R)..... 785
Electromagnetic metal washing machine (P)*..... 208
Electromagnetic wave receiver (P)*.. 336
Electromechanical compounding of generator sets (R)..... 78
Electrostatic voltmeter for high potentials, an (R)..... 667
Electrotherapeutic apparatus (P)*.... 821
Eliminating isolation and distance from farm life..... 200
Enclosed mercury reversing commutator, an (R)..... 462
Engineering and commerce..... 117
Engineering, lines of progress in (E).. 43
Engineering, telephone line, by C. J. H. Woodbury..... 100
Europe, electrical notes from, by C. L. Durand.....114, 414, 776, 941
Evening courses in electric transportation..... 1003
Exhibition of cooking by electricity... 804
Extraction of nitrogen from the air... 200

F

Facilitating export and import business with Austria..... 547
Faraday society, the..70, 367, 579, 692, 943
Field for the illuminating engineer, a, by Louis B. Marks..... 620
Financial statement of the United States Telephone Company..... 466
Fire-alarm, automatic..... 103
First electric railway in Manila..... 627
First transmission of power in Europe at 40,000 volts, the, by Enrico Bignami*..... 11
First woman telephone operator, the* 903
Fish shoals located by electric apparatus..... 19
Five-thousand-horse-power turbo-alternator at Frankfort, Germany (R) 123
Fixation of nitrogen, the (E)..... 141
Fogs, electric lighting during (E)..... 44
Foreign scientists to lecture at Columbia University..... 583
Form of voltage curves before and after transformation, the (R).... 698
Formosa, electric plant in..... 412
Forty thousand volts, the first transmission in Europe, at, by Enrico Bignami*..... 11
Foucault currents in the armatures of continuous current machines (R). 426
Frame for dynamo electric machine (P)*..... 464
Franklin Institute election..... 7
Franklin Institute, the.....512, 663
Fuel economy in steam power plants, by William H. Booth and J. B. C. Kershaw.....327, 370, 410
Fundamental features of electric elevators, by E. R. Carichoff*..... 1006
Furnace, a simple experimental (E)... 681
Furnace, electric (E)..... 524
Future of railways, the (R)..... 339
Future of the electric automobile, the (R)..... 629

Digitized by Google

G

Gas and electric plant at Muskogee, I. T., the* ... 238
Gas engine ignition dynamo (P)* ... 22
Gas engines, some continental central stations operating with, by Franz Koester* ... 60
Gaslights in bedrooms (E) ... 255
Gas turbine, the ... 852
Gas turbine, the question of the (R) .. 947
General instructions for accepting electrical machinery (R) ... 463
German electrical developments ... 452
German electrical firms combine ... 648
German electrical industries ... 211
German electrical installations—mine drainage and ventilation (R) ... 165
Germany, electrical combinations in ... 585
Germany, statistics of electric power plants in (R) ... 427
Giving a dog a bad name (E) ... 609
Good roads convention ... 861
Government light and power plant, a (E) ... 356
Grand Junction Electric and Gas Company, by J. E. Johnston* ... 881
Group photograph of the members present at the dinner of the Technical Publicity Association* .. 910
Great Lakes, electric water power from the (E) ... 1
Grounded transmission mediums, by J. Stanley Richmond* ... 5
Gyroscope, electrically propelled ... 184

H

Hair-drying apparatus (P) ... 163
Heating effect of the gamma-rays of radium ... 21
High-speed railroad in Germany (E) .. 182
Heat-conducting insulating varnishes (R) ... 858
Heating, electrical system of (P)* ... 781
Heating, electric (E) ... 1001
High-pressure in electric railroading .. 582
High-pressure line construction for alternating-current railways, by Theodore Varney* ... 686
High-speed electric railway tests in Germany ... 855
High-speed, long-distance, electric traction at the New York Electrical Society ... 804
High-speed, long-distance, electric traction, by Charles A. Mudge ... 936
High-speed railway propositions in Germany ... 231
High-speed railways (E) ... 837
High-speed trains (E) ... 919
High temperatures, the measurements of ... 780
High-tension apparatus, a possible danger to (E) ... 273
High-tension insulators* ... 887
High-tension underground hauling gear 577
Hippodrome, the application of electricity in the New York* ... 694
Homopolar dynamos (R) ... 462
Hongkong, electric tramways in (R) .. 207
How to remember the wire table, by Charles F. Scott ... 653
Hydroelectric developments at Grenoble, France ... 25
Hydroelectric installation of Trubigo, Lombardy, Italy (R) ... 947
Hydroextractors, an electric drive for* . 402

I

Imperfect contacts, a contribution to the study of (R) ... 164
Incandescent lamp (P)* ... 337
Incandescent lamp as a foot-warmer, the (E) ... 681
Incandescent lamp manufacturers' meeting ... 297
Incandescent lamps (R) ... 987
India, electrical project in ... 821
Indianapolis & Cincinnati Traction Company, the* ... 291
India rubber in 1904 ... 358
Induction apparatus (P)* ... 22
Induction motors and the fire hazard, by George F. Sever ... 572
INDUSTRIAL SECTION.
Air compressors at the St. Louis World's Fair. L.-D.-G. Co ... 346
Allis-Chalmers literature, some notable. A.-C. Co ... 125
Alternating-current apparatus, new. A. E. & C. Co.* ... 599
Alternating-current and direct-current solenoids. A. E. & C. Co.* .. 864
Alternating-current ceiling fans. H. F. & M. Co.* ... 669
Apparatus for automatically transcribing Morse signals.* ... 668
Apparatus for the new power-house of the Ohio Street Railway Company ... 475
"Arc-burst," a new form of. B. E. Mfg. Co.* ... 81
Arc lamp, new form of. L. B.* ... 432
Armature disc and segment notching-press. E. W. B. Co.* ... 344
Adams secondary generator, the. W. S. Co.* ... 258
Allis-Chalmers sales-office organization, change in ... 263
Alternating-current solenoid brake applied to induction motors. G. E. Co.* ... 213
Arc-lamp resistance, high-tension transformers and autostarters. W. E. & Mfg. Co.* ... 826
Asbestos building lumber. W. & McD.* ... 740
Automatic electric controller, an. A. E. Co.* ... 862
Automatic numbering machine, a new. B. M. Co.* ... 988
Automatic release starters and motors for heavy duty. C.-H. Co.* .. 864
Automatic reversible starters for alternating-current motors. A. S. Co.* ... 596
Automatic speed adjuster, a new. C.-H. Co.* ... 744
Automatic starter for induction motors, an. A. E. & C. Co.* ... 791
Automatic system of refrigeration, an. F. A. R. Co ... 385
Battery fan motor outfit, a new. E. M. & E. Co.* ... 704
Battery switch, a new. A. K. Mfg. W.* ... 172
Belt-driven alternator, a new form of. G. E. Co.* ... 170
Belt-type, alternating-current generators. C.-W. Co.* ... 477
Best Manufacturing Company's valves* ... 383
Bids wanted—water power electric plant ... 861

INDUSTRIAL SECTION—*Continued.*
Bijur high-duty storage battery, the. G. S. B. Co.* ... 705
Blake electric railway signal. B. S. & Mfg. Co.* ... 33
Blake insulated staples, the. B. S. & Mfg. Co.* ... 88
Burke Electric Company—fire not serious ... 516
Business suggestion, a good ... 29
Cable clamp, a new. D. E. B. Co.* 432
Cable dog, a new type of. S. E. B. Co.* ... 991
Cable-laying engine. F. M. Co.* .. 171
Carey-Foster bridge and commutator, the. Q. & Co.* ... 551
Cartridge fuse cutouts. H. T. P. Co.* ... 263
Case controller, the. C. Mfg. Co.* . 550
Ceiling board, new form of. G. E. Co.* ... 706
Ceiling switch, a new form of. P. S.* ... 258
Central Electric Company's plant burned ... 306
Changes in the Arnold Electric Power Station Company ... 513
Closing bulkhead doors by electricity. L. A. S. Co.* ... 386
Combination fan, a new type of. E. E. Co.* ... 476
Combination gasoline soldering iron and blow torch. E. B. Mfg. Co.* ... 790
Comparative test of a small boring mill with and without maintained cutting speed. A. E. & C. Co.* ... 260
Consolidation of the Stanley Electric Manufacturing Company and the General Incandescent Arc Light Company ... 788
Consolidation of the Ingersoll-Sergeant Drill Company and the Rand Drill Company ... 1028
Constant-potential inverted arc lamp. C. J. T. Co.* ... 80
Construction of telephone systems. A. E. Co ... 668
Contracts for pumping on a large scale. A. C. Co ... 791
Cook protector, a new. F. B. C.* .. 429
Cooper Hewitt mercury-vapor converter. C. H. E. Co.* ... 548
Crescent time switch. C. Co.* ... 259
Crocker-Wheeler Company, annual convention of the officers and branch office managers* ... 264
Cutler-Hammer "Compound" starting and regulating rheostats. C.-H. Co.* ... 342
Dan River Power and Manufacturing Company. W. E. & Mfg. Co.* 595
Decade resistance box, a new. L. & N. Co.* ... 825
Demonstration of electric heating and cooking apparatus at R. H. Macy & Company. P. E. Co.* .. 80
Demonstration of heating and cooking by electricity. P. E. Co ... 701
Deutsch electric train-lighting system. E. C. & S. Co.* ... 863
Direct-current generating set with horizontal engine. I. E. & Mfg. Co.* ... 256
Direct-current dynamos and motors, a new line of. S.-G. I. Co.* . 909

Digitized by Google

INDUSTRIAL SECTION—*Continued.*

Direct-connected, variable-speed motor drive for planers. E. C. & S. Co.* ... 341
Direct-reading bond-tester. M. & R.* ... 84
Dixon crucible meeting ... 788
Double-speed telegraph key, a. J. H. B. & Co.* ... 90
"Duplex" mast arm, the. B. S. Mfg. Co.* ... 825
Dull's carbon type flasher. R.-D. F. Co.* ... 384
Duncan direct-current wattmeter, the. D. E. Mfg. Co.* ... 83
Dynamotor, a new type of. N. E. M. Co.* ... 950
Eastern Carbon Works product ... 259
Efficiency tests of a 400-kilowatt steam turbine. W. M. Co.* ... 988
"Economy" switch, the. S.-M. E. Co.* ... 671
Electrical department of the Allis-Chalmers Company, the ... 90
Electrical specialties, new. C. J. M. 169
Electrically operated whistle, an. E. A. Co.* ... 258
Electric Appliance Company, Chicago, a new home for the* ... 906
Electric flashlights. S. & P.* ... 171
Electric launch, the. E. L. Co.* ... 700
Electric ventilating fans. C. W. Co.* ... 861
Electricity in industrial applications. W. E. & Mfg. Co. ... 630
Electro-lifting magnets. E. C. & S. Co.* ... 304
Electromagnetic clutch and brake, an. W. E. M. Co.* ... 745
Enclosed automatic engine. C. & T. Co.* ... 433
Entrance switch, a new iron-clad. T. E. Co.* ... 905
Equipments being installed by the Allis-Chalmers Company ... 595
Exhibit of the H. W. Johns-Manville Company* ... 950
Extensions to the Carnegie Institute Building at Pittsburg. N. E. Co. ... 346
Extensive additions to the Allis-Chalmers Milwaukee works ... 669
Extensive power plant equipment. A.-C. Co. ... 630
Fast railroad service as a business aid ... 476
Fan outfits. R. & M. Co.* ... 598
"Firefly," the. C. O. S.* ... 430
Flexible steel-armored hose. S. E. Co.* ... 473
Flywheel accidents and their prevention. C. E. S. Co. ... 85
Fort Wayne Electric agents' Convention ... 130
Fort Wayne induction integrating wattmeters, the. F. W. E. W.* ... 824
Fort Wayne integrating wattmeters. F. W. E. W.* ... 515
Fort Wayne prepayment wattmeters. F. W. E. W.* ... 948
Fort Wayne prepayment wattmeters. F. W. E. W. ... 989
Four thousand kilowatt alternators for the Chicago Sanitary District. C.-W. Co.* ... 513

INDUSTRIAL SECTION—*Continued.*

Fuseless rosettes. T. E. Mfg. Co.* 259
Ganz system of three-phase alternating-current electric traction in the United States ... 1024
General Electric Company, annual report of the ... 746
Grinnell cable-hauling machine, the. K. C. Co.* ... 167
Hancock valves, the. H. I. Co.* ... 85
Handsome railway congress souvenir, a ... 825
Hartford time switch, the. H. T. S. Co.* ... 88
"Hiko" electrical specialties. A. Mfg. Co.* ... 431
Henry S. Manning retires from the firm of Manning, Maxwell & Moore ... 130
High-tension oil switches. H. C.-B. Co.* ... 904
High-tension strain insulator. L. I. Mfg. Co.* ... 514
Hubbell pull sockets. H. H.* ... 862
Hydraulic governor, a new form of. L. G. Co.* ... 633
Ignition timing apparatus. A. K. Mfg. Co.* ... 1028
Improved angle wall sockets. H. T. P. Co.* ... 430
Incandescent lamp filaments. S.-M. Co. ... 264
Incandescent lamp, new form of. M. A. Co.* ... 906
Incorporation of Manning, Maxwell & Moore ... 952
Induction motor in a tannery. G. E. Co.* ... 387
Industrial beneficial association, an. C.-W. Co.* ... 599
"Innovate" adjustable hangers, the. I. Mfg. Co. ... 631
Insulator book, the. L. I. Mfg. Co. 261
Interesting exhibit, an ... 34
"Interpole" variable-speed motor, the. E. Co.* ... 89
Jandus series alternating arc lighting system. J. E. Co.* ... 255
Lamp socket, new form of. E. L. S. Co.* ... 828
Large flashed sign at the St. Louis exposition. R. Mfg. Co.* ... 82
Largest electric motor ever built, the. A.-C. Co.* ... 429
"Liberty" turbine cleaner, the. L. Mfg. Co.* ... 124
"Little Giant" hand punch, the. R. & M.* ... 128
"Loew" grease and oil separator, the. L. S. Mfg. Co.* ... 342
Los Angeles-Pacific railroad ... 385
Lubricants, a new method of testing* ... 1024
Luminous radiator, the. G. E. Co.* ... 789
Lundell universal motors. N. E. Co.* ... 168
Madison Square Garden electrical show ... 599
Magnetic couplings and accelerators. C.-H. Mfg. Co.* ... 671
Manufacture of Armington & Sims engines, the ... 632
Manufacture of field and armature coils, to. M. W. Co. ... 701
Marshall sockets. M. E. Mfg. Co. 80
"Metaphone," the* ... 631

INDUSTRIAL SECTION—*Continued.*

Milo G. Kellogg's present plans and work* ... 952
Mine conductor line material, new. G. E. Co.* ... 990
Modern hydraulic elevator plant, a* 951
Moulding branch block, a new type of. E. C. E. Co.* ... 950
Motor-starting panels with circuit-breakers. W. E. & Mfg. Co.* 305
National Electric Company reorganized ... 745
Newcode receptacle. S. & P.* ... 789
New district offices of the National Electric Company ... 305
New electrical apparatus. W. E. & Mfg. Co.* ... 742
New attachment plugs and Fielding receptacles. H. T. P. Co.* ... 591
New design of field rheostats. W. L. Co.* ... 597
New electric light plant at Cook County Court House, Chicago ... 599
New Westinghouse electrical apparatus* ... 786
New York Telephone Company's new directory ... 1028
Novelties for fixture work. S. Co.* 431
Open feed-water heaters in connection with steam turbines. H. S. B. W.* ... 166
Orders for Allen-Bradley controllers. A. E. F. Co. ... 701
Orders for Westinghouse draft gear. W. A.-B. Co. ... 949
Ore and coal-handling machinery. W.-S.-M. Co. ... 1028
Oscillating fan, a new. P. E. Co.* 863
Outlet box, a new. S. Co.* ... 790
Panel-board cabinets. H. O. S. Eng. Co.* ... 257
Pease blue-print washing and drying machine. C. F. P.* ... 260
Peerless thawing transformer, the. P. E. Co.* ... 306
"Pen-Dar" all steel locker, the. E. D. & S. Co.* ... 86
Pointers. A. V. C. Co. ... 261
Pole cable terminal. F. B. C.* ... 385
Portable electrical internal grinder, a. H.-W. Co.* ... 597
Portable electric power plant, a. F. G. E. Co.* ... 124
Portable electrically driven grinders and drills. H.-W. Co.* ... 384
Portable photometer. Q. & Co.* ... 515
Portable wattmeter calibrators. F. W. E. W.* ... 28
Prize contest for the design and finish of motor cars, a. G. N. P. Co. ... 672
Prometheus system of electric heating and cooking. P. E. Co.* ... 262
Publicity. D. G. & E. Co. ... 704
Queen standard potentiometer. Q. & Co.* ... 473
Queen standpipe rheostats. Q. & Co.* ... 473
Quick deliveries to Mexico from the Schenectady works of the General Electric Company ... 514
"Reco" electric sign flasher, the. R. E. F. Mfg. Co.* ... 81
Recording voltmeter for both direct and alternating current. B. Co.* ... 989

Digitized by Google

INDUSTRIAL SECTION—*Continued.*
Removal of the general offices of the Allis-Chalmers Company.... 597
Reynolds-Corliss engines..... 434
Richmond Electric Company's induction motors*..... 949
Rock drills on the Panama Canal. I.-S. D. Co.*..... 634
Sales organization of the Westinghouse Machine Company, new arrangement in the..... 864
"Sarco" specialty, a new. S. Co.*.. 88
Selective central-call system, the. T. & A.*..... 344
Shade-holder, a simple wire. J. S.-H. Co.*..... 634
Single-phase alternating-current crane motor, a new. W. E. & Mfg. Co.*..... 860
Single-phase integrating wattmeter, a new. W. E. & Mfg. Co.*..... 87
Single-phase motors for electric hoist and traveling crane service. W. E. Mfg. Co.*..... 549
Skeleton bells. S. & P.*..... 129
Small dynamos and motors. R. M. C. Co.*..... 214
Small electric light equipments. R. E. Co.*..... 478
Small, engine-driven, revolving-field generators. G. E. Co.*..... 345
Small motors wanted..... 431
Small multipolar motors. D. Mfg. Co. 474
Some new snap switches. M. E. Co.* 256
Some new automatic telephone exchange installations. A. E. Co.* 594
Some recent installations of water-wheels. A. D. Co..... 598
Special commutators. H. C. Co.... 598
Standard wiring for electric light and power..... 211
Stanley rotated jewel-bearing wattmeter. S. I. Co.*..... 210
Starting compensators for alternating-current motors. G. E. Co.* 632
Steam turbine plant in the Klondike 346
Steel-armored cable fittings. S. Co.* 630
Sterling Company's book on boilers, the..... 790
Subway station panels. W. & Co.* 82
Switchboard ammeters and voltmeters. T. E. Co.*..... 212
Switch type of Queen decade portable testing set. Q. & Co.*..... 212
Telephone apparatus from the Connecticut Telephone and Electric Company, some new. C. T. & E. Co.*..... 128
Telephone specialties, two. Y. S. Co.* 346
Thirty-five-ton induction motor-driven crane. G. E. Co.*..... 516
Thomas soldered rail bonds. L. E. Co.* 254
Transformer outfits for thawing pipes. W. E. & Mfg. Co.*..... 214
"Turndown" type "arc-burst." B. E. Mfg. Co.*..... 828
"Tuxeda" bronze union, the. T. Mfg. Co.*..... 124
Valuable convention souvenirs*... 172
Vertical engine, a new. A. B. Co.* 213
"Vitæ" stirrup, the. W. S. A. Co.* 475

INDUSTRIAL SECTION—*Continued.*
Visit to works of the Ingersoll-Sergeant Drill Company..... 791
Walrath gas and gasoline engines. M. G. E. Co..... 302
Warner arc lamp, the. W. A. L. Co. 80
Water-power plant for lighting the city of Chicago. C.-W. Co..... 904
Watertown four-valve engine. W. E. Co.*..... 788
Water-tube cleaner, new type of. G. S. Co.*..... 862
Weber key socket, the. W. E. Co.* 905
Weiny-Phillips repeaters, the..... 630
Westinghouse bipolar motors for direct-current circuits*..... 343
Westinghouse choke coils. W. E. & Mfg. Co.*..... 670
Westinghouse New York changes.. 704
Westinghouse No. 93 railway motor. W. E. & Mfg. Co.*..... 30
Westinghouse 92-A railway motor. W. E. & Mfg. Co.*..... 126
Westinghouse-Parsons steam turbine, the..... 259
Westinghouse type K voltmeters and ammeters. W. E. & Mfg. Co.* 257
Westinghouse sales meeting..... 302
Williams electric clutch and safety device, the. W. E. M. Co..... 32
Winch, an electric derrick*..... 475
Winking sign specialties. P. Co... 516
"Wire-Grip" moulding. I. M. Mfg. Co.* 634
"Wireless" electric battery, a. W. E. Co.*..... 634
Wright demand meter, the use of the..... 478
Infection of laboratories by radium, the 569
Influence of hysteresis upon the parallel operation of alternators, the (R)..... 26
Installation and maintenance of storage battery for track circuits, by C. C. Anthony 931
Installation of a transmission plant, the 162
Institute election, the (E)..... 801
Insulation of armature or other coils of high-tension apparatus (R).... 339
Insulators for electrical work (E).... 872
Insulation resistance of impregnated, paper-covered, high-potential cables (R) 698
Insulators, high-tension*..... 887
In the early days, by Frank B. Rae..573, 647
Interference in wireless telegraphy (E) 487
Interference in wireless telegraphy, by John Stone Stone*..... 502
Internal combustion engines, the, by J. R. Bibbins*..... 198
International electrical exhibition..... 944
International Railway Congress, the (E) 799
Interrupters for induction coils (R).. 784
Inventions and investments (E)..... 355
Ionic theory of the arc and spark, the, by Henry Crew*..... 416
Iowa telephone association..... 335
Isolated plants or central station power for factories (E)..... 356
Is the steam locomotive doomed (E).. 355
Italian hydroelectric installation, an important, by Enrico Bignami*... 403

J
Japan, the manufacture of electrical machinery in (E)..... 645
Japan, the manufacture of electrical machinery in, the, by William Dinwiddie.* 649
Jungner-Edison accumulator, a contribution to the theory of the (R)... 426

K
Kern River power plant started up, the 162
Kilmarnock electric light and power scheme (R)..... 27

L
Lamp manufacturers' meeting..... 802
Lamps, the new (E)..... 961
Larger units, a plea for..... 1022
Lead, the world's output of..... 346
Lectures on electricity in 1751..... 783
Legislation for Milan, Italy, exhibition. 237
Legislative enquiry on New York city lighting 662
Lewis and Clark Exposition, electric lighting at the.....804, 901
Light and power plant, and suburban railway in Santiago de Cuba..... 226
Lighting investigation in New York city 720
Lighting of railway cars, the, by E. L. Elliott.. 758
Light of the future, the (E)..... 644
Lightning discharge effects (R)..... 700
Lightning protection (E)..... 920
Lightning rods 760
Line construction for high-pressure electric railroad, by George A. Damon* 537
Lines of progress in engineering (E). 43
Locomotive, a large electric (E)..... 873
Locomotives as fog-makers..... 736
Lodge electric igniter for internal combustion engines.*..... 167
London, Brighton & South Coast Railway, by J. Stanley Richmond..... 340
London, electric power supply in (R). 511
London tramways..... 71
Long-distance after-dinner speech..... 249
Long-distance transmission of energy (R) 338
Luminous efficiency of the carbon filament, on the (R)..... 592

M
Machine tools, the motor-drive for, by Herbert Condict..... 664
Machine for grinding commutators (P)* 945
Magnetic and electric properties of various kinds of sheet steel and steel castings (R)..... 946
Magnetic change speed-gear..... 583
Magnetic clutch or speed accelerator (P)* 623
Magnetic Club, the..... 663
Magnetic survey of Japan, a..... 583
Magnetic survey of the North Pacific ocean (E)..... 181
Magnetic survey of the North Pacific ocean by the Carnegie Institution, a contemplated, by Dr. L. A. Bauer 201
Maintenance of electric automobiles, by Herbert H. Rice..... 572
Malta, motor buses in..... 885
Manila Electric Light and Lighting Company, the new plant of the*.. 727

Digitized by Google

Manufacture of concrete blocks and their use in building construction, the 619
Marconi invention, important..... 423
Massachusetts, street railway conditions in..... 277
Matter, the constitution of..... 545
Means for converting electric currents (P)* 590
Means for regulating electric circuits (P)* 590
Measuring the efficiency of the incandescent lamp (E)..... 643
Measurement of high temperatures in the electric laboratory (R)..... 380
Mechanical construction of steam turbines and turbo-generators, by W. J. A. London* 624
Meeting of electrical contractors and supply dealers 423
Meeting of the Railway Signal Association 882
Mercury arc, the (R)..... 381
Mercury arc, the, by E. Weintraub, Ph. D.*..... 767
Metal pump (P)*..... 22
Method of cultivating plants by electricity (P)*..... 589
Method of extracting metals from ore (P)* 588
Method of protecting against voltage rises for transmission systems... 576
Metric system of weights and measures, the (R)..... 206
Metropolitan Railway, the electrification of the 8
Mexican substitute for rubber..... 155
Mica, the dielectric strength of certain specimens of..... 26
Milan exposition, the..... 575
Mineral resources of the United States. 160
Mines, electricity in..... 7
Mines, electricity in (E)..... 608
Mines, electric power in (E)..... 3
Model illustrating Hittorf's theory of the migration velocity of ions (R) 252
Modern isolated electric light plant, by George W. Frost*..... 591
Motor control system (P)*..... 428
Motor omnibuses and tramcars in England 671
Motor omnibuses, engine equipment of (R) 546
Motor-starter (P)* 121
Motor-starting device (P)*..... 782
Mrs. McFarlands' death..... 856
Municipal electric plant in New York city 373
Municipal light and power in Tacoma, Wash., by Howard Joslyn..... 778
Municipal lighting plant in New York city, for a..... 4
Municipal lighting (E)..... 223
Municipal ownership setback, a (E).. 999
Municipal plants and rates for electrical supply (E)..... 488
Murnau-Oberammergau single-phase railway, the (R)..... 593
Murray type-printing telegraph, the... 526
Muskogee, I. T., the gas and electric plant at*..... 238
Mystery of electricity, the (E)..... 357

N

Nantes transfer bridge, the (R)..... 206
Narragansett Electric Lighting Company's plant*..... 227
National conference on standard electrical rules, meeting of the..... 683
National Electric Light Association, the (E) 960
National Electric Light Association awarded a gold medal..... 405
National Electric Light Association..72, 205
National electrical conference on standard electrical rules..... 534
Needed improvements (E)..... 271
Nernst lamp, its present performance and commercial status, by E. R. Roberts 965
New England, electric lighting in, by C. L. Edgar 49
New England, street lighting in*..... 816
New England, the largest municipal electric plant in, by Alton D. Adams* 363
New era in railway operations, a (E).. 753
New testing car of the Berlin Traction Company, by C. L. Durand*..... 584
New tunnel construction company in New York city, a..... 72
New York & New Jersey Telephone Company, report of the directors of the..... 375
New York city telephone service..... 69
New York Electrical Contractors' Association dinner.....296, 377
New York Electrical Society, 72, 249, 509, 665, 811, 945, 1003
New York Motor Boat and Sportsmen's Show 405
Niagara Falls, significance of the hydroelectric developments at (E)..... 224
Niagara power commissioners, the conclusions of the, regarding Niagara. 496
Niagara power, wheel pits and tunnels for, by Alton D. Adams*..... 805
Nickel-iron accumulator, the use of caustic alkalies (R)..... 823
Nitrogen, fixation of (E)..... 837
Nitrogen from the air, extraction of... 200
Nominations for officers of the New York Electrical Society—new members elected..... 945
Notes on induction integrating wattmeters and their use..... 251
Notes on the use of rare earths in electric illuminants, by Murray C. Beebe* 657
N-rays 23

O

OBITUARY.
Ackerman, William K..... 353
Baldwin, William Henry, Jr..... 39
Bowen, George S..... 267
Campbell, John..... 554
Capen, Dr. Elmer Hewitt..... 554
Castelli, Paoli..... 485
Cockey, Edward C..... 519
Comstock, William B..... 309
Conklin, D. H..... 485
Cooper, Edward..... 393
Curtiss, Frederick H..... 309
Davis, Arthur Breese..... 605
Detrick, Calvin..... 393
Durin, W. H..... 519
Dygert, Wells..... 795
Espy, Thomas P..... 675
Fagin, William Walter..... 439
Ferguson, Nathaniel R..... 309
Flynn, Henry P..... 795
Frost, Arthur C..... 711

OBITUARY—*Continued.*
Goddard, A. P..... 393
Hayes, Richard Somers..... 439
Johnson, George Moore..... 605
La Roche, Fred A..... 439
Leslie, Edward A.*..... 954
Man, Albon..... 353
McKinstry, J. C..... 915
McTighe, Thomas J..... 554
Mullin, Edward Hemphill*..... 220
Mundy, William Offutt..... 605
Phillips, Eugene F..... 353
Pope, Franklin Leonard Wainwright 915
Potter, William Frederick..... 605
Rothschild, Baron Alphonse de.... 915
Schiffhauer, Frank..... 439
Sewall, Charles H..... 554
Sheerin, Hon. S. P..... 1002
Swift, Louis R..... 94
Warren, Charles C..... 554
Wick, Dudley B., Jr..... 439
Wiley, Seabury Brewster..... 485
Office building, electric power in an (E) 2
Office of the Brooklyn *Eagle*, the..... 326
Official catalogue of the exhibition of the German Empire at the Louisiana Purchase Exposition..... 627
Ohio Society of Mechanical, Electrical and Steam Engineers..... 781
Oil for insulating purposes*..... 470
Oil-insulated transformers (E)..... 447
Oil-insulated *versus* air-blast transformers, by M. A. Sammett*..... 449
One-cent telephone call..... 672
Open-air telephone service, by George A. Long*..... 434
Ore-unloaders at Conneaut, Ohio, the electric* 721
Ormond-Datona beach and race meet, the* 24
Ornamental trolley poles (E)..... 752
Oscillograph and its uses, the, by Lewis T. Robinson*..... 841
Oscillograph, the (E)..... 836
Oscillograph wave tracer, a new..... 760
Osmium lamp, the*..... 467
Overhead construction for electric railways (E)..... 523
Overload cutouts for hoists (P)*..... 886

P

Pacific coast water powers for electrical operation of railroads..... 333
Panama directors..... 664
Parallel running of alternators driven by large gas engines (R)..... 546
Paris, the future of electricity in (R). 27
Paris electric railroad, the new, by C. L. Durand*..... 285
Patent progress during the year, by E. G. Siggers..... 56
Paxtang power plant unharmed by explosion* 853
Peculiar photographic action..... 374
Personnel of the Allis-Chalmers Company* 202
Pertinacious current, a (E)..... 607
Phase indicator (P)* 589
Philadelphia Bell Telephone Company. 448
Philadelphia rapid transit, the growth of 48
Platinum resources of the United States 622
Plug and spring-jack switch (P)*..... 781
Polarization of X-rays (E)..... 445

Digitized by Google

Polarized Roentgen radiation, by Dr. C. G. Barkla..... 452
Pollak-Virag writing telegraph, the... 23
Popular electricity (E)..... 560
PORTRAITS.
Eyre, M. K..... 1031
Goldsborough, W. E..... 179
Gray, Mrs. Margery M..... 903
Leslie, Edward A..... 954
Mullin, Edward Hemphill..... 220
Randall, Frank C..... 1031
Scholz, Charles E..... 1031
Warren, Charles C..... 555
Wheeler, Schuyler Skaats..... 803
Possibilities of the small central station, the*..... 493
Postal cars at Paris, France, the new* 21
Power capacity of a running stream without storage, by W. G. Raymond*..... 570
Power from Niagara falls (E)..... 314
Power-house and single-phase car equipment of the Indianapolis & Cincinnati Traction Company*..... 454
Power-house fuel supply*..... 458
Power plants in the Canadian Niagara district (R)..... 253
Practical management of maintenance and operation of a telephone exchange, by C. E. Stinson..... 697
Practical wireless telegraphy (E)..... 871
Prevention of rail lengthening and track spreading*..... 323
Prizes for inventors..... 906
Process of electric welding (P)*..... 121
Production and utilization of ozone, the (R)..... 122
Production and value of copper, lead and spelter in the United States in 1904..... 1002
Progress in electric lighting, by J. H. Hallberg..... 54
Progress in electric lighting (E)..... 525
Progress in electric heating; electric power in factories; district heating 1014
Progress of electric heating, by James I. Ayer..... 1014
Progress in the development of the electric drive, by Sidney B. Paine..... 820
Progress in the electrolytic alkali and bleach industry, by J. B. C. Kershaw*..... 847
Progress in the technology of lighting (R)..... 298
Projection lantern, universal (R)..... 380
Proposed method of investigating earth currents (R)..... 784
Protection, central station..... 897
Protective apparatus..... 472
Publicity as an aid to manufacturers, by Arthur Warren..... 854
Public Service Corporation settles dispute with Newark, N. J..... 146
Purchased electric power in factories, by E. W. Lloyd..... 1016
Purifying drinking water by electricity 1023
Pyrometry, electrical methods in optical (E)..... 398

Q

Quebec mine, an installation of electric power for a (R)..... 206

R

Radioactive product from actinium, a new (R)..... 298
Radiology and ionization congress at Liege, Belgium..... 809
Radium, heating effect of the gamma-rays of..... 21
Radium infection (E)..... 561
Radium, sources of..... 249
Railroad Young Men's Christian Association..... 25
Railway and telegraph rates in Panama 547
Railway signal systems, by Azel Ames, Jr..... 374
Railways, the future of (R)..... 510
Railway trains, electric lighting of (R) 884
Raising steam in boilers..... 891
Rapid transit subways..... 333
Rare earths in illumination, the use of (E)..... 3
Real efficiency of steam boilers, the (R) 986
Recent improvements in telegraphy, by J. C. Barclay..... 50
Reflector (P)*..... 945
Refractory material, manipulation of (P)*..... 163
Refuse destructors (E)..... 183
Regulation of state protection for central stations, by Ernest H. Davis. 67
Report of New York state railroad commissioners on traffic conditions in Greater New York..... 297
Report on methods for increasing the capacity and reducing the noise of the Union elevated loop, Chicago, Ill..... 491
Report on present methods of protection from lightning and other static disturbances, by Alex Dow and R. S. Stewart*..... 966
Responsibility for accidents (E)..... 559
Responsibility in strikes (E)..... 447
Retrogressive telephone legislation (E) 487
Reversal of charge of electrical induction machines, the (R)..... 164
Reversal of charge from electric induction machines (R)..... 252
Review of the storage battery situation for the year, 1904, by Lamar Lyndon..... 67
Review of the year in Great Britain and the Continent, by C. L. Durand.... 57
Rheostat (P)*..... 464
Rolling road at Cleveland, Ohio, the new, by D. A. Willey*..... 580
Rome to Paris telephone..... 879
Rubber, Mexican substitute for..... 155
Rural electric roads, by Dr. Louis Bell. 685
Russian petroleum field, the production and use of electricity in a, by Franz Koester*..... 846

S

Safety devices for high-tension lines (R)..... 207
Safety devices for preventing excessive pressure rise in alternating-current systems*..... 453
Schenectady visit of the delegates to the International Railway Congress on the long tour*..... 880
Schmitt accumulators (R)..... 947
Schuyler Skaats Wheeler*..... 803
Searchlights in lighthouses (E)..... 561
Searchlight on Mount Hood (R)..... 510
Secondary Roentgen radiation, the (R) 546
Self-propelled fire-engines (E)..... 680
Series alternating arc lighting, by E. P. Warner..... 203
Serius accumulator, the (R)..... 1023
Sewickley, Pa., city street lighting at. A successful six-glower Nernst lamp system..... 108
Shad, electrical men enjoy planked.... 854
Short-sighted (E)..... 489
Siberian railway, the Baikal lake section of the..... 82
Siemens & Halske oscillograph, the.... 577
Signaling in the subway, by J. M. Waldron..... 980
Significance of the hydroelectric developments at Niagara falls (E).... 224
Signs of spring (E)..... 355
Silicon and its alloys (E)..... 751
Simple condenser with a variable capacity for experiments in syntonization, a..... 757
Single-phase, alternating-current system of distribution (P)*..... 209
Single-phase locomotive for heavy railroad service, a large*..... 895
Single-phase motors on polyphase systems, by H. W. Doubrava*..... 274
Single-phase railway system in Italy, the (R)..... 1022
Single-phase repulsion motor driving a pump..... 461
Small electrical generating units considered from the point of view of the economical production of electrical energy (R)..... 666
Society of Post Office Engineers..... 720
Some continental central stations operating with gas engines, by Franz Koester*..... 60
Some economic aspects of electric power distribution (R)..... 593
Some notes on the efficiency of steam plant (R)..... 822
Some points on the selection of electric cables, by L. B. Atkinson and C. J. Beaver*..... 497, 527
Some of the unsolved problems in electrical engineering (E)..... 752
Some tests conducted with an electrolytic rectifier and motor-generator (R)..... 380
Some tests on the use of the synchronous motor in compensating for lagging currents in a circuit, by E. A. Regestein*..... 316
South Dakota Telephone Association, the officers of the..... 192
Sparking device for explosive engines (P)*..... 782
Special report on street and urban railways..... 468
Speech recording, reproducing and distributing apparatus (P)*..... 821
Speed indicator, an electrical (R)..... 164
Starting and braking of direct-current electric motors by a compound rheostat (R)..... 666
Starting resistance for induction motors (E)..... 446
Station interruption (E)..... 645
Station simplification (E)..... 313
Steam and fogs (E)..... 715
Steam engines, the efficiency of..... 8
Steam roads, application of electricity to, by S. Cass..... 283
Steam turbine progress (E)..... 959
Steam turbines for driving dynamos.. 65
Steam turbine tests at the Neepsend, England, electric station (R)..... 547

Digitized by Google

Steam turbine wear (E)..... 919
Steel-plate combine in Germany..... 880
Steel wire worth $80,000 a ton, by Alfred N. Barber..... 648
Steljes's telegraph system (R)..... 628
Stopping and releasing mechanism (P)*..... 336
Storage batteries for block signal work. 184
Storage battery situation for the year 1904, a review of the, by Lamar Lyndon..... 67
Street lighting in New England*..... 816
Street lighting, the cost of (E)..... 98
Street railway conditions in Massachusetts..... 277
Street railway history and organization 301
Strike on Interborough Rapid Transit Company's system in New York city..... 423
Subway, proposed extension of the New York..... 23
Subway weather, more (E)..... 139
Suits for infringement..... 587
Svea Caloric engine, by Emil Hesse*.. 478
Switch and connections controlling electric motors and power transmitters (P)..... 821
Switchboard simplification (E)..... 315
Switch, electric (P)*..... 886
Switch for electric circuits (P)*..... 985
Synchronism indicator (P)*..... 857
Synchronous motor (P)*..... 589
Synchronous motor with clutch (P)*.. 623
System for operating electric vehicles (P)*..... 623
System of connections for driving pumps on portable fire engine (P)* 985
System of decorating (P)*..... 782
System of electrical distribution (P)*. 665
System of electrical distribution for electric railways*..... 119

T

Taking moving pictures in the subway* 856
Tantalum incandescent lamp, the, by Dr. Louis Bell..... 963
Tantalum lamp measurements (R).... 884
Tantalum lamp, the, (E)..... 272
Tantalum lamp, the, by Dr. W. von Bolton and Dr. O. Feuerlein*..... 279
Taping-machine (P)*..... 985
Technical education in France..... 372
Telegraphy, recent improvements in, by J. C. Barclay..... 50
Telephone and tallow-candle methods.. 527
Telephone and telegraph statistics (E) 97
Telephone and telegraph statistics.... 146
Telephone and thunderstorms (E).... 835
Telephone, an electrolytic..... 145
Telephone apparatus for the war department..... 852
Telephone development, scope and effect of competition on..... 452
Telephone engineering, by J. C. Kelsey*.....400, 610
Telephone growth (E)..... 524
Telephone infection (E)..... 873
Telephone in war, the (E)..... 445
Telephone line engineering, by C. J. H. Woodbury..... 100
Telephone men, meeting of..... 297
Telephone relay (P)*..... 428
Telephone rates in Great Britain.... 653
Telephone, Rome-to-Paris..... 879
Telephone service during thunderstorms (E)..... 753
Telephone service, planning New York, for twenty years..... 508
Telephone service, New York city..... 69
Telephone system in Riga, Russia, the (R)..... 629
Telephone system of to-day, the, by C. J. H. Woodbury..... 770
Telephone transmitter (P)*..... 120
Telephonic detection of wine adulteration..... 545
Telephonic gauger, a (E)..... 523
Telephony, by Herbert Laws Webb.... 646
Telephony in 1904..... 68
Temperature curves and the rating of electrical machinery (R)..... 592
Tendencies in central station design, by William H. Bryan..... 249
Tesla patents, an important decision sustaining the..... 388
Test of 5,000-kilowatt alternator (R) 822
Test of a 5,000-kilowatt alternator, by L. L. Gaillard*..... 849
Tests to determine the comparative heat conduction and radiation of insulating varnishes, by John C. Dolph*..... 531
Texas telephones, by Frank B. Knight 77
Textile factories, the electrical operation of (E)..... 273
Therapeutic importance of electric light, the..... 106
Thermit rail joints (R)..... 858
Third-rail protection, live..... 20
Thirty-thousand-volt, long-span, transmission line (R)..... 122
Thirty-six-thousand-volt hydroelectric installation of the Celina, Italy, (R)..... 701
Three-phase railway system, the (E).. 1000
Tool steel, a new..... 882
Trade-mark law, the new federal, by James Hamilton..... 542
Trade opportunities in foreign countries..... 974
Train lighting, a new dynamo for (R) 823
Train lighting, slow progress in (E).. 919
Train-lighting system, a new (R).... 510
Trains, the electric lighting of (R).... 26
Transfusion, electrical, by James Edmondson, M. D..... 413
Transformer insulation (R)..... 986
Transmission of power, electrical.... 49
Transmission outlook (E)..... 315
Transmission problems, economics of, by F. A. C. Perrine..... 378
Trees for wireless telegraphy (E).... 97
Tribelhorn accumulators (R)..... 884
Trinidad electric and tramway power plant..... 845
Trolley cars in the Far East (E).... 181
Trolley wires, a device for measuring the wear of..... 214
Trunk lines, the electrification of, by W. Caryl Ely..... 48
Tuning of thermoelectric receivers for electric waves, the (R)..... 700
Turbine, the gas..... 852
Turbines, the wear of (R)..... 510
Two-motor *versus* four-motor equipments, by N. McD. Crawford*.... 368
Typo-telegraph, by Frederick J. Swift 1025

U

Unimproved opportunity, an (E)..... 961
United Engineering Building, the.... 72
United States Navy's floating repair ship, the, by George E. Walsh.... 658
United Telpherage Company, a change in the..... 472
Units and standards (E)..... 799
Use of incandescent lamps for decorative and advertising purposes*... 246
Utilizing the magnetic pull of dynamos for adjustment purposes..... 66

V

Vacuum gauges.....
Valtellina locomotives, the new*..... 332
Valtellina railway, electrical tests on the..... 507
Valtellina road, electric locomotives for the..... 1008
Variable-speed motors (R)..... 298
Variations in one period of the luminous flux emitted by an alternating-current arc (R)..... 462
Ventilating electrical machine, means for (P)*..... 163

W

Wagner Electric and Manufacturing Company, the..... 161
Washington, D. C., the proposed central power station at*..... 406
Water heater, electrical (P)*..... 382
Water power and steam power in the British Isles (R)..... 79
Water-power tunnel on Vancouver Island..... 991
Water rheostats (E)..... 561
Watt-hour meter, the (E)..... 959
Wave distortion on transmission lines, by W. S. Franklin*..... 240
Weather reports by wireless (E)..... 751
Wheeler, Schuyler Skaats*..... 803
Wheel-pits and tunnels for Niagara power, by Alton D. Adams*..... 805
Where a consulting engineer is needed (E)..... 609
Winding form (P)*..... 588
Wireless on trains (E)..... 959
Wireless telegraphy experiments at Purdue University..... 945
Wireless telegraphy in Canada..... 620
Wireless telegraphy in England..... 511
Wireless telegraphy for Polar trips (E) 524
Wireless telegraph licenses in Great Britain..... 587
Wireless telegraphy, on a new system of..... 452
Wireless telegraphy, trees for (E).... 97
Wireless telegraphy in Arctic exploration..... 167
Wireless telegraphy in the home, by William Maver, Jr..... 421
Wire table, how to remember the, by Charles F. Scott..... 653
Wisconsin power company, a new.... 910
Wood for gas power..... 984
World's production of copper, the (R) 986

Z

Zirconium lamp, the (R)..... 1022

Digitized by Google

AUTHORS OF ARTICLES IN VOL. XLVI OF THE ELECTRICAL REVIEW

Adams, Alton D., Electric Supply in the Gate City* ... 73
The Largest Municipal Electric Plant in New England* ... 363
Wheel Pits and Tunnels for Niagara Power* ... 805
Adams, W. P., The Combination of Dust Destructors and Electricity Works Economically Considered ... 16, 110, 156
Ames, Azel, Jr., Railway Signal Systems ... 374
Anthony, C. C., Installation and Maintenance of Storage Battery for Track Circuits ... 931
Archibald, E. M., Effect of Load-Factor on Cost of Power* ... 359
Atkinson, L. B., and C. J. Beaver, Some Points on the Selection of Electric Cables* ... 497, 527
Ayer, James I., Progress in Electric Heating ... 1014
Barber, Alfred N., Steel Wire Worth $80,000 a Ton ... 648
Barclay, J. C., Recent Improvements in Telegraphy ... 50
Barkla, Dr. Charles G., Polarized Roentgen Radiation ... 452
Bauer, Dr. L. A., A Contemplated Magnetic Survey of the North Pacific Ocean by the Carnegie Institution. 201
Beadle, Alec A., Electrolytic Corrosion in Underground Pipes ... 19
Beaver, C. J., and L. B. Atkinson, Some Points on the Selection of Electric Cables* ... 497, 527
Beebe, Murray C., Notes on the Use of Rare Earths in Electric Illuminants* ... 657
Bell, Dr. Louis, The Electric Railway Situation ... 51
Rural Electric Roads ... 685
The Tantalum Incandescent Lamp .. 963
Bibbins, J. R., The Internal Combustion Engine* ... 193
Bignami, Enrico, The First Transmission of Power in Europe at 40,000 Volts* ... 11
An Important Italian Hydroelectric Installation ... 403
Bolton, Dr. W. M., and Dr. O. Feuerlein, The Tantalum Lamp* ... 279
Booth, William H., and J. B. C. Kershaw, Fuel Economy in Steam Power Plants ... 327, 370, 410
Brown, E. O. Forster, Notes on the Application of Electric Power at Mines in Germany ... 901
Bryan, W. H., Tendencies in Central Station Design ... 249
Carichoff, E. R., Fundamental Features of Electric Elevators* ... 1006
Cass, S., Application of Electricity to Steam Roads ... 283
Clark, Wallace S., The Choice of an Insulated Cable* ... 933
Condict, Herbert, The Motor Drive for Machine Tools ... 664
Cooper, William, Control of Electric Locomotives ... 568
Crawford, N. McD., Two-Motor *versus* Four-Motor Equipments* ... 368
Crew, Henry, The Ionic Theory of the Arc and Spark* ... 416
Damon, George A., Line Construction for High-Pressure Electric Railroads* ... 537
Davis, Ernest H., The Regulation of Static Protection for Central Stations ... 67
Denton, James E., The Best Economy of the Piston Steam Engine at the Advent of the Steam Turbine ... 574
Dillon, E. P., Colorado Springs Electric Company* ... 927
Dinwiddie, William, The Manufacture of Electrical Machinery in Japan* 649
Dolph, John C., Test to Determine the Comparative Heat Conduction and Radiation of Insulating Varnishes* 531
Doubrava, H. W., Single-Phase Motors on Polyphase Systems* ... 274
Dow, Alex, and R. S. Stewart, Report on Present Methods of Protection from Lightning and Other Static Disturbances* ... 966
Durand, C. L., Electricity in Agriculture* ... 422
Electric Crane at St. Triphon Quarries, Switzerland* ... 529
Electrical Notes from Europe ... 114, 414, 776, 941
New Testing Car of the Berlin Traction Company* ... 584
Review of the Year in Great Britain and the Continent ... 57
The New Paris Electric Railroad* .. 285
Edgar, C. L., Electric Lighting in New England ... 49
Edmondson, M. D., James J., Transfusion (Electrical)—A Study of the Theory and Physiological Experiments and Therapeutical Application of Curative Agents through the Tissues by Static Electricity .. 413
Elliott, E. L., The Lighting of Railway Cars* ... 758
Ely, W. Caryl, The Electrification of Trunk Lines ... 48
Feuerlein, Dr. O., and Dr. W. M. Bolton, The Tantalum Lamp* ... 279
Franklin, W. S., Wave Distortion on Transmission Lines* ... 240
Frost, George W., A Modern Isolated Electric Light Plant* ... 591
Gaillard, L. L., Test of a 5,000-Kilowatt Alternator* ... 849
Geare, R. E. Spencer, Driving Two Alternators in Parallel ... 621
Gelstharp, F., Electrolytic Preparation of Tin Paste ... 66
Gibson, George H., The Efficiency of the Incandescent Lamp ... 683
Guarini, Emile, The Manufacture of Air-Insulated Cables* ... 104
Hallberg, J. H., Progress in Electric Lighting ... 54
Hamilton, James, The New Federal Trade-Mark Law ... 542
Hammer, W. J., Application of Wireless Telegraphy for Domestic Purposes 340
Hesse, Emil, The Svea Caloric Engine* 478
Howlett, Charles A. S., The Commercial Aspect of Engineering ... 448
Humphrey, C. W., The Electrical Properties of the Denver Gas and Electric Company* ... 874
Jacobus, D. S., Counterweights for Large Engines* ... 1011
Jaeger, W., Application of the Differential Galvanometer to Exact Measurements of Resistance, Translated by M. G. Lloyd* ... 981
Johnston, J. E., The Arkansas Valley Electric Company* ... 881
The Grand Junction Electric and Gas Company* ... 881
Joslyn, Howard, Municipal Light and Power in Tacoma, Wash ... 778
Kelsey, J. C., Telephone Engineering, 400, 613
Kent, Robert Thurston, Electricity in the Anthracite Coal Mines* ... 563, 613
Kent, William, Efficiency of the Incandescent Lamp ... 648
Kershaw, John B. C., The Progress in the Electrochemical and Electrometallurgical Industries in 1904 .. 52
Kershaw, J. B. C., and William H. Booth, Fuel Economy in Steam Power Plants ... 327, 370, 410
Kershaw, J. C. B., Progress in the Electrolytic Alkali and Bleach Industry* ... 847
Knight, Frank B., Texas Telephones ... 77
Koester, Franz, Some Continental Central Stations Operating with Gas Engines* ... 60
The Production and Use of Electricity in a Russian Petroleum Field* .. 846
Lister, C. A., and D. K. Morris, The Eddy-Current Brake for Testing Motors* ... 892
Lloyd, E. W., Purchased Electric Power in Factories ... 1016
Lloyd, Morton Githens, Translation of Application of the Differential Galvanometer to Exact Measurement of Resistance, by W. Jaeger* ... 981
London, W. J. A., Mechanical Construction of Steam Turbines and Turbo-Generators* ... 624
Long, George A., Open-Air Telephone Service* ... 434
Lyndon, Lamar, A Review of the Storage Battery Situation for the Year 1904 ... 67
Mann, A. S., Can a Steam Turbine be Started in an Emergency Quicker than a Reciprocating Engine of the Same Power? ... 1005
Marks, Louis B., A Field for the Illuminating Engineer ... 620
Maver, Jr., William, Wireless Telegraphy in the Home ... 421
Morris, D. K., and G. A. Lister, The Eddy-Current Brake for Testing Motors* ... 892
Mudge, Charles A., High-Speed, Long-Distance, Electric Traction ... 936
Noeggerath, J. E., Acyclic (Homopolar) Dynamos* ... 188
Paine, Sidney B., Progress in the Development of the Electric Drive .. 820
Patterson, A. H., The Designing of Fixtures for Modern Lighting ... 59
Peavey, J. E., The New Canal Telephone Exchange at Cincinnati, Ohio* ... 185

Digitized by Google

Perrine, F. A. C., Economics of Transmission Problems..... 378
Plummer, John, Australian Tramway Systems 379
Potter, W. B., Developments in Electric Traction 142
Rae, Frank B., In the Early Days..573, 647
Raymond, W. G., Power Capacity of a Running Stream without Storage* 570
Regestein, E. A., Some Tests on the Use of the Synchronous Motor in Compensating for Lagging Currents in a Circuit*..... 316
Rice, Herbert H., Maintenance of Electric Automobiles..... 572
Richmond, J. Stanley, Grounded Transmission Mediums*..... 5
Richmond, J. Stanley, London, Brighton & South Coast Railway..... 340
Roberts, E. R., The Nernst Lamp, Its Present Performance and Commercial Status..... 965
Robinson, Lewis T., The Oscillograph and Its Uses*..... 841
Sammett, M. A., Oil-Insulated *versus* Air-Blast Transformers*..... 449
Scott, Charles F., How to Remember the Wire Table..... 653
Sever, George F., Induction Motors and the Fire Hazard..... 572
Seyfert, Stanley S., The Difficulty with the Commutator*..... 492
Sharp, Clayton H., Accuracy Checks of Switchboard Instruments..... 243
Siggers, E. G., Patent Progress During the Year..... 56
Sprague, Frank J., Electric Railways—the Art and the Men..... 324
Stewart, R. S., and Alex Dow, Report on Present Methods of Protection from Lightning and Other Static Disturbances* 966
Stinson, C. E., The Practical Management of Maintenance and Operation of a Telephone Exchange..... 697
Stone, John Stone, Interference in Wireless Telegraphy*..... 502
Street, Clement F., Electricity on Steam Roads 723
Swift, Frederick J., Typo-Telegraph*... 1025
Trowbridge, Dr. John, Electrical Theories 55
Van Every, M., Carborundum for Meter Bearings 840
Varney, Theodore, High-Pressure Line Construction for Alternating-Current Railways*..... 686
Vreeland, H. H., Electric Railway Operation in a Great City..... 334
Waldron, J. M., Signaling in the Subway 980
Walker, Sydney F., Electrical Mining Notes 684, 775
Walsh, George E., The United States Navy's Floating Repair Ship..... 656
Warner, E. P., Series Alternating Arc Lighting 203
Warren, Arthur, Publicity as an Aid to Manufacturers 854
Webb, Herbert Laws, Telephony..... 646
Weintraub, E., The Mercury Arc*.... 767
Willey, D. A., The New Rolling Road at Cleveland, Ohio*..... 581
Williams, C. H., Distribution and Dollars 232
Woodbury, C. J. H., Telephone Line Engineering 100
Woodbury, C. J. H., The Telephone System of To-Day..... 770
Zimmerman, Clarence Irving, The Aluminum Electrolytic Condenser*... 813

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 1. NEW YORK, SATURDAY, JANUARY 7, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . . LUCIEN W. MARSHALL, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Electric Water Power from the Great Lakes . . . 1
Electric Power in an Office Building . . . 2
Electricity for City Work . . . 2
The Use of Rare Earths in Illumination . . . 3
Electrical Transmission in Europe . . . 3
Electric Power in Mines . . . 3
Electric Railroads in Connecticut in 1904 . . . 4
For a Municipal Lighting Plant in New York City . . . 4
Ohio Electric Light Association . . . 4
Test of the Canadian Niagara Falls Power Company's Turbines . . . 4
Grounded Transmission Mediums, by J. Stanley Richmond . . . 5
Breakdown of the Bradford, England, Municipal Light and Power Station . . . 6
Franklin Institute Election . . . 7
Electricity in Mines . . . 7
Vacuum Gauges . . . 7
The Efficiency of Steam Engines . . . 8
The Electrification of the Metropolitan Railway . . . 10
The First Transmission of Power in Europe at 40,000 Volts, by Enrico Bignami . . . 11
BOOK REVIEWS . . . 14
Influence of the Sun on Meteorology and Atmospheric Electricity . . . 15
The Combination of Dust Destructors and Electricity Works Economically Considered, by W. P. Adams . . . 16
Fish Shoals Located by Electric Apparatus . . . 19
Electrolytic Corrosion in Underground Pipes, by Alec A. Beadle . . . 19
Live Third-Rail Protection . . . 20
Bone Fractures Located by Electricity . . . 21
Heating Effect of the Gamma-Rays of Radium . . . 21
The New Postal Cars at Paris, France . . . 21
ELECTRICAL PATENTS . . . 22
Proposed Extension of the New York Subway . . . 23
The Pollak-Virag Writing Telegraph . . . 23
Annual Dinner of the American Institute of Electrical Engineers . . . 24
The Electrification of the Belfast, Ireland, Railways . . . 24
The Ormond-Daytona Beach and Race Meet . . . 24
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 26
INDUSTRIAL SECTION:
Portable Wattmeter Calibrators . . . 28
A Good Business Suggestion . . . 29
Westinghouse No. 93 Railway Motor . . . 30
The Williams Electric Clutch and Safety Device . . . 32
Blake Electric Railway Signal . . . 33
An Interesting Exhibit . . . 34
CURRENT ELECTRICAL NEWS . . . 35

ELECTRIC WATER POWER FROM THE GREAT LAKES.

Water from the Great Lakes has already been employed to develop large powers at points other than Niagara Falls, and opportunity for other plants of like sort is not lacking. One instance may be seen in the Chicago drainage canal, which is to develop 27,000 horse-power at a single point. The Illinois river into which this canal discharges has an elevation of 405 feet above sea level at its mouth, or about 180 feet below the surface of lake Michigan. In northern Indiana, the Kankakee and Tippecanoe rivers, the former a branch of the Illinois and the latter of the Wabash, may serve to carry water diverted from the lake.

At Lafayette, Ind., near the mouth of the Tippecanoe, the elevation of the Wabash river is 506 feet, or seventy-nine feet below the surface of lake Michigan, and where this latter river joins the Ohio, at the point where Indiana, Kentucky and Illinois meet, the water elevation is only 311 feet, or 274 feet below the lake. It thus seems that the construction of a comparatively short canal in Indiana might suffice to draw an indefinite quantity of water from the Great Lakes, and to create large water powers in that state. With lake Erie on the north and the Ohio river on the south, the state of Ohio would present an attractive field for the development of great powers with water from the lake, but for the high table-land that runs east and west across the state with an elevation that reaches one thousand feet. In contrast with the elevation of 573 feet on lake Erie, the Ohio river at Cincinnati is 431 feet, and at Portsmouth is 468 feet above tide-water. Though the diversion of lake water would not be as easy in Ohio as it is in Indiana and Illinois, it is not certain that such diversion would be impracticable. Pennsylvania, in the part that borders lake Erie, is so elevated that no large amount of water is likely to be diverted through that state. On the Allegheny river at the mouth of French creek, about fifty miles from lake Erie, the water elevation is 969 feet, or nearly 400 feet above that of the lake.

In Canada abundant opportunity exists for the creation of great water powers by canals that conduct the water from lake to lake. Georgian bay, an arm of lake Huron, comes within about sixty miles of lake Ontario, at Toronto, and the difference of elevation between these two bodies of water is about 330 feet. A canal between the bay and lake would not only shorten the water route between Duluth and Chicago on the west and Montreal on the east by several hundred miles, but might also be employed to develop an indefinitely large water power. The strip of Canadian territory some forty miles long and twenty-seven miles wide, that separates lakes Erie and Ontario, may easily be pierced by one or more additional canals, substantially parallel with the Niagara river, to utilize the water head of 327 feet between these lakes for power purposes. The Welland canal, constructed primarily to give the commerce of the Great Lakes an outlet down the St. Lawrence river, is also being used for power development, both in local manufacturing plants along its bank and for electric transmission to cities.

At many points along the Niagara river above the falls, both in New York state and in Ontario, canals and pipe lines may be started to divert its water to the Niagara escarpment, where it may be used for power with a head of about 300 feet. The Erie canal, which diverts water from the head of Niagara river at Buffalo, furnishes a large volume for power development at Lockport, though, of course, the main object of this canal is navigation. Parties operating under what is known as the Love charter have started work on a canal 120 feet wide and twenty feet deep that is to convey water from Niagara river at La Salle to a point known as the Devil's Hole, in the gorge below the whirlpool rapids, for power purposes.

Digitized by Google

ELECTRIC POWER IN AN OFFICE BUILDING.

The New York *Times* has just moved into a new building in Times Square, New York city, which embodies many noteworthy features. One of these is the extensive use of electrical methods and apparatus. In fact practically all the work of this enormous structure is done by means of electrical power.

The elevators, which are operated by electric motors, are noteworthy on account of their great speed and the high lift. The numerous pumps throughout the building are driven by motors, as are also the large rotary presses and the transporting systems for handling the paper. There are over one hundred motors used throughout the building, aggregating nearly 1,200 horse-power.

The lighting features of the building are remarkable, for advantage has been taken of the different kinds of electric lamps available so as to obtain the most suitable kind of illumination in every part of the building. There are in use over 6,000 incandescent lamps, and there are, in addition, arc lamps, mercury vapor and Nernst lamps, the vacuum tube lamp, and a powerful searchlight. Each of these has been installed with a specific object in view, which is best served by that particular lamp.

The facilities for communication are most complete. They include complete telephone and telegraph systems and electric calls and alarms. There is also an electric time service, which is synchronized daily from Washington. In wiring the building thirty-nine miles of wire were used, and this work has been carried out in the most approved style. In fact, in certain places the necessities of the building required specially designed fixtures to be made, in order that the great weight of long stretches of cable might be supported safely.

As has been said all of the principal work of the building is carried out by means of electrical devices, but their use does not end here, for they have been employed in many minor applications. For instance, there will be no steam in the building during the summer months, for it was decided to employ the city service rather than to install a generating plant for the building. This lack of steam would have put the restaurant to some inconvenience had not electric cooking utensils been available. Electric heating is used, as well as soldering-irons and various other devices.

The building does not contain its own generating plant, the reasons for this being the material saving in the first cost, and the valuable space in the subbasement saved for other purposes. The handling of coal and ashes will be eliminated, and the objectionable heat of the boiler plant in summer will be avoided. All the requirements of a newspaper and office building can be met by electricity, except that of heating during the winter.

It will be seen from this brief outline that the Times Building is undoubtedly the most completely equipped office building in the world. It is in every sense a modern newspaper office, and is entirely worthy of the great paper of which it is the home.

ELECTRICITY FOR CITY WORK.

There is no doubt that electrical power furnishes the most satisfactory method of conducting the work of a city, and there is good evidence that this is now being recognized. In furnishing transportation the electric car practically monopolizes the field. In lighting the electric lamps are forging ahead and pushing the gas to one side. Naturally, the change in the method of illumination has been made first in office buildings, hotels, stores and public structures, but the smaller buildings are now following suit. A realization of the dangers involved in the use of gas is having some effect in hastening the substitution of the new and better method for the old and less satisfactory.

The systems of communication—the telephone and telegraph—have developed to such an extent that it is difficult to realize how dependent we are upon them. A serious interruption to the telephone service of a large city very nearly brings business to a standstill, and makes the younger generation wonder how the business world ever managed to get along before it had the telephone.

The electric motor is rapidly displacing the isolated power plant in the city factory. For city work the motor is an ideal source of power, for the supply of power is always available, the fire risk is reduced to a minimum, and boiler and engine equipment is unnecessary.

While on the whole the adoption of electrical methods in cities has taken place at a satisfactory rate, there are some lines of work in which the application of the electric motor is being made but slowly. We are still hauling our heavy fire engines by horses, though better time and safer running would result from the use of self-propelled vehicles. Such fire engines are coming into favor rapidly in Europe, and they have many advantages: they are always ready to start, they make a much better speed than the horse-drawn vehicle, and they are far more easily controlled and can wind their way in and out among other vehicles in a crowded street with astonishing ease. Nor does there seem to be any reason to-day why we should not discard the steam-driven fire engine, for electrical energy is available at every part of the city, and at all hours of the day and night. A motor-driven fire pump would be lighter than the present steam pumps, it would be more reliable and capable of more hard, continuous work.

There is, however, other work to which the electric motor might be adapted with good results. We still depend largely upon the small, dirty, noisy steam-hoisting engine, although the work done by it could be done more satisfactorily by smaller, cheaper motor equipments, which would not only be more easily controlled, but more easily carried from place to place.

The uses of electricity in cities just mentioned are by no means all, for there are innumerable minor applications of this ever-ready supply of power which, taken singly, are of little moment, but altogether are an important factor in advancing the comforts and happiness of city life. In fact, when one starts to think of it, it is surprising to find what a large part is played by electricity in every-day life.

Digitized by Google

THE USE OF RARE EARTHS IN ILLUMINATION.

The use of the rarer earths for increasing the brilliancy of illuminants has been one of the important recent developments in the lighting art. In gas lighting the use of Welsbach burners has increased enormously, while in electric lighting the use of the Nernst lamp, in which these materials have been applied by Nernst to obtain a highly efficient electric light, may be expected to increase in popularity rapidly. In both of these illuminants time has been required to develop fully the technique of manufacturing.

The advantage of these illuminants is the high efficiency, or, in other words, the larger quantity of light produced for a given consumption of energy. One obstacle to be contended with is the scarcity and high price of the materials used, for while the amount used in each lamp is small, the total quantity required is large. The discovery, however, of numerous deposits containing these rare materials would tend to improve conditions so far as their use for illuminating purposes is concerned, were it not also true that the same materials have a wide application in various other industries. They have been applied in the color industry, in the manufacture of glass and the production of chemicals. Welsbach has made use of them in a storage battery, and they are now used in photography and in various other processes. These applications would increase the demand and tend to make the material more expensive, were it not also true that, in preparing the pure material for these various uses, by-products, which have valuable properties, are produced, which should reduce the cost of oxides of cerium and thorium, the principal materials used in the Welsbach burner and in the Nernst glower.

ELECTRICAL TRANSMISSION IN EUROPE.

The development of electrical transmission in Europe has been carried out along lines differing somewhat from those followed in this country. In general, the distances of transmission have been shorter and the powers of the waterfalls have not been very large. The three-phase alternating-current system has generally been adopted. The voltage most generally found is in the neighborhood of 10,000. There are exceptions, however, to the use of alternating currents for transmission, for the Thury high-potential, direct-current series system has been installed in several places. This development in electrical transmission has been going on principally in Switzerland, Italy and France.

In this issue of the ELECTRICAL REVIEW an important Italian system which presents several interesting features is described by Signor Enrico Bignami. The first feature, which may be noted, is the high voltage, as it is higher than has been used anywhere else in Europe, namely, 40,000 volts. In this respect the plant follows American practice and, indeed, in reading Signor Bignami's description one is rather struck with the general resemblance there to the methods used in this country. For instance, the lines are carried on wooden poles and cross-arms, although, from recent discussions of high-tension transmission practice, one is led rather to expect Italian systems to use iron towers. The plan of erecting a separate switch-house having several floors, on which the different controlling devices are installed, has also been followed.

As the voltage used here was exceptionally high for a European plant the greatest care has been exercised in designing the plant and arranging the circuits so as to secure the greatest safety for the system and for the attendants. One feature which contributes much toward this is the simplification of circuits and apparatus, and the elimination of all devices not essential for the reliable operation of the plant. This was not particularly difficult to do with a plant of such size as here described, there being but three generating units and, at the present time, one transmission line, but it is a principle which should be followed as far as possible, not only in high-tension work, but in all other lines. In fact there has been a noticeable tendency of late toward simplification in various lines of electrical development. It should be noted, however, that this simplification has been made possible by the wider experience and greater skill in the design and construction of electrical machinery gained from previous work.

ELECTRIC POWER IN MINES.

One application of electricity of which the layman hears little is its use in carrying on the work in mines. Here the electric locomotive is rapidly displacing the other methods of hauling. The electric light is recognized as the only satisfactory method of illumination, and the motor-driven pump is proving to be the most satisfactory and the cheapest method of draining mines. In coal mines the electrically driven cutting machines have largely increased the output. These machines at the same time bring other advantages, as they can be used in places where it would be almost impossible for work to be carried on by the old system of pick and drill.

The reasons for this excellent showing are the same as those which have made electrical methods so successful in other lines of work. Thus, there is the possibility of operating so many machines and of doing so many different kinds of work by means of the same form of energy. The electric motor is suitable for driving all mining machinery, from the drill to the hoisting engine. It drives the ventilating fans, and the electric light furnishes the necessary illumination; and all of this work may be done by one power-house. Another important feature of the electrical system is its flexibility. The system can be extended or changed about, motors shifted from point to point easily and quickly. There is no part of the mine where a man can work which is not also accessible to the electric lamp and the electrically driven tool. Another point which may be urged in its favor is the ease with which electrical appliances are controlled and regulated.

While, of course, these are important and even essential features in a system of power supply for mining, they still would not be sufficient to gain consideration for the electrical system if it were not primarily a safe system. When properly installed the risk of explosions is reduced to a minimum, and there is practically no danger to the miners themselves. These features of the electrical system are being appreciated by mine operators, and it seems hardly unreasonable to look forward to a time not far distant when electricity will be recognized as the only power for mine working.

Digitized by Google

For a Municipal Lighting Plant in New York City.

A great deal of public interest attaches to the message transmitted on January 1 by George B. McClellan, mayor of New York city, to the board of aldermen, because of the prominence given to the department of city lighting. Mayor McClellan has come out unqualifiedly in favor of the establishment and maintenance of a municipal plant to furnish electric light for the streets, parks and buildings of the various boroughs. In connection with his decision in this matter the following may be quoted from the mayor's official document:

"I am in favor of municipal ownership and operation of an electric lighting plant to light the streets, parks and public buildings of New York. I do not believe that the government should engage in any service which can be done better or as well by a private enterprise, or should invade business fields in competition with the legitimate trade of the citizen. Where service rendered by private corporations is unsatisfactory, either because of its inferiority or excessive cost, it becomes the province of the government to take control of that utility for its own uses.

"This matter has received the attention of the board of estimate and apportionment, and at its last meeting, after hearing the opinion of the corporation counsel and Judge Dillon, a commission was appointed, consisting of Professor George F. Sever, of Columbia University, Professor Cary T. Hutchinson, electrical engineer, and Nelson P. Lewis, the engineer of the board of estimate and apportionment, and instructed to report, as soon as possible, general plans and estimates of cost for a municipal lighting plant for the streets, parks and public buildings of the city as a whole, by boroughs and by districts."

The mayor points out the possibility of using the rights reserved in the grants heretofore given to the Consolidated Telephone and Electrical Subway Company and the Empire City Subway Company. This, he considers, will eliminate a large element of expense.

In connection with the subject the mayor calls attention to the possibility of using refuse destructors as an aid to the economical generation of current. He emphasizes the possibility of cooperation by the street cleaning department. He quotes the experience of the towns and cities in England, Ireland, Scotland and Wales, and suggests that the incinerator used by the street cleaning department in West Forty-seventh street, New York city, where current is generated for lighting the stable and dock, shows the practical result that may be obtained even on so small a scale.

The mayor holds that while the right and authority of the city to establish and maintain a plant for supplying light to the public streets and buildings appear evident from the recent opinions of the corporation counsel and Judge Dillon, it is quite possible that considerable litigation may be indulged in if the whole authority is left at this point. He has therefore caused to be prepared a measure for introduction in the legislature about to convene. This measure will be simply declaratory of the right and power already existing in the city, and its enactment is merely to prevent litigation.

Electric Railroads in Connecticut in 1904.

Particulars of the operations of the electric roads in Connecticut, contained in the annual report of the railroad commissioners, are as follows: the gross earnings for the year ending June 30, 1904, were $4,924,151.46, which is $420,583.17 more than for the preceding year. The gross earnings per mile operated were $7,187.20, and per mile run, $0.2164. The number of miles operated was 685.-128. The largest gross earnings per mile were $10,819.24, on the lines of the New London street railway. The second largest were $9,704.49, on the lines of the Hartford street railway. The net earnings for the year were $1,637,037.91, as against $1,338,972.22 for 1903. They were $2,389.39 per mile operated, and $0.0719 per mile run.

The operating expenses for the year were $3,287,113.55, which was $122,-514.48 more than for 1903. These expenses are equivalent to $1,797.81 per mile operated, and $0.1445 per mile run. The total expenses were 66.75 per cent of the gross earnings. The various companies paid in taxes to the state $260,-046.07. Interest on the total bonded and floating indebtedness of $24,747,531.57 was paid to the amount of $876,658.99. Dividends amounting to $120,050 were paid by eight companies on capital stock amounting to $1,900,000. No dividends were paid on $28,759,748 of capital stock.

The number of passengers carried was 93,111,402, a decrease of 3,746,380. The steam roads in the same time carried 64,315,374 passengers, which was a decrease of 603,098 from the number carried in 1903. The number of passengers per mile of main track operated was 135,903, compared with 146,213 the previous year. The total number of miles run was 22,750,560, which is 1,720,671 more than during the previous year. The gross and net earnings per mile are slightly greater, and the operating expenses slightly less than in 1903.

The number of employés was 3,297, or about 4.8 per mile of road operated.

The total capital stock of the street railway companies in Connecticut outstanding is $30,659,748, representing 631.825 miles of street railway owned. Some of this capital stock, however, represents ownership of gas and electric properties. The total bonded debt of the street railways is $22,207,312.27, but this also covers gas and electric properties. The companies controlling the greatest mileage of main tracks are the Consolidated Railway Company, representing 181.81 miles; the Connecticut Railway and Lighting Company, 168.27 miles, and the Hartford Street Railway Company, 76.87 miles.

The number of persons killed and injured in the operation of street railways in 1904 was 383, compared with 370 in 1903. These were divided as follows: number of passengers injured, 208; killed, 4; employés injured, 18; killed, 2; other persons—killed, 17; injured, 134.

Test of the Canadian Niagara Falls Power Company's Turbines.

The Canadian Niagara Falls Power Company, the ally of the Niagara Falls Power Company on the American side of the river, set in motion on January 2 two of its 10,000-horse-power turbines. The officers of the power company, the commissioners of the Niagara Falls Queen Victoria Park, and other guests were witnesses. The trial was successful.

Francis L. Stetson, of the New York, and President W. H. Beatty, of the Canadian company, turned on the power, and each machine, under full power, developed 12,000 volts.

After the test a luncheon was served at the Hospice of Mount Carmel on the high bluff of the Niagara. The guests, including Mr. Stetson, made congratulatory speeches.

Ohio Electric Light Association.

The next meeting of the Ohio Electric Light Association will be held at the Hotel Victory, Put-in-Bay Island, August 16, 17 and 18, 1905. The executive committee, together with the president and secretary, is planning a very complete programme both as to information and pleasure. Mr. D. L. Gaskill, Greenville, Ohio, is secretary-treasurer.

Digitized by Google

GROUNDED TRANSMISSION MEDIUMS—VII.

BY J. STANLEY RICHMOND.

(*Conclusion.*)

TRANSVERSE STRAY TRANSMISSION.

Having treated, in the previous articles, in a somewhat cursory way of the general conditions, tests, apparatus and improvements connected with the subject of the electrolytic corrosion of metals earthed in the neighborhood of grounded returns, the writer will now endeavor to take up a very interesting but, up to the present, theoretical phase of the whole question. This is the factor which he has termed transverse stray transmission by pipes and other similarly buried metals.

Referring to the previous article under the heading of "Stray Transmission,"[1] it can be taken for granted that the relative rail, pipe-line and earth resistances are the really important factors affecting the question at issue; and particularly is this the case when one remembers how very much greater is the resistance of a given length of pipe-line than that of an equal length of rail, if the latter is properly bonded.

In order to deal in an approximately correct way with the factors by the use of plain arithmetic, it is necessary to allow that a certain portion of the ground act as a connection between the rails and a contiguous pipe-line; which portion may, for convenience, be termed soil, while the remainder of the ground may be termed earth. Professor Blake, in the *Electrical World and Engineer* of December 16, 1899, gave the following data in respect to the resistance of cast-iron pipe and pipe-joints:

Class of pipe, six-inch cast-iron.

Length of pipe sections, twelve feet.

Average resistance of each length of pipe, 0.000345 ohm.

Time pipe had been in use, thirteen years.

Average resistance of each joint, 0.0092 ohm.

Total resistance of pipes, 0.556 ohm.

Total resistance of joints (58), 0.535 ohm.

Total resistance of pipe-line (687 feet), 1.091 ohms. Such a pipe-line, 1,000 feet long, will have, therefore, a resistance of 1.588 ohms.

For rail resistances, the following data may be assumed:

Class of rail, girder.

Resistance of 1,000 feet of rail, 0.006 ohm.

Length of each joint, three feet.

Number of joints to 1,000 feet of laid rail, thirty-three.

Equivalent in straight rail of each joint, eighteen feet.

Equivalent in straight rail of 1,000 feet, of laid rail, 1,495, say 1,500 feet.

Resistance of 1,000 feet of laid rail, 0.009 ohm.

A lower soil resistance than is generally

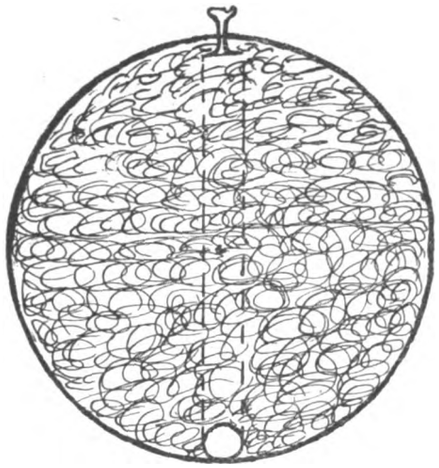


FIG. 32.—RELATION OF CONNECTING SOIL BETWEEN RAIL AND PIPE.

allowed is forty ohms for a block three feet long, having connecting faces of three square feet each. Assume a rail laid parallel to and ten feet away from a six-inch cast-iron water main; in which case, though the cross-section of the soil directly connecting the rail and the pipe, as shown by the dotted lines in Fig. 32, is ten feet by only a narrow width, it must not be forgotten that the real cross-section of the connecting soil, due to by-paths, is a much greater area. Consider, therefore, that the cross-section of the connecting soil is equivalent in area to that of a circle with a diameter of ten feet; or, roughly, to a length of ten feet by eight feet. This is a liberal allowance, and it is probable that tests properly carried out would show that the equivalent area is less and the resistance, therefore, greater.

Now if soil three feet long with connecting faces of three feet by three feet has a resistance of forty ohms, a block of soil ten feet long having connecting faces of three feet by eight feet will have a resistance of $40 \times \frac{10}{3} \times \frac{3}{8} = 50$ ohms.

As to the factor of one or more rails, it must be remembered that the stray transmission between one rail and a pipe-line with a load x will be, approximately, the same as that between two rails and a pipe-line when the load on each rail is one-half x, or between four rails and a pipe-line when the load on each rail is one-fourth x. For all practical purposes, therefore, it can be assumed that there is only one rail and that it is carrying the full load.

Fig. 33 represents, diagrammatically, 10,000 feet of rail laid parallel to and ten feet away from 10,000 feet of pipe-line; in which AB is the rail, the continuity of which is broken at the point C; D is the power-house and EG the pipe-line of which F is the middle point. The resistance of EF or FG, at 1.588 ohms per thousand feet, will be 7.94 ohms. The soil resistance between AC and EF, or between CB and FG, will be $50 \times \frac{3}{5{,}000} = 0.030$ ohm. Consider a load of 250 amperes evenly distributed over AB. Such a load will be equivalent to a similar load applied at the centre of AB, as shown at H, and will have two paths; first, by means of the rail AC, then by the soil between AC and EF, then by the earth, then by the soil between FG and CB and then by the rail CB to the power-house; second, by means of the rail AC, then by the soil between AC and EF, then by the pipe-line EG, then by the soil between FG and CB, and then by the rail CB to the power-house.

Allowing that the resistance of the earth is nil, the resistance of the first path will be $\frac{1}{2}$ AC + $\frac{1}{2}$ (soil between AC and EF) + earth + $\frac{1}{2}$ (soil between FG and CB) + $\frac{1}{2}$ CB, while the resistance of the second path will be $\frac{1}{2}$ AC + (soil between AC and EF) + $\frac{1}{2}$ EG + (soil between FG and CB) + $\frac{1}{2}$ CB, which, substituting figures, gives for the first path $\frac{1}{2}$ (0.009 × 5) + $\frac{1}{2}$ 0.03 + 0

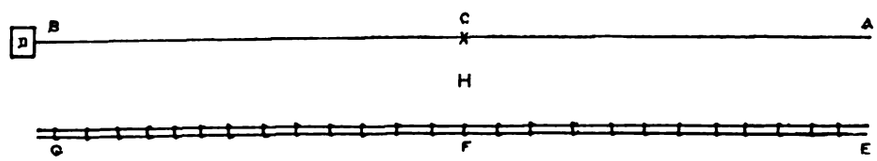


FIG. 33.—DIAGRAMMATIC REPRESENTATION OF RAIL LAID PARALLEL TO PIPE-LINE.

[1] ELECTRICAL REVIEW, December 17, 1904.

Digitized by Google

$+ \frac{1}{2} 0.03 + \frac{1}{2} (0.009 \times 5) = 0.075$ ohm, and for the second path will be $\frac{1}{2} (0.009 \times 5) + 0.03 + \frac{1}{2} (1.588 \times 10) + 0.03 + \frac{1}{2} (0.009 \times 5) = 8.145$ ohms. The transmission will be divided between the two, therefore, in the proportion of 8,145 to 75; that is, the earth will act as the transmission agent for 247.7 amperes and the pipe-line for 2.3 amperes of the total 250 amperes.

Now consider the case when the break at C is closed. This will give a third path by means of the rail only, the resistance of which will be $\frac{1}{2}$ AC + CB = $\frac{1}{2}$ $(0.009 \times 5) + (0.009 \times 5) = 0.0675$ ohm. When the break is closed, therefore, the transmission by the three paths will be divided up in the proportion of 1,629, 15 and 1,810; that is, the earth's transmission will be 117.90 amperes, the pipe's transmission will be 1.09 amperes and the rail's transmission will be 131.01 amperes, a total of 250 amperes. Such calculations as have been given are, of course, only arbitrary, but they come, approximately, very near the truth. As a result, it will be easily understood that besides longitudinal transmission, there is also transverse transmission by means of the various accidental transmission agents. For the large amount of transmission which takes place by means of the earth must find its legitimate transmission agent (the rails) at some portion of the system. This portion, as is well known, is in the neighborhood of the power-house, where the tracks converge; where, if the accidental transmission agents are in close proximity to the rails, electrolytic corrosion will result. It can be easily understood, therefore, that though an accidental transmission agent may show no drop across a considerable length and is, therefore, not acting as a transmission agent longitudinally, it may be acting as a very considerable transmission agent transversely; which probably accounts for the fact that pipes have shown the evidence of electrolytic corrosion when by the usual tests they have been proclaimed as immune from damage. For this reason, all pipes at converging points should be closely examined whenever possible; especially if they are in near proximity to the rails. It may sometimes be considered advisable to dig out the dirty soil surrounding the pipes at such points and fill in with clean sand, and it may even be necessary, in a few special cases, to wrap the pipes for a short distance with tarred felt paper. All service pipes in such converging districts should be so wrapped.

Provided that such transverse transmission is the case, it must not be forgotten that the transmission will, for short distances, be also longitudinal. Very careful tests by a fully qualified expert should, therefore, be made in such districts.

In conclusion, the writer trusts that, out of all the matter given, and in spite of its many imperfections, some useful information may have been obtained by the reader.

Breakdown of the Bradford, England, Municipal Light and Power Station.

A serious breakdown of the Bradford (England) electric light station took place on Thursday, December 9. The following account is from the *Electrician,* London:

A short-circuit occurred upon the negative side of the system on Thursday morning at 6.10, developing into a heavy short across the outers ten minutes later, and upon investigation a fault was located in a feeder laid across the iron bridge which passes over the main line of the Midland Railway in School street. The feeder was disconnected at both ends, but a heavy fault still remained. The pavement upon the railway bridge was opened up, when it was found that the arcing had burned a hole in the iron plates forming the bottom of the bridge. The cable was cut upon each side of this, and tested bad in both directions.

At 8.30 the pavement opposite the Midland station, about a quarter of a mile distant from the bridge, was displaced by an explosion, and the ground was immediately opened up to expose the cables, which at this point are laid in two parallel brick and stone culverts, which contain the cables supplying current to the four most important feeding points in the centre of the town. While this work was proceeding, violent explosions occurred, and the pavement was displaced at other points in the immediate vicinity. The explosions became so serious that at 9.55 the works were shut down in order that the faulty cables might be cut clear.

There are at each feeding point three pavement boxes arranged side by side, and the links in all except the centre boxes were removed at the four feeding points and at the works, but the explosions continued after the current was cut off with increasing violence, so that it was not considered advisable to commence running again until the ground had been opened up, and the culverts ventilated in places by the removal of the cover stones, which are six inches thick, and consequently heavy to handle. Observation at this time showed that nearly all the fifteen cables in the two culverts were burned asunder.

The works were started up again at 12.35, when smoke commenced to reissue from the ground, the mains being at the time fed by 1,800 kilowatts of plant across the outers and 320 kilowatts of steam balancers on each side. The ground was accordingly opened up below the bottom of the culverts and short lengths of armored cable—which, by the way, no one upon the job knew were located there—pulled out in a very heated condition, and it was difficult at the moment to account for the cable being alive, as the whole of the cables had, so far as could be ascertained, been disconnected at both ends upon the positive and negative poles. The bottom of the culvert, which also consisted of stone slabs six inches thick, was removed for some yards and arcs exposed, which were, however, kept down by recovering them with earth, and the works and feeding-point boxes again visited to confirm that all the links in the outside boxes and at the works had been removed. This proving to be the case, and as the arcing continued with unabated vigor in close proximity to a large gas main, the works were shut down a second time at 2.35, as the feeders remaining were not in any event nearly adequate to carry the evening load. It was subsequently found that pieces were fused out of the gas main which was not cut off, and it is, therefore, probable that the damage would have assumed very serious proportions had the arcing continued.

The whole of the cables upon each side of the fault were now cut, and every available man set trimming back the ends, as it was necessary to test the cables to ascertain which were usable as they had been very considerably heated carrying the heavy currents to the faults, and the terminal points of the individual cables in each direction were unknown, owing to the cables having been massed in the culvert.

While this work was proceeding new cable was got on to the job, and pulled in to bridge the gap, which was 160 yards in length. Several of the cables to different parts of the town were found to have dead earths upon them, which so reduced the capacity of the mains between the fault and the feeding points that the supply could not be reinstated until such time at night as the load fell to the capacity of the available mains.

The supply to practically the whole

Digitized by Google

town was reinstated at midnight, but while the main fault was being dealt with another developed in quite another part of the town, and this was taken in hand, and the supply recommenced here soon after six next morning. During the night the faults upon the more important of the defective cables were located, and the following day additional temporary cables were got in to augment those bridging the gap caused by the destroyed cables.

The cables that were the cause of the mishap, and those burned out thereby, were laid between eight and one-half and sixteen years ago, and were burned through in many places at old-fashioned cast-iron straight-through joint-boxes fitted with rubber glands, the cables having lead sheaths and hygroscopic insulation. The Bradford system of mains has until the last few months consisted wholly of single-core cables, and there are no fuses upon these.

The mystery of the live cables beneath the culverts was cleared up in tracing the cables out, and found to be caused by a set of three single-pole disconnecting boxes being arranged with the negative between the positive and neutral, instead of the neutral box being in the centre, as in all other parts of the town. The trouble is attributed to stray currents upon the cable sheaths causing a fault at the point where a cable entered a rubber gland joint-box, and thus raising the potential of the lead sheaths; the lead sheaths are not electrically continuous across the joint-boxes.

The distribution to the tramways was unaffected.

It appears that the city electrical engineer and manager had submitted a report on the bad condition of the network to the electricity committee a short time ago, and that it was down for consideration by the committee on the very day that the breakdown occurred.

Franklin Institute Election.

The annual election of officers and committees of the Franklin Institute was held recently in Philadelphia, Pa. The following officers were chosen: president, John Birkinbine; vice-president, Washington Jones; secretary, William H. Wahl; treasurer, Samuel Sartain; auditor, Dr. William H. Greene; managers: Edwin S. Balch, Walton Clark, Thomas P. Conrad, Charles Henry Howson, Louis E. Levy, Charles Longstreth, Isaac Norris and Coleman Sellers. The Institute's committee on science and the arts for the new year will be A. W. Allen, Hugo Bilgram, Amos P. Brown, Frank P. Brown, W. W. Canby, Kern Dodge, W. C. L. Elgin, Daniel Eppelsheimer, Jr., E. Goldsmith, Lewis M. Haupt, Lucien E. Picolet, C. J. Reed, James S. Rogers, Harrison Souder, George P. Scholl, E. Alexander Scott, Mr. Sellers, H. W. Spangler, A. H. Stewart and Martin I. Wilbert.

Electricity in Mines.

At a recent meeting of the Glasgow local section of the Institution of Electrical Engineers, of Great Britain, the secretary of the section, Mr. Robert Robertson, discussed at some length the use of electricity in mines. The great advantages of electrical power for mining are its sufficiency of production and transmission, its reliability and, most important of all, its flexibility and the facilities with which the apparatus may be changed from place to place. Electricity is, without doubt, the most suitable form of power for the purpose. Its only serious rival is compressed air. While there are certain circumstances where the latter is more suitable, there is no doubt that the great balance of experience is in favor of electrical power.

While present practice in England is in favor of direct currents, and while much can be said in favor of each system, the speaker believes that the alternating-current system is the most suitable, all things being considered, and that it will be the most used in the future. He thinks that the advantages of this system will be much increased with the adoption of the single-phase series motor for driving mining machinery.

In discussing Continental mining plants attention was called to the elaborate and even extravagant buildings and appliances which one finds. It was held that this practice has been carried to excess, but that there is a decided advantage in housing properly electrical apparatus, as this tends toward cleanliness and assures better attention.

Methods of hoisting by means of electric motors were described briefly, reference being made to the Ilgner system, in which a heavy flywheel is used as an energy accumulator to carry the motors over the peak of the winding load. This system is thought to have a number of points in its favor.

Although there has been an important development in the application of electricity to mining in England, it was thought that this development had not been as great as it should have been. Taking one important mining section of England, only eleven per cent of the mines are using electric motors; or, on a basis of output, twenty per cent. The number of mining plants with a rating of 100 horse-power and over is very small. There are but few plants where the power exceeds 200 horse-power, and only one or two cases where it exceeds five or six hundred horse-power.

While the speaker was in favor of electrical operation, he cautioned against any generalizations. Each case must be considered on its merits. He is convinced, however, that there is sufficient justification to warrant every mine owner giving the question of electrical operation careful consideration. In one case with which the speaker was familiar the substitution of electric haulage in place of horse haulage underground brought about a saving sufficient to repay the capital expenditure in between two and three years. In another case the saving effected by an electric pumping system over steam and rope driving cleared the cost in about three years. Other examples could be given, in some cases the saving claimed being sufficient to meet the cost in two years.

Another important feature of electrically driven mining tools is that this method makes it possible to work the lower and thinner seams. It is thought that by properly applying electric power it will be commercially possible to work seams which could not otherwise be worked at a profit.

The question of securing a supply of electric power is now being solved in certain districts by the establishment of central generating plants which deliver power at the mines.

Vacuum Gauges.

At a recent meeting of the Newcastle section of the Institution of Electrical Engineers, of Great Britain, Mr. C. Turnbull discussed the defects of the usual type of vacuum gauge used in connection with condensers. The chief objection to the ordinary type of gauge is that its indications depend upon the atmospheric pressure. Moreover, it is rather long for convenient arrangement. A type of gauge more suitable has the form of a short mercury barometer sealed at one end, with the other end connected to the exhaust pipe or the condenser. This gauge may be read directly, and it need be only ten inches in length. This will be sufficient to show a vacuum as low as twenty inches. It is also important to have the vacuum gauge properly placed. If it be too low an error is introduced by the pressure of the water which collects in the piping.

Digitized by Google

The Efficiency of Steam Engines.[1]

The second report of the royal commission on coal supplies contains two interesting contributions by Mr. John G. Hudson, M. Inst. C. E., of Hick, Hargreaves & Company, Bolton, and Mr. Henry McLaren, of J. & H. McLaren, Leeds. The first contribution by Mr. Hudson dealt with the efficiency of and fuel consumption in steam engines, and was as follows:

It is understood that the term "steam engine" includes the whole steam plant, that is the boiler, and the superheater and economizer if any, in addition to the engine proper.

The first step in this enquiry is to ascertain the margin that theoretically exists for further improvements between the results obtained by the best engines of the present day, and those that are possible from a perfect plant. A committee of the Institution of Civil Engineers on "the thermal efficiency of steam engines," a few years ago decided upon such an ideal engine to serve as a standard of comparison for actual engines. This ideal engine was assumed to utilize the whole of the heat theoretically available under the conditions of working, and to be free from the imperfections and losses which must necessarily occur in an actual engine. Even this perfect ideal engine is very far from being able to utilize the whole of the heat furnished to it in the steam and convert the same into power, the possible return even under the most favorable conditions being about thirty per cent, the bulk of the balance being unavoidably lost in the exhaust steam discharged from the engine, except a comparatively small portion lost in the chimney gases. Of this thirty per cent, which is all that can be theoretically realized by the ideal engine, about one-half, or fifteen per cent, has been realized by the best actual engine, so that the total margin for improvement in the present engine is represented by a reduction of the fuel required to one-half. To obtain this reduction, the actual engine must be made to resemble the ideal one, so as to lose no heat by radiation; it must be free from friction, must have no clearances in the cylinder, and a number of other similar qualities which are absolutely unattainable in practice in the present state of knowledge, though they are not barred by any natural laws. It would, therefore, appear that no very considerable proportion of this theoretical possible saving is likely to be attained in practice.

[1] The *Mechanical Engineer*, London, England, December 17.

The improved economy of steam engines, which has been going on steadily for many years, may be ascribed to improved design, to increase in steam pressures and, in more recent years, to superheating. Any further marked improvement due to a further increase in steam pressure can hardly be looked for, the further possible gain by this means being small, while the accompanying disadvantages, such as the reduced efficiency of the boiler due to increased loss by radiation and otherwise, become more and more marked. In like manner, as regards superheating, the temperatures already reached approach, if they do not exceed, those to which the materials now used for the working parts of cylinders, pistons, valves, etc., can prudently be exposed, so that but little more improvement can be looked for under this head. There only remains improvement in design, which can hardly be expected to secure any marked improvement over the best results obtained, but may fairly be looked to to make such results more easily approached in every-day practice, though it must be borne in mind that even to secure this approach requires not only that the conditions should be favorable, but a very large amount of personal care and constant supervision, which the owner is rarely able to afford or willing to pay for. Greater stress is generally laid on securing certainty of continuous running without accidental stoppages, accompanied by steady or even turning, with a fair measure of economy. It may fairly be argued that such a view is commercially correct, with fuel at the comparatively low value generally obtaining in England; in other words, that a maximum steam economy may not justify the original extra outlay and constant extra care needed to obtain it.

By far the greatest loss from either an ideally perfect or an actual steam engine, is that of the heat necessarily and unavoidably contained in the exhaust steam, and lost when same is either discharged into the atmosphere or spent in heating up condensing water, the heat so wasted representing about sixty per cent of the potential heat in the fuel. In some cases, and to a greater extent in America than in England, this heat is used for drying or heating purposes, and where this can be done a very great economy results. But it is quite common to find this source of economy neglected, the steam from an engine being condensed in order to secure the comparatively small advantage due to a vacuum being obtained, while steam is taken direct from the boiler for heating purposes.

Although hardly coming, strictly speaking, under the head of an improvement to the steam engine, attention may be drawn to what is known as the "waste heat engine." This is an adjunct to a steam engine, and it has indeed been shown practically that by such means a considerable economy may be obtained, but the process involves a good deal of additional and more or less delicate plant, an ample supply of condensing water at a low temperature, as well as practical difficulties in the working, and for these reasons is not likely in its present form to come into extended use.

Summing up, in view of the foregoing circumstances, while small improvements in detail will no doubt continue to be made, there does not seem to be any justification for anticipating any marked improvement on the best results hitherto recorded, but it may reasonably be hoped that improvements in design and detail will enable such results to be more easily, and, therefore, more generally, approached in every-day practice, particularly in the case of steam plants of sufficient magnitude to justify the necessary attention to good design and subsequent attention.

Mr. McLaren's remarks also dealt largely with steam engine economy, and were substantially as follows:

All engineers are aware that the steam engine, at its best, is a very crude arrangement of converting heat into power. The following figures, taken from *Power*, make this fact very obvious. There are very few mill engines in this country working on as little as two pounds of coal per indicated horse-power per hour. The figures given are based on a consumption of two pounds of coal per indicated horse-power, each pound containing 13,500 British thermal units of heat; this is the calorific value of a good average coal. The heat losses of a steam engine working under the above conditions are approximately:

	British Thermal Units.	Percentage of Total Heat in Coal.
Loss through grate bars	135	1.00
" by radiation from boiler	675	5.00
" in chimney gases.	2,970	22.00
" radiation from main steam pipes.	210	1.56
" radiation from auxiliary pipes...	30	.22
" in auxiliary engines exhaust....	190	1.40
" radiation from engine	280	2.08
" in engine exhaust	7,737	57.31
" engine friction...	76	.56
Total losses.....	12,303	91.13
Heat converted into brake-horse-power	1,197	8.87
Total heat in one pound of coal..	13,500	100.00

If this engine be used for driving an

Digitized by Google

alternator generating electricity for power purposes there will be additional losses as follows:

	British Thermal Units.	Percentage of Total Heat in Coal.
Loss between furnace and engine.....	12,303	91.13
" in electric generator	48	.36
" in electric mains	115	.85
" in transformers..	52	.39
" in motor.....	98	.73
Total losses.....	12,616	93.46
Power delivered to factory shafting.....	884	6.54
Total heat in one pound of coal..	13,500	100.00

8.87 per cent of the total heat in the coal converted into power at the engine appears to be a very poor result; but if all condensing engines throughout England did equally well, and the non-condensing engines in the same proportion, considerably over fifty per cent of the engine fuel now used would be saved. The further drop of twenty-six per cent (*i. e.*, from 8.87 to 6.54) between the engine and the factory shafting is not encouraging to advocates of central electric power stations, especially when interest, rates, etc., on the large amount of capital sunk in the mains are added.

To the question, how can the coal of England be saved, I answer as follows: scrap all condensing steam engines and boilers not capable of converting six per cent of the total heat of the coal used into power; this equals 3.2 pounds per brake-horse-power with coal containing 13,500 British thermal units. Scrap all non-condensing engines not capable of converting four and one-half per cent of the total heat in the coal used into power, equal to 4.2 pounds of coal per brake-horse-power with coal containing 13,500 British thermal units. A good condensing engine working at 150 pounds pressure should convert ten per cent of the heat into brake-horse-power. A good non-condensing compound engine should convert six per cent into brake-horse-power.

A very large saving can be effected by better management of steam engines and boilers. Condensing engines should show at least twenty-five per cent better fuel economy than non-condensing engines of the same type, yet from recent investigations I have made in the coal consumption of 177 electric generating stations throughout the country, I find the non-condensing engines, on the average, beat the condensing in fuel economy by thirteen per cent. Therefore, 13 + 25 = 38 per cent loss has to be accounted for by the condensing stations. A large proportion of this is due to bad arrangement of the plant and want of proper management.

From the figures already given it will be observed that the largest loss of heat is in the exhaust steam. I anticipate that in the near future steam turbines will be driven by the exhaust steam from high-pressure engines. If the exhaust steam from a high-pressure engine be dried before entering the turbine great economy should result from this method of working, especially if the turbine exhausts into a good condenser. The engine would take the resilience out of the high-tension steam, the turbine taking the kinetic energy, which is at present lost. Experiments are at present being made in this direction.

I anticipate that more use will be made of exhaust steam for heating buildings. In America there are companies which buy the exhaust steam from power plants in the large cities and distribute it for heating purposes. At the Yorkshire College, Leeds, we have the engine exhausting into the low-pressure mains for heating purposes, and at my firm's works in the winter time every unit of heat passing through the engine either goes for power or heating purposes. Exhaust steam can also be used for boiling where vacuum pans are used.

I anticipate that more attention will be given to the loss of heat passing away in the chimney gases. At present fuel economizers are placed in the boiler flues; these are used for heating the feed water by means of the waste heat, but if too much heat is abstracted the chimney draught is spoiled. This can be got over by using some system of mechanical draught, such as "Howden's" or "Ellis and Eaves'," now used in marine practice. By means of fans, the air on its way to the furnace is passed through tubes surrounded by the waste gases leaving the economizer, thus cooling the gases to a much lower temperature than is permissible with natural draught.

I anticipate considerable saving in coal by generating electric power with economical steam engines, and distributing it in bulk for lighting and tramways, also for driving machinery in shipyards, ironworks, mines, etc., and supplying users of small powers. But I do not anticipate that central power schemes will be able to supply mills and factories to compete with the ordinary mill engines of even moderate economy, generating the power on the spot, and driving direct on to the mill shafting.

The percentage of the heat in the coal which the best class of engine that we have made utilizes (and we have laid ourselves out for the manufacture of economical engines) is twelve and three-quarters per cent of the total heat of the coal. A good condensing engine working at 150 pounds pressure should convert ten per cent of the heat into brake-horse-power; but we have done twelve and three-quarters per cent (these are engines that have been tested by independent engineers), although, as a rule, we only guarantee ten and one-half per cent for that type of engine; that is to say, a triple-expansion condensing engine. That is a very small percentage; but if all steam engines did as well there would only be a fraction of the coal used that is used to-day for steam engines. These figures, twelve and three-quarters per cent, mean one and one-quarter pounds of coal per indicated horse-power. One and one-quarter pounds of coal per indicated horse-power is the best we have done in triple-expansion engines; two pounds is a very good economy; in fact, it is vastly above the average of mill engines in England to-day.

The gas engine shows a higher thermal efficiency, but there are other things which seem to bring it down in practice to almost worse than the steam engine. For instance, take the Board of Trade returns for the consumption of fuel in electric lighting stations in England last year (1902). There were only two stations wholly driven by gas engines; Northwich was one, driven by Mond gas, and Redditch was another, driven by Dowson gas; and in both cases the ultimate cost of coal and cost of generating a unit of electricity was more than in the steam engine stations. I can find steam engine stations to beat the gas engine stations. That is in practice, but when we come to speak of the gas engine thermally it is nearly twice as good as the best steam engine. The gas engine does not give as good mechanical efficiency as the steam engine; that is, if you get a high thermal efficiency per indicated horse-power, that is on the piston, there is more friction loss. Of course the pistons in a large gas engine are nearly red-hot when they are running. But even then their efficiency per brake-horse-power is still much higher than in the case of a steam engine, so that that would not account for all of the loss.

The cost of the coal in the case of the Mond Northwich plant was 0.48 penny per Board of Trade unit, and in the case

Digitized by Google

of an almost adjacent station at Leigh, in Lancashire, where non-condensing steam engines were used, it was 0.4 penny or 0.35 penny. The Redditch station, with the Dowson gas, was very much higher than the steam engines. At Northwich they buy their gas from the Mond company and pay a high price for it, they do not generate it on the spot, but they pay twopence per 1,000 cubic feet, buying it wholesale from Mond's works. I should think for a decent-sized station that would increase their costs; but for a small-sized station of about 104,000 units per annum I should say they could not make it any cheaper than twopence per 1,000 cubic feet; they might be able to do so, but a Mond gas plant does not lend itself to manufacturing in small quantities.

Northwich, using Mond producer gas, has an output of 104,000 units. Its fuel cost is 0.48 penny per unit; works costs are 1.48 pence per unit, including maintenance, water, oil, waste, stores, and everything else. Out of that 1.48 pence total costs, 0.48 penny is coal or fuel, so there is one penny for other charges, *i. e.*, 1.48 pence represents the total cost, including the coal. This is handsomely beaten by Leigh, a station with a larger output, using non-condensing steam engines, which comes out at twenty-eight per cent less in fuel and fifteen per cent less in works costs. Redditch, the other gas engine station, using Dowson producer gas (which, of course, they manufacture on the premises) has an output of over 172,000 units, and coal costs are 1.3 pence per unit. That is all anthracite; it is expensive coal, and they have to bring it from South Wales. The works costs there are 2.61 pence per unit, as compared with 1.48 pence Northwich. There are over a dozen smaller-sized steam engine stations that beat these results (of course, in a year or two's time, I think we shall see better results from gas engines); these are the only two stations wholly using gas engines in 1902.

These costs per unit are not high compared with some of the London electric stations. At Glasgow electric light is 0.36 penny for fuel, and 0.95 penny for works costs. These costs are not the final costs before delivering the current to the consumers. They do not include distribution nor interest on capital, management, etc. Leeds is about the best in regard to economy, in England, that is 0.27 penny per unit for fuel, and its works costs are 0.62 penny. But they get coal very cheaply; they buy the coal in the coal pits round about, and they have the canal up to the works, and they buy the very poorest "smudge," and find they get more thermal units for one penny from that coal than from any other quality of coal. I do not think it is done so much by economy in the steam engine as in buying the coal and working it economically. In making these comparisons it is necessary to take into account the actual cost of coal at each place. Assuming a common price for the coal, the Glasgow tramway power-house would show up better than that at Leeds.

From figures already given, it will be observed that the largest loss of heat in steam engines is in the exhaust steam. I anticipate that in the near future steam turbines will be driven by the exhaust as an auxiliary—taking power out of the same heat. In a steam engine we can only expand it (to keep the engine within reasonable size) down to certain limits. The steam turbine, especially the De Laval, works with a very low-pressure steam, in fact, they expand the steam before they put it through the turbine. If they are working at 120 pounds they expand it down to a fraction of one pound before it really touches the wheel. All turbines are more or less glorified windmills; they receive their power from heat energy, converted into kinetic energy; it is the rush of the steam; wind would do as well if you could supply it for driving the turbines. There are experiments being made just now (August, 1903)—especially by Rateau—to use the exhaust steam from a high-pressure engine to drive the turbine, and to generate electricity with that again, and there is every possibility that that will be successful. That is, if they can get the steam dry enough, the slightest amount of water through a turbine is apt to pull it up by the friction of the water—the clearances are so small—but by just superheating or drying the exhaust steam from a steam engine they ought to be able to get a great economy by using it through a turbine after it leaves the engine on its way to the condenser.

The Electrification of the Metropolitan Railway.

The first step toward the entire conversion of the London underground railways from steam to electric working was marked by the Metropolitan Railway Company running an electrically propelled train, conveying a large party of distinguished railway officials and other guests, from Baker street to Uxbridge on December 12, 1904. The run was successful in every respect, the distance being covered in about thirty minutes; and it is intended to work a considerable proportion of the traffic on this section electrically after January 1. The train, which bears a strong general resemblance to the rolling stock to which travelers on the Central London Railway are accustomed, consists of six bogie corridor coaches, the first and last of which are motor-coaches. A central passage, with longitudinal and transverse seats on each side, runs through the coaches, terminating at each end in a sliding door opening on to the platform at the end of each coach, swing-back gates at each side affording entrance to these platforms from the exterior of the train. The coaches, which are fifty-two feet six inches in length, are divided into two classes, differing only in the extent of the internal decoration, both classes being well lighted and equipped with electric heaters. Each coach is carried on a pair of four-wheeled bogie-trucks, the motor-coaches having a separate motor of 150 horse-power to drive each axle. The whole of the rolling-stock is of English manufacture; the coaches were built at Birmingham and Manchester by the Metropolitan Amalgamated Railway Carriage and Wagon Company, and the electrical equipment was supplied by the British Westinghouse Company. The current is collected from the live rail by means of cast-iron shoes, and the whole of the motors are controlled from either end of the train by the Westinghouse electropneumatic control system. A separate insulated return-rail, independent of the running rails, forms the return circuit for the current. The main generating station is at Neasden, and contains at present two 3,500-kilowatt Westinghouse-Parsons turbo-alternator sets, two more similar sets being in course of erection. They are supplied with steam at 180 pounds per square inch, superheated to 520 degrees Fahrenheit, from Babcock & Wilcox boilers. The exhaust steam is condensed by ejector condensers, and the overflow from the hot-well pumped through cooling towers before returning to the cooling-pond. The alternators generate three-phase current at 11,000 volts, which is distributed at this pressure by three-cored armored cables to nine substations along the line. At the substations it is transformed down to 440 volts, passed through rotary converters, and delivered to the live rail as continuous current at from 550 to 600 volts. The conversion of the track has been carried out without in any way interfering with the very frequent steam service over the route, the work having been done by the railway company itself.—*Engineering (London), December 16.*

Digitized by Google

The First Transmission of Power in Europe at 40,000 Volts.

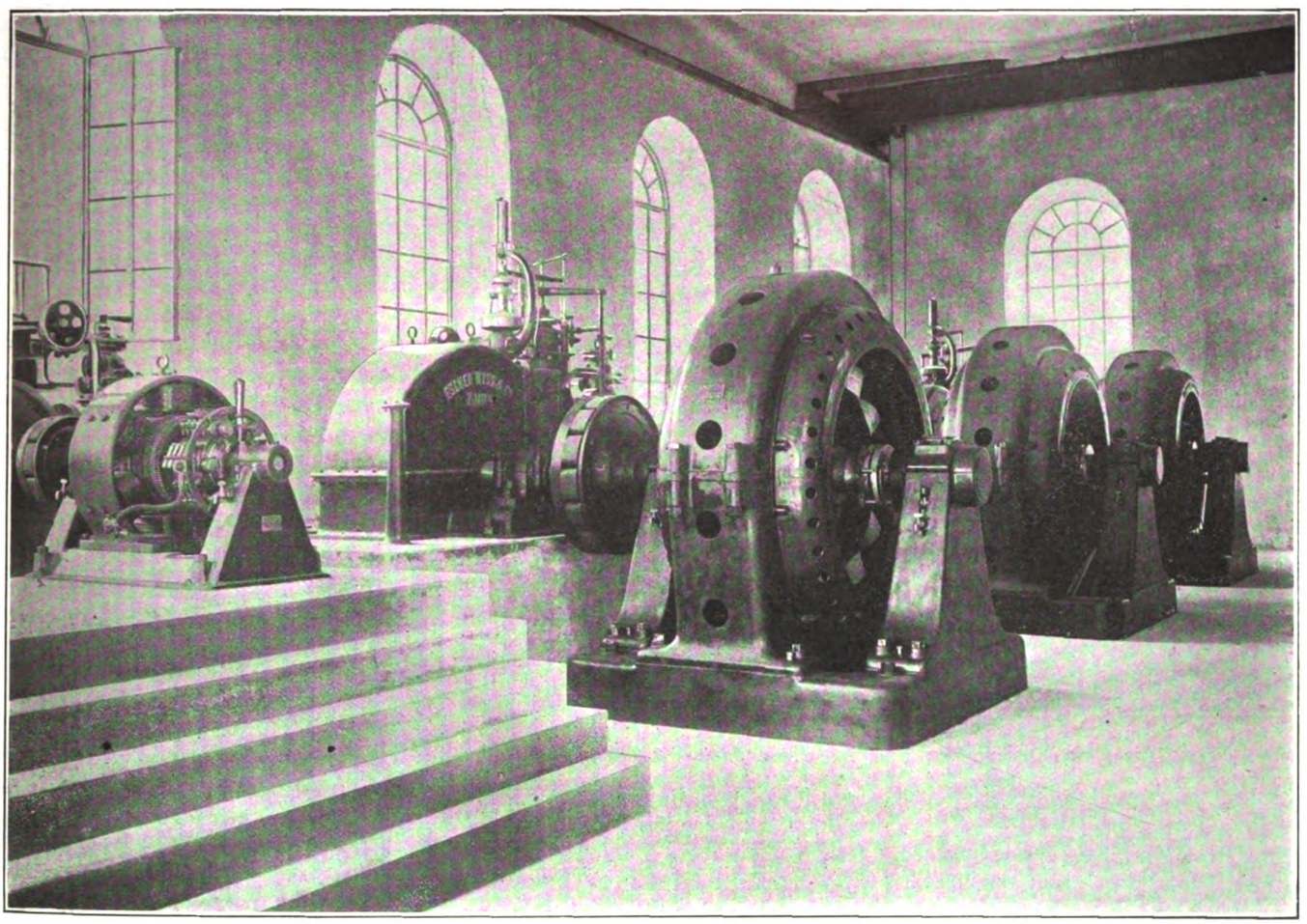
By Enrico Bignami.

LOMBARDY has been for some time the first in many industries, and it is now, as well, leading all sections of Italy in applications of electrical energy. In fact, one finds that the electrical installations there are the most numerous and most important, and to-day the electric transmission system from Gromo to Nembro, in the very interesting valley of Serio, is operated at the highest voltage which has been adopted in Europe. At Gromo there is available 2,000 hydraulic horse-power, and a little further up the river there is an additional 2,000. At the present time it is intended to install the first generating station only. All of the energy will be transmitted from Gromo to Nembro by means of three-phase currents carried over two lines supported on the same poles. At first but a single line will be erected, the possibility of transmitting energy easily a still greater distance being held in reserve. As all of the energy available will be disposed of, the line loss should be small and, at the same time, it was desired that the cost of the installation should be kept as low as possible. Bearing in mind all of these circumstances, it was decided to adopt a tension of 40,000 volts. In order that there might be a reserve, three generating units, each of 1,000 horse-power, and two exciting machines, each of twenty-five kilowatts, were installed.

Each of the 1,000-horse-power generators is connected directly to a turbine by a Zodel coupling. It delivers current to a transformer rated at 850 kilovolt-amperes, without the interposition of collecting bars. The latter receives the current furnished at 4,000 volts by the generators, transforms it to 40,000 volts, and passes it on the bus-bars, where the machines operate in parallel. The switches necessary for parallel operation are placed in the 40,000-volt transformer circuit. The current and pressure transformers for the ammeters and voltmeters, as well as for the relays which control the automatic circuit-breakers, are connected on the low-voltage circuit. As the ratio of transformation is one to ten, the ammeters and voltmeters measure simultaneously the current and voltage, and, during operation in parallel, the phase of the 4,000-volt circuit and of the 40,000-volt circuit. Another advantage of this arrangement is greater reliability of measuring transformers on the low-voltage circuit.

For each generator group there are three connecting links, placed between the 40,000-volt circuit-breakers and the bus-bars. These links are removable, permitting the complete disconnection of the circuit-breaker from the high-tension circuit. The high-tension circuit-breaker is controlled automatically, and makes the break under oil. It can, as well, be operated manually or electrically by means of a two-pole overload relay connected on the 4,000-volt side of the current transformers.

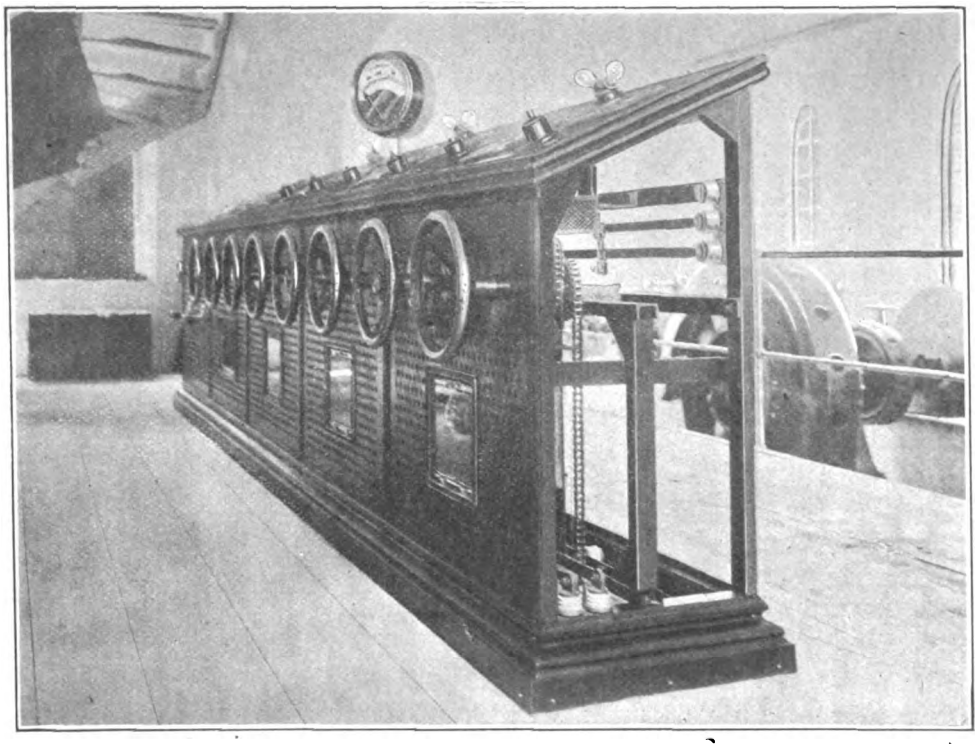
These transformers are rated at 850 kilovolt-amperes. They operate at sixty cycles with a ratio of transformation of from four to forty thousand volts. Their efficiency with a unity power-factor, under



TURBO-GENERATORS, 40,000-VOLT TRANSMISSION SYSTEM, GROMO-NEMBRO, LOMBARDY, ITALY.

Digitized by Google

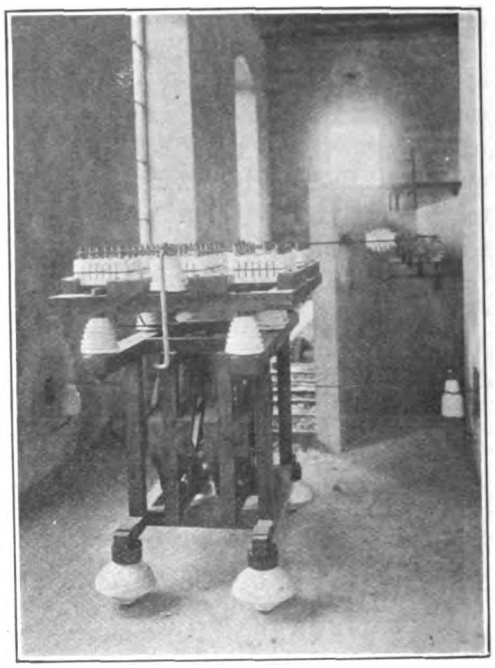
full load, was found to be 97.8 per cent, although the guaranteed efficiency was only ninety-seven per cent. The insulation between the primary and secondary windings was tested at a pressure of 67,000 volts. The dimensions of these transformers are: length, 1.6 metres; width, 1.36 metres; height, 2.18 metres. These are oil-cooled core transformers with water-cooling pipes. Each of the transformers uses eighteen litres of water per minute. The core is formed of three vertical columns, placed in the same plane and connected above and below by yokes. The primary and secondary windings are cylindrical, arranged concentrically and separated by an insulating covering. For greater safety the high-tension winding is subdivided into a series of small coils, the voltage of each of which is low, not exceeding 300.



CONTROLLING TABLET, FOR DISTRIBUTING CIRCUITS, GROMO-NEMBRO TRANSMISSION SYSTEM.

Although the arrangement, as adopted, was very simple, particularly that for the high-voltage circuit, the operating table and distributing switchboard have received much careful study, in order to avoid all disagreeable surprises from the day the plant was put into operation.

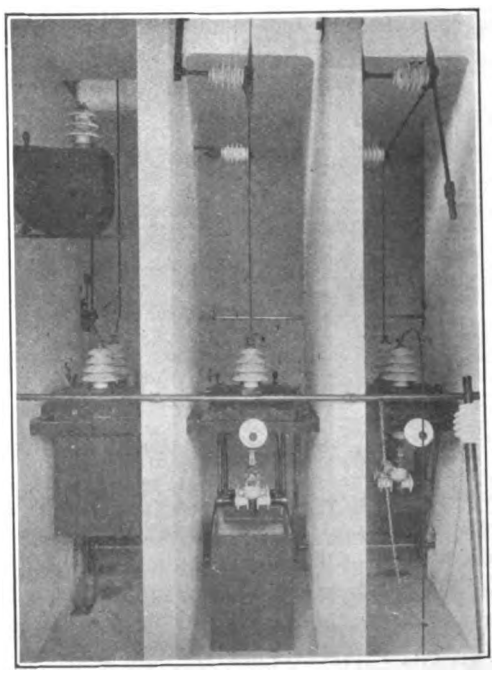
The operating table is formed of inclined tablets, which contain only low-tension apparatus. The whole table is divided into five panels: three for the generator, one for the line, and one for the exciters. Each of the generator panels and the line panel contain two hand-wheels for operating the oil-break, high-tension circuit-breaker and regulating the voltage of the system. The hand-wheels for operating the voltage regulators of the three generators can be coupled together by means of a lever, so that all of the generators can be regulated simultaneously from any one of the panels. Below the hand-wheels are placed a two-pole overload relay for each of the generator panels and a three-pole overload relay for the line panel. The push-buttons for disconnecting electrically the high-tension switches, and the phasing lamps and their switches are placed upon the board. The lever for opening the circuit-breakers mechanically is connected to the hand-wheel. The exciting panel contains the handles of the shunt rheostats of the exciting generators and two double-pole switches. The main voltmeter is mounted on a column above the central distributing panel. A building of ample size has been placed back to back with the station building. This is intended for the transformers and their auxiliary appliances. This building contains a basement and three floors, where there is available a floor space of ten by seven metres, allowing for a good arrangement of apparatus. The basement is divided into two rooms. The first, 1.2 metres below the level of the generating-room floor, contains the rheostats and the framework for the 4,000-volt circuits and instruments. Under the floor are the conduits running from the generating room. The second room of this basement is placed 2.7 metres below the floor of the generating room. It contains the step-up transformers. The first floor is also divided by a partition. In the front, opening out into the generating room, is the distributing and operating switchboard, with the measuring instruments and the controlling wheels. In the second room are the automatic, high-tension switches and



LIGHTNING ARRESTERS, 40,000-VOLT INSTALLATION, GROMO-NEMBRO, LOMBARDY, ITALY.

the three current transformers for the line. On the second floor are the collecting bars and the voltmeter transformers. On the third floor are the lightning arresters, and here the line leaves the building.

The 4,000-volt conductors and those carrying the exciting currents are placed



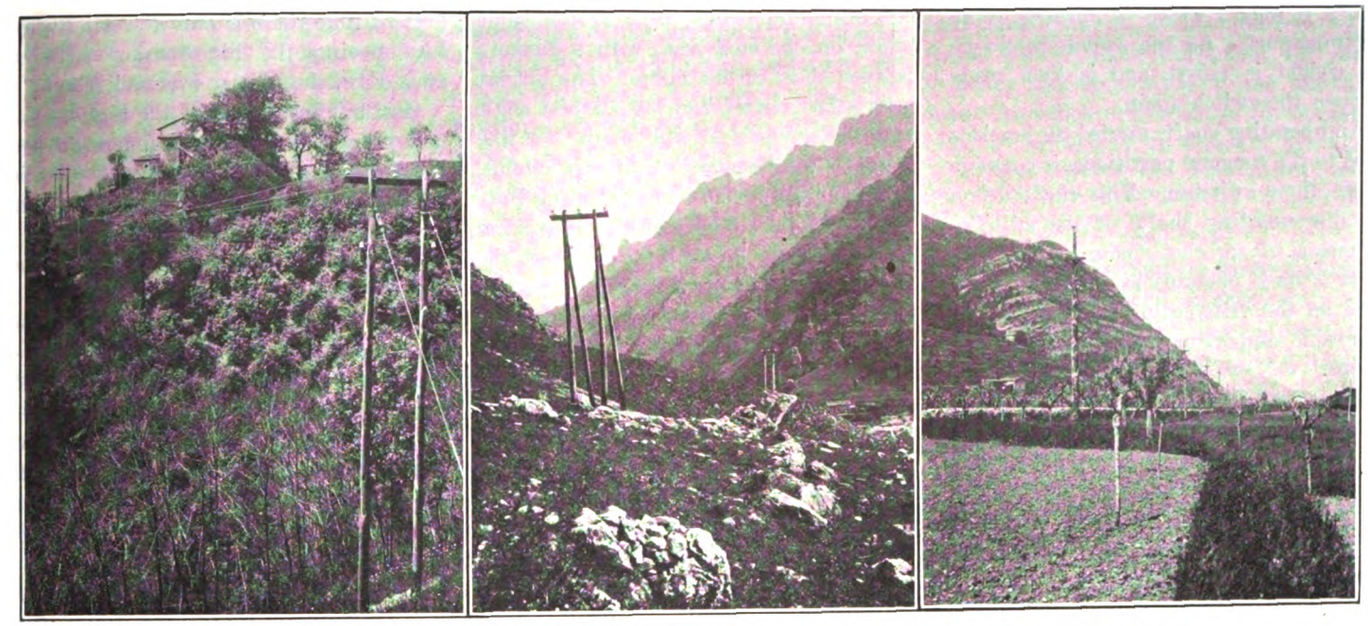
HIGH-TENSION, AUTOMATIC OIL SWITCHES, GROMO-NEMBRO, LOMBARDY, ITALY, 40,000-VOLT INSTALLATION.

in a conduit which passes under the regulating rheostats and the instrument framework, and into the basement.

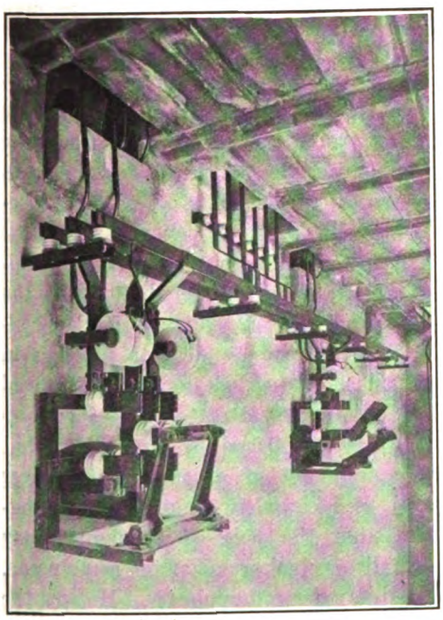
Each generator has been provided with

Digitized by Google

an iron framework, on which is mounted its auxiliary apparatus. Each of these frames is placed with its back to the wall dividing the basement. On each are mounted three high-tension, single-pole fuses for protecting the generator; a voltage transformer and its fuses, and two current transformers. At the back of the framework three glass tubes, enclosed in clay tubes built into the wall, lead into the space reserved for the transformers.



Views on the Transmission Line, Gromo-Nembro, Lombardy, Italy, 40,000-Volt Installation.

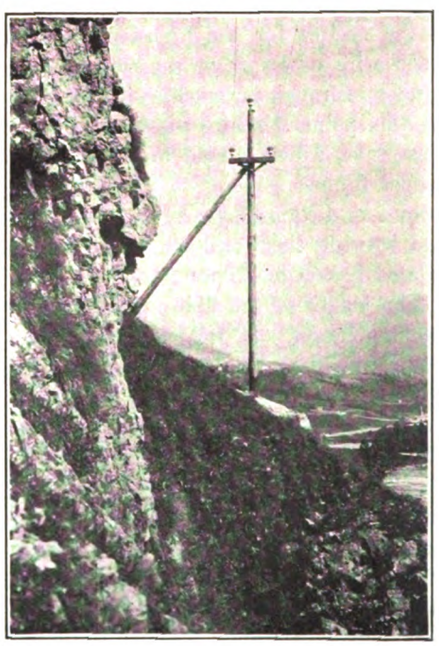


Secondary Disconnecting Switches in Substation at Nembro.

The collecting bars for the high-tension system are carried on insulators in three parallel passages, so that each bar is separated from its neighbors by a wall of concrete 120 millimetres in thickness. Special pains have been taken to insulate these bars from the ground. The standard type of insulator was not thought to be satisfactory, and a new type has been made. It consists of three separate pieces, baked separately but enameled together. Each insulator was tested before delivery at 100,000 volts. Above the collecting bars on the first floor are the high-tension switches. In order to avoid heavy apparatus three single-pole oil switches are employed, instead of one three-phase switch. The three switches are operated simultaneously. In order that these switches might be arranged similarly to the collecting bars, each switch is separated from its neighbors by a concrete wall 120 millimetres thick. To this wall are fixed the supports of the switch.

The single-pole switch is of standard type, constructed for 40,000 volts, but it presents some interesting details. It may be operated from a distance by rotating the controlling wheel. This is a good and elegant arrangement for a mechanical apparatus of this kind. In addition it allows considerable latitude in selecting a place for the switch. The breaking contacts, as well as all metallic parts under tension, are submerged in oil, so that the only parts above the level of the oil are the insulators or parts connected to the ground. The oil reservoirs are easily removed, so as to allow inspection of the contacts. The conducting parts of the switch are solidly made, but to prevent fusion of the main contacts small auxiliary contacts, between which the arc is drawn, are attached. These are easily renewed. In order to extinguish the arc surely and quickly, a jet of oil is directed against it at the moment of opening the switch. Although these particular switches are single-pole, a three-pole switch of the same type is made. In the latter the oil reservoirs for each phase are also independent.

Turning the hand-wheel, the contacts of the switch are closed and the disconnecting springs are extended. If the hand-wheel is then turned to the dead point, the switch remains closed, and this is the normal position if the switch is operated by hand. If it is to be operated automatically, the hand-wheel is not turned all the way to the dead point. The switch is held closed by a cam and catch. If



An Angle in the Transmission Line, 40,000-Volt Installation, Gromo-Nembro, Lombardy, Italy.

Digitized by Google

the catch is tripped, the tension of the springs opens the switch. In the small sizes the catch is tripped directly by an electromagnet. With the switches used in this installation, where all three are disconnected simultaneously, a shaft trips the catches. This shaft is driven by the fall of a weight which is released by an electromagnet. As the switch is closed, the weight is raised, and is then ready to open the switch again.

An operating shaft, carried on brackets fixed to the concrete partitions, is common to all three switches. This shaft drives the disconnecting shafts of the switches by means of sprocket chains. The main shaft is itself operated by the hand-wheel fixed on the distributing table, by means of a cable supporting pulleys and sprocket chains.

These switches can be opened by hand without throwing the overload relay, by means of a rod which turns the disconnecting shaft. In addition, the circuit of the electromagnet is closed by means of a push-button, and this releases the weight and opens the switch.

On the third floor of the building are the lightning arresters, that for each phase being separated from the others by a partition. These arresters are of the well-known cylindrical Würtz type, and are insulated from the ground several times by porcelain insulators.

On the floor with the lightning arresters is the exciter for the high-tension line. Each wire passes from the station by a window, through an opening in the glass. At this point the wire passes in a thick glass tube, which is held in place by two copper funnels soldered to the wire. The minimum distance between the conductors and between them and all bodies not insulated is 250 millimetres.

The length of the line is about thirty-two kilometres. It follows more or less the course of the Serio river in the "Val Seriana," and terminates at Nembro at the cotton mills of the Maison Crespi et Cie., of Milan. The line has been designed for transmitting a total of 4,000 horse-power with a maximum loss of five per cent. It consists of three copper wires 6.5 millimetres in diameter, mounted on delta insulators made at the Hermsdorf porcelain works. These insulators were submitted before delivery to a tension of 80,000 volts. This test assures a safe and satisfactory insulation of the line.

The insulators are mounted on wooden cross-arms and poles. In general the line is carried on a single pole, in the form of a triangle, with 850 millimetres on a side. The poles generally have a height of eight metres above the ground. This is increased to nine metres at crossings. The lower insulators are normally at a height of 7.5 metres above the ground, and 8.5 metres at crossings. Where there are long spans or sharp angles, two poles are used, the insulators being fixed at the same height on one cross-arm, with a distance between them of one metre. The longest span is 120 metres, and the sharpest angle is 145 degrees. At one point the line crosses a single-phase, 2,000-volt circuit. At other places it crosses conducting lines and the canal. The transformer station is at Nembro. When it reaches here the line is at a tension of 38,000 volts, and the station at Gromo is regulated to give that voltage. The substation contains at the present time only two three-phase transformers rated at 500 kilovolt-amperes, of the same tvpe, although smaller than those at the Gromo station. Space has been reserved for a third transformer. The ratio of transformation is from 38,000 to 500 volts. The plans at the substation for carrying in the high-tension lines are the same as those at the Gromo station. A three-pole protecting switch, mounted on a wooden pole, is placed just outside of the building, enabling the secondary distributing system to be entirely disconnected from the high-tension circuit.

After entering the building the same arrangement has been adopted as where the lines leave the Gromo station. The lines pass through the lightning arresters and terminate at the primary collecting bars. From these bars conductors run to the transformers. In each of these lines are a disconnecting link and a single-pole, high-tension automatic oil-break switch. In the secondary circuit of each transformer there are a three-pole, disconnecting switch, and two current transformers, of which one supplies the overload relay and the ammeter, and the other the relay alone. These transformers are connected to the 500-volt distributing bus-bars, from which the distributing lines start. The latter are protected by fuses.

The transformer station has a ground floor and two upper stories. The ground floor and the floor just above are divided into two rooms. The rear room on the ground floor contains the transformers. In the front room, against the dividing wall, are the secondary collecting bars, the movable disconnecting links, and the current transformers. On the floor above, over the space occupied by the transformers, are the automatic high-tension switches. The arrangement here is the same as that in the generating station. In the front room there are at the present time two switchboards for controlling the two high-tension oil switches and a framework on which are mounted two 500-volt switches and 500-volt fuses. The rear of the apparatus panels is the same as at the Gromo switchboard. At the present time there is only the hand-wheel for opening the high-tension switches, and below, the bipolar overload relay.

On the upper floor are the high-tension collecting bars. The arrangement here is identical to that at Gromo. On the same floor are the lightning arresters and the entrance of the high-tension lines.

The electrical material was furnished and put into operation by the house of Brown, Boveri & Company, of Baden, Switzerland. The turbines were furnished by Escher, Wyss & Company, of Zurich, Switzerland.

This installation, which was put into operation five months ago, proves beyond question that the high voltage adopted has brought no disadvantages to the installation. By its good operation, and on account of the arrangement adopted, it does not require any more attention for its service and presents no greater danger than an installation of moderate pressure.

BOOK REVIEWS.

"The Letter of Petrus Peregrinus on the Magnet, A. D. 1269." Translated by Brother Arnold, with introductory notice by Brother Potamian. New York. McGraw Publishing Company. Cloth. 41 pages. 6½ by 9 inches. 4 drawings. Supplied by the ELECTRICAL REVIEW at $1.50.

Petrus Peregrinus, a distinguished engineer in the engineering corps of the French army, was as well an enthusiastic searcher for the truths of nature. In contrast to the methods of other philosophers of his time, he believed in experimentation, and as a result of his indefatigable labors he is credited with the following noteworthy discoveries: he was the first to assign a definite position to the poles of the lodestone. He proved that unlike poles attract and similar poles repel. He established, by experiment, that every fragment of a lodestone, however small, is a complete magnet. He recognized that the pole of a magnet may neutralize a weaker one of the same name, and even reverse its polarity. He was the first to pivot a magnetized needle surrounded with a graduated circle. He used the magnetic compass as done today, in surveying, and lastly, though this can hardly be credited as a discovery, he invented the magnetic perpetual motion machine—a machine which has probably been rediscovered many times during each

Digitized by Google

succeeding century. This present work is a translation of his letters, written primarily to announce to an intimate friend the invention of his perpetual motion machine; but, as there were few persons at that time who knew anything whatever of the properties of the lodestone, he thought it necessary to lead up to a description of his machine by a discussion of the properties of the lodestone. The introductory notice gives a brief summary of the early knowledge of magnetism, and puts these letters as the first great step forward in this science. The translation of the letters is excellently done, making the book very readable. Needless to say, it is interesting. The translation is very acceptable to those who are interested in the early history of this science, but who are not able to read the letter in the original. It has been made from a copy of the first printed edition, which was prepared by Achilles Gasser, and printed in Augsburg in 1558, a copy of which is among the Wheeler collection in the library of the American Institute of Electrical Engineers.

"Practical Laws and Data on the Condensation of Steam in Covered and Bare Pipes," to which is added a translation of Péclet's "Theory and Experiments on the Transmission of Heat through Insulating Materials." Charles E. Paulding. New York. D. Van Nostrand Company. Cloth. 102 pages. 6 by 9¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

The main object of this book, as stated in the preface, is to bring to the attention of engineers an accurate and rational method of estimating the loss of heat from steam pipes and boilers covered with any of the well-known non-conducting materials now on the market. This method worked out long ago by Péclet seems to have been generally overlooked in this country, perhaps, because no translations of Péclet's work existed. Numerous experiments on the loss of heat from steam pipes have been made during the last few years, and the results have been published in the Transactions of the American Society of Mechanical Engineers and elsewhere, but hitherto no one has made any attempt to collate the results with a view of deducing principles and formulæ from them, which may be conveniently used in designing. Mr. Paulding has made this attempt and he has succeeded admirably. He first takes the laws of radiation and conduction of heat laid down by Péclet more than fifty years ago, and deduces from them general formulæ applicable to horizontal and vertical cylinders, and in order to obtain the constants for use in these formulæ uses the results obtained from modern experiments on various pipe coverings. He then calculates the values of C, the coefficient of conductivity, for all these recorded experiments and tabulates their values. The effects of differences of temperature of the air, and of the objects radiated to, of different pressures of steam, thicknesses of covering, sizes and positions of cylinders, are shown by curves, and simple directions are given for the use of the formulæ and curves in practical cases. The loss of heat from bare steam pipes is discussed in a separate chapter, and it is shown that recent experiments lead to an average value of 0.87 for a coefficient of loss, while Péclet's experiments point to a value of 0.64. The author is at a loss to explain the difference, except on the ground that Péclet's experiments were made with small differences of temperature. The remainder of the book, about two-thirds of the whole, is taken up with a translation of those portions of Péclet's "Traite de la Chaleur," which relates to the subject of the emission and transmission of heat. The results have been translated into English weights and measures, which is a great convenience to American readers. This translation of Péclet is commended to all students of the subject as an account of a splendid set of experiments made in France more than fifty years ago. It is to be regretted that no experimenter in this country or in England, during the last fifty years, has made any attempt to repeat Péclet's work for the purpose of correcting certain errors that appear in it, and of deducing laws which can be applied in engineering practice. We note a few minor errors in Mr. Paulding's book which may be corrected in a future edition. On pages 3 and 6 the meanings of A and R are not clearly stated. Equation 4, on page 7, lacks a parenthesis and the second equation, numbered 4, should be numbered 5. "Data has," page 26, should be "data have." The derivation of the figure 1.61, on page 9, should be shown and not left to be puzzled out by the reader. The method of deriving equation 4 from equations 1 and 2 should be made more clear. The minus sign of the first equation, on page 7, seems to be an error. The derivation of the curves and figures, on page 9, is not stated. They probably come from Péclet, but references to the pages in the translation where their derivation may be found should be given. The foot-note, at the bottom of page 19, should refer to the table following page 7. The book would be more valuable if the author had added to it a convenient table showing the loss of heat in bare pipes, and in pipes with one inch thickness of good covering for different diameters and different steam pressures. It would also be more convenient for use if tables had been made of the various quantities which are shown in the curves, Figs. 1 to 9. It is difficult to take from such curves the figures required for calculations without great liability to error.

Influence of the Sun on Meteorology and Atmospheric Electricity.

In an address to the section of cosmical physics of the International Congress of Arts and Sciences, at St. Louis, Mr. A. Lawrence Rotch made the following statement:

"It is incontestable that the sun, the source of all terrestrial energy, has great influence upon the magnetic conditions of the earth. The cause of atmospheric electricity has always been an enigma to meteorologists, but the discovery of 'ions,' or 'electrons,' as carriers of electricity, has thrown some light on this question. It is of importance in geophysics to know how the capacity of the air for positive and negative electrons varies with altitude, and also the periodic and non-periodic variation of the potential at the earth's surface.

"Attempts to regard all atmospheric phenomena as periodic and due to the influence of the sun or moon have long occupied the attention of eminent investigators, but it must be admitted that the effects of neither the periods of solar nor those of lunar rotation upon the earth's meteorology can be claimed to have been proved, although a correspondence has been found in regard to the frequencies of auroras and thunder-storms and the position of the moon in declination. To Professor Arrhenius is also due the remarkable generalization that the pressure of light emanating from the sun causes alike the streaming away from it of comets' tails, the zodiacal light and the aurora borealis. The relation of sun-spot frequency, which has a periodicity of about eleven years, to atmospheric changes on the earth, especially as manifested by barometric pressure, rainfall and temperature in India, has been investigated, and the coincidences, even if nothing more, which have been shown to exist by Sir Norman Lockyer and his son are suggestive. It may be pointed out that the same action of the sun might cause simultaneously increased rainfall in India, and a deficiency of rainfall in England, because rising currents in one region are necessarily accompanied by descending currents elsewhere, and, therefore, no objection can be offered to a theory of cosmical influence which produces different weather conditions in different parts of the globe."

Digitized by Google

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED.[1]

BY W. P. ADAMS.

Any attempt to enter upon a general description of the various makes of destructors would be out of place in a paper dealing more particularly with results obtained, yet a brief description of the more generally known types will be useful in showing the difficulties to be contended with in securing good steam-raising results and the problems that still await solution before the perfect destructor is evolved.

The type of combined destructor furnaces and boilers employed by Messrs. Manlove, Alliott & Company, is well illustrated in t' e Shoreditch installation. Two furnaces are placed, one on either side of a water-tube boiler erected in the customary manner, and the gases from the destructor pass sidewise into the boiler furnaces and thence between the tubes to the flues. The ordinary boiler grate is available for burning coal, both when the destructors are in use and when shut down. Dampers are provided between the destructor and the boiler furnaces to cut off the former when not in use, and the boiler front is made as far as possible air-tight. These precautions are taken to prevent the access of volumes of cold air to the boiler and flues. The destructor ashpits are closed, and forced draught is provided by fans driven either by independent steam engines or by electric motors.

The refuse is admitted from the top on to an inclined hearth at the back of the furnace, whence it is raked forward onto the grate. The refuse is partially dried on the hearth, and all gases therefrom have to pass over the hottest parts of the fire to the side openings into the boiler furnaces. This system of top-feed on to an inclined drying hearth is common to nearly all modern destructors.

The Horsfall destructor consists of a number of independent cells with independent ashpits placed side by side, and where the number is large, back to back. The refuse is fed in the same manner as in the Manlove-Alliott cells, and the gases pass from the furnace into side exhaust flues arranged between the cells, and thence into the main flue at the back of the cells. This main flue plays the important part of a combustion chamber where all the products of combustion are raised to high incandescence. The boilers are placed in the main flue as near as possible to the cells. An ingenious device to prevent burning away of the firebrick lining of the furnace immediately above the bars has been adopted in the shape of cast-iron boxes, arranged on either side of the grate, into which the air blast is drawn by steam jet blowers, the outlet from the boxes being beneath the furnace bars; by this means a hot blast is secured while the boxes remain comparatively cool.

The Meldrum "Simplex" destructor is arranged as one furnace with several independent grates with separate ashpits; one long firebrick arch covers the several grates, and clinkering doors are provided to each cell. Hand-feeding through the clinkering doors is preferred, but top feed is arranged when desired. At one end of the furnace, or at the back, is a combustion chamber in which all gases are mixed, and with the shortest possible length of flue this chamber is connected to the boilers. The grates are fed and clinkered alternately, so that the temperature in the combustion chamber and flues is maintained so far as possible at a constant point. Forced draught is provided in each ashpit with independent control, so that as each grate is fed or clinkered the blast can be stopped. Steam blast is preferred, but fans are provided when desired; in both cases a regenerator in the flues behind the boiler is provided to raise the temperature of the air to some 300 or 400 degrees Fahrenheit.

Another type of furnace made by Messrs. Meldrum Brothers is the Beaman & Deas, which consists of a pair of cells with independent grates and ashpits, but with a common combustion chamber behind. The forced draught is provided by either steam blast or fan, as in the Simplex. The feed is from the top on to an inclined hearth, the grate is horizontal, and clinkering is carried out through side doors. Each pair of cells is generally provided with one water-tube boiler placed immediately beyond the combustion chamber; the usual boiler coal-firing grate is provided with firing-doors at the side instead of in front. To secure some uniformity of temperature in the combustion chamber, charging and clinkering should be done in each cell alternately.

The Heenan & Froude destructor has some features in common with the Simplex; several cells are placed side by side to form a continuous furnace ending in a combustion chamber, the ashpits are independent and closed, and hot-air blast is provided by fans which draw cold air through a generator placed in the flues behind the boiler. During clinkering the blast is shut off below the grate and admitted above; this is said to prevent the inrush of cold air through the open doors and the consequent cooling of the furnace and flues generally, which is a fault in some other types of destructor. A feature of this furnace is the building of the roof in a series of parallel arches, one over each cell; by this means incandescent gases from one cell are deflected on to the top of the refuse in the next, thus securing combustion of the refuse from above as well as from below. The boiler, generally a water-tube, is placed by preference immediately above the combustion chamber. The undermining of the walls in the furnace above the grate bars by blowpipe action is prevented by the provision of shelves of firebrick.

The Hughes & Stirling destructor has, in common with several other types, the top feed, sloping hearth and grate and closed ashpit. Forced draught is provided by fans, and the gases from the fires are brought into a common flue between each pair, or double pair, of cells; this flue serves as a combustion chamber and opens out into a main flue which conducts the gases to the boiler. Water-tube boilers are preferred, and one is usually provided for each pair of cells.

The points in common with all modern high-temperature destructors are, forced draught, preferably heated, means of drying the refuse in part before placing on the grate, and a combustion chamber in which all gases are mixed and brought to a state of high incandescence and their temperature equalized so far as possible.

Steam blast for producing forced draught is claimed to have advantages over simple air blast in that it produces water gas in passing through the incandescent fuel, which materially aids combustion; it also tends to keep the fire bars cool, thus giving them an appreciably longer life and clinkering is rendered easier. These claims have been sufficiently verified, but it is to be doubted whether the large percentage of steam used in practice secures an adequate return. The Horsfall Company claims that its system of hot steam blast requires five to ten per cent of the total steam raised, but no figures, test or otherwise, have come into my hands showing anything approaching such results. Messrs. Meldrum Brothers will guarantee that the percentage of steam with hot-air blast provided through a regenerator shall not exceed fifteen per cent of the total steam generated, and they claim that it is often

[1] Paper read before the Institution of Electrical Engineers, London, England, December 15. Abridged.

Digitized by Google

as low as twelve per cent. It is an extremely difficult matter to measure the steam blast, except on specially arranged tests, but it is a very simple matter to measure the power used by electrically driven fans. However, it is a question that does not turn entirely on the relative consumption of power, as the improved combustion with fuel of high calorific value may outweigh the extra percentage of steam used with steam blast. This is one of the interesting points upon which additional information would be of value, but I venture to think that it will be a hard matter to justify the application in the blast of twenty to forty per cent of the total steam generated. Economy in the blast is of considerable importance, as the absorption of power is continuous, and if a wasteful form be used a large percentage of its power available is wholly lost.

The prevention of air leakage is another important matter, and long and badly arranged flues are also a prolific source of lost power. A principle never to be lost sight of in the construction of destructors is, that after the perfect cremation of the refuse has been secured, the heated gases should be applied directly to the boiler without having to pass through long flues. Again, the charging arrangements are sometimes crude and not designed or constructed with a full appreciation of the problem involved; the furnaces of the boilers are often a source of trouble through air leakage and unsatisfactory combustion effects, and not a few combined works show poor results through careless and indifferent handling of the refuse and management of the burning.

The composition of refuse varies largely in different parts of the country; in the neighborhood of coal mines it is often rich in carbon. In towns having a staple industry, where much waste material from the factories is sent to the destructor, the calorific value of the refuse may be high or low, according to the carbon in such waste material. Suburban residents generally provide quantities of garden stuff to feed the destructor, and although the percentage of carbon in this stuff is large, so also is the percentage of moisture, and it is therefore not regarded with favor by destructor managers. It is a strange fact that some of the richest refuse comes from poor localities. Mr. Vincent, the electrical engineer of Bermondsey, claims that his refuse has an unusually high value because the neighborhood is poor, and this, I have observed, is also the case in another London borough where good refuse is collected in a poor district near the destructor, and refuse of only average value is obtained from a wealthy residential district a little distance away. This anomaly is due to the more extravagant habits of the working classes, who, unlike the middle classes, rarely sift the ashes from their fires before consigning them to the dustbin. It has recently been stated that where coal is expensive, there refuse will be poor and the utilization of steam therefrom of doubtful value; but I hold that the exact contrary is the case. The quantity of coal and ashes is probably less, but the fuel value of what coal there is and of the other carbon in the refuse is of proportionately greater value.

Some of the finest samples of refuse which have come to my notice are those from Warrington and King's Norton, near Birmingham. At the former place the electrical engineer states that his Beamen & Deas furnaces generate three

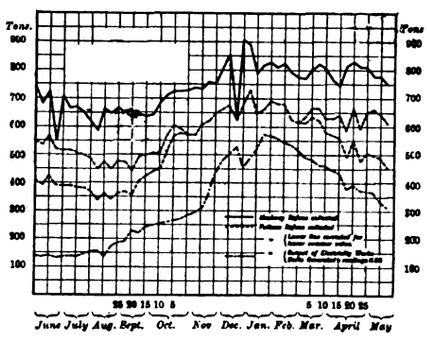


FIG. 1.—DIAGRAM OF REFUSE COLLECTION IN HACKNEY AND FULHAM

pounds of steam per pound of refuse all the year round, and as an explanation he gives the proportion of cinder in the refuse as from sixty to seventy per cent; this, doubtless, includes a quantity of ash. The result is of some value, as it has, I understand, been arrived at over a lengthy test under working conditions. At King's Norton the refuse for several days was sampled, and the samples submitted to an analyst—Dr. Frankland, of Birmingham—who gave, as the result of his investigations, 36.8 per cent of carbon, 7.3 per cent of oxygen, 12.12 per cent of moisture.

It will be observed that the samples were comparatively dry, but, nevertheless, an available 4,500 British thermal units per pound is a fine figure. Some 2,500 British thermal units per pound of refuse may be taken as a fairly representative average of English town refuse in winter; this would be sufficient to evaporate two pounds of water from fifty degrees Fahrenheit to steam at 140 pounds pressure, neglecting the evaporation of moisture in the refuse itself, and the heat absorbed in raising the clinker to some 2,000 degrees Fahrenheit; under varying conditions of moisture these two items would absorb from 500 to 1,000 British thermal units.

In some places refuse of unusually low value is collected. At Llandudno, where the bulk of the refuse is collected in summer, during the season when fires are in little use, and therefore the percentage of carbon small, the evaporation on test was as low as 0.7 pound water per pound of refuse. At Royton, in Lancashire, where a careful calorimeter test was made, only 997 British thermal units were obtained per pound. Such figures as these point very forcibly to the desirability of a careful and independent examination of refuse before combined schemes are entered upon. This is all the more necessary if the scheme be for a town outside the limits of England, for astonishingly poor refuse is collected in some Continental towns where destructors have been erected, a residue of some sixty to seventy per cent of combustible matter being left after cremation in a high-temperature furnace.

There is often a considerable difference between the value of winter and summer refuse in a given town, and also a variation in the quantity collected; but it is worthy of note that these variations correspond very fairly with the fall and rise of the summer and winter output of electricity, the winter refuse generally being of the highest value (see Fig. 1).

Some of the difficulties to be met with in the utilization of refuse-raised steam for electrical purposes are—uncertain delivery of the refuse, the varying value of the refuse from day to day and hour to hour, and the varying percentage of moisture contained; also in winter snow may prevent collection for many days, fog sometimes greatly hampers collection, and holidays occasionally prevent collection for days. By careful management and forethought some of these difficulties may be largely neutralized, but it is merely sufficient to call attention to them to demonstrate that only under favorable conditions may a combined plant be expected to run for any length of time on refuse alone.

To equalize to some extent the varying quantities collected, and also to adapt the quantity burnt to the varying demand for electricity, some system of storage is desirable; this is especially so where the electricity works has a small day load. The refuse itself may be stored and burnt as the demand requires, or, when direct-current plant is used, a battery may be

Digitized by Google

employed with advantage. A large destructor plant is best run steadily throughout the twenty-four hours, and no great difference in the rate of burning during the day and on the peak is admissible. With a twelve-cell plant, eight cells might be run during the day and twelve at night. This represents a maximum variation, and it will, therefore, be seen that where the day load is small, a peak load some five times greater could not be coped with in this manner. Personally, I am a strong advocate of the use of batteries, for they not only serve for storage during the day, but with a suitably arranged reversible booster they equalize the load when the steam generation varies, as it does very rapidly sometimes. To secure the best results such a battery need not be abnormally large. A combined station burning some 30,000 tons per annum would require a battery of about 1,000 to 1,500-kilowatt-hour capacity, assuming a simple lighting load with a day demand about one-fifth of the peak load.

Before I pass on to consider the commercial results achieved with joint schemes, I will deal briefly with the financial aspect of combined plants from the point of view of capital expenditure. It is fairly obvious that in an undertaking of moderate size the combination of electricity works and destructor on the same site should result in several economies. These are embraced under site, buildings, chimney and plant.

Site—As a rough approximation, it will generally be found that one-third of the land space required for the separate undertakings is saved by combination.

Buildings—An entire boiler house is sometimes saved; on the other hand, the destructor with boilers will cover more space than one without. Sundry offices, messroom, lavatories, weigh-house and weigh-bridge would all require to be duplicate in separate works, and often no inconsiderable saving is effected in boundary wall and street paving.

Chimney—In separate works, separate chimneys would be erected and a saving of a complete stack is therefore effected by combination.

Plant—Some boilers are saved to the electricity works, together with steam and feed piping, pumps, etc. In large works a generator to supply motors, and perhaps fans and lighting, are saved to the destructor; on the other hand, an unusual length of steam main may be necessary.

So many different methods of apportioning capital outlay are in vogue that I would venture to suggest the following as a basis of arrangement in new works. Opinions will probably differ on this point, but I will give my suggestions for what they are worth in the hope that the already heavy labors of electricity and sanitary committees may in one or two cases be somewhat lightened when the burning question of apportionment of capital expenditure arises.

Site—Actual value of ground space covered by the joint undertaking to be equally divided; spare land available for extensions to be debited to each undertaking in accordance with probable future requirements.

Buildings and Chimney—An estimate of the cost of buildings for each undertaking erected separately should be got out, and the actual cost to be divided in the proportion of the estimate.

Plant—All boilers save one should be debited to the electricity works, together with steam and feed-piping pumps, etc The entire saving in piping and pumps to the destructor would be a fair set-off against additional flues required by the additional boilers. The saving of an electric generator and the cost of its upkeep and attendance can best be dealt with by the electricity works making a small charge to the destructor for electricity supplied.

The cost of maintaining the buildings and chimney would be apportioned on the basis of the original estimate, until extensions took place, and then the additional outlay would be debited to the department extended, and the cost of upkeep apportioned accordingly. I do not pretend that this is by any means a perfect adjustment, but there must of necessity be a certain amount of give and take in partnership of any description. With regard to repairs and maintenance, the destructor department should bear all expenditure on furnaces and other destructor plant, one boiler, and all flues and brickwork; even in maintenance a saving should be effected in joint works, as the fierce heat from the furnace is absorbed by the boilers and not turned loose into the flues and chimney to do damage to linings and brickwork. The supply of electricity and light and power to the destructor is a possible bone of contention between committees. By obtaining current from the electricity works some outlay on plant is saved to the destructor and also some running expense; on the other hand, the electricity used is generated from refuse steam and, apart from running costs, it ought to be supplied to the destructor free. The system adopted at Hackney seems fair: all electricity generated from the refuse is credited to the destructor at 0.39 penny per unit generated, its ascertained coal value, and a charge of one penny is made per unit supplied to the destructor; anything over one penny is, I think, extravagant unless the credit to the destructor exceeds one-half per unit.

Revenue earned by a destructor combined with electricity works will be chiefly from the sale of current generated, and in addition there will be the sale of steam for other purposes, sale of clinker, flue dust, and other residuals; the destruction of trade refuse—which is paid for—and besides these items, which are more or less common to all combined undertakings, receipts are sometimes obtained from other sources. Fulham seems especially favored in the matter of miscellaneous receipts, for no less than £300 per annum is received for the privilege of picking over the refuse as it is turned out of the carts.

In some undertakings not the remotest idea is held by those in charge as to what proportion of electricity generated is due to the refuse-raised steam, and while such a condition of things holds it is not surprising that the clumsiest of systems of crediting the destruction is devised. In every undertaking the average coal consumption can be ascertained from time to time when the destructor is out of use, or is purposely shut down, and then such average figure could be taken as a basis for ascertaining the units generated by each undertaking. In the larger works there really ought to be no excuse for not ascertaining what electricity should be credited, as the feed of the destructor boilers can with small cost be measured, and the average pounds of water per unit generated would form the basis of the adjustment; this method is less simple, perhaps, where steam blast is used in the furnaces, but a fair percentage of this could be agreed upon and deducted. The steam meter recently introduced by Mr. Bamber, of the Manchester Electricity Works, should prove most valuable in conjunction with combined works.

The cash credit to the destructor for electricity generated should be on the basis of the actual cost; personally, I can see no reason why the full ascertained coal value should not be credited as in the case at Hackney. It is often suggested that owing to variations in steam pressure and other causes, refuse-raised steam is of less value than coal-raised steam, but on a large output surely this can not be a matter of moment. Then, again, it is suggested that the dust and general nuisance from the destructor causes extra

Digitized by Google

work and increased repairs; judging from my own observations this would appear to need demonstrating.

The sale of steam for other purposes is a most difficult item to adjust in the absence—to the present time—of any means of measuring the quantity delivered to baths, laundries, disinfectors, etc. Here again I think the Bamber steam meter may be of great value; the need of some such apparatus will be readily appreciated when I am dealing with the London combined works.

In some towns all the destructor costs are borne by the health or sanitary department, and the electricity works gets the benefit of all the steam generated; in others an arbitrary allowance is made, and the difference between that and the actual cost of disposal is debited to the electricity works for steam; this debit is sometimes largely in excess of the coal value of steam. The fairest method is that in use at Fulham and Hackney, where the actual destructor revenue is deducted from the total costs and the balance is made up by the health department. As the utilization of the steam and clinker increases the credit will diminish, and I have every hope that not a few of the large destructors combined with electricity works will become self-supporting in course of time. It is important to bear in mind that every penny earned by a destructor is direct saving or profit to the ratepayers, for a destructor is provided in the first instance as a sanitary appliance, and not as a commercial concern like electricity works; it is for this reason that I would urge that proper balance-sheets be provided for every destructor, showing all costs and every item of revenue. It is very usual in the annual reports of local authorities to find brief statements made giving the net cost of disposal "after deducting value of electricity and sale of clinker," without stating what the various values are. I trust this system will soon fall into disuse, and that carefully kept destructor accounts will lead to the same emulation between the managers of combined works in the securing of records in costs that have been so important and valuable a feature in the development of electricity works and the reduction of costs of generation.

Before leaving the financial aspect of combined works I must devote a few moments to table A, in which I have set out particulars of units sold, with values of coal and refuse-generated electricity for comparison. Besides fuel costs I have included wages and management, both items which might reasonably be expected to be favorably influenced by combination; and for the purpose of comparing the London combined undertakings with the uncombined, I have given the average of six uncombined municipal undertakings. While not laying too much stress upon the fact, I will ask you to notice that the wages and management costs at Shoreditch, Stepney and Hackney are the lowest on the list, thus tending to confirm my belief that in combined stations there is actually a substantial saving on both of these items. These remarks do not apply in the case of Fulham, but here the records given are for the first year.

	Name of town.	Year.	Units sold.			Fuel costs.		Total fuel costs per unit sold.	Wages per unit sold.	Management per unit sold.	Total costs per unit sold.
			Coal generated.	Refuse generated.	Total.	Per coal-generated unit sold.	Per refuse-generated unit sold.				
London.	Shoreditch Coronet-street works only ..	1898-9	812,200	719,148	1,031,348	d. 1·0	d. 1·0	d. 1·0	d. 0·37	d. ..	d. 2·05
	Stepney	1902-3	664,349	1,095,000	1,759,349	0·885	0·446	0·65	0·16	0·23	1·23
	Fulham	1902-3	297,677	512,000	809,677	1·0	0·78	0·86	0·54	0·43	2·74
	Hackney	1902-3	469,000	1,146,000	1,615,000	0·48	0·48	0·48	0·19	0·24	1·03
	Bermondsey	1902-3	Nil	401,000	401,000	..	..	..	..	..	..
	Average of six municipal uncombined works	1902-3	2,057,500	..	2,057,500	..	..	0·93	0·33	0·33	2·21
Provincial.	Shipley	1902-3	218,369	83,000	301,369	0·515	0·62	0·54	0·22	0·34	1·48
	Beckenham	1901-2	129,461	70,000	199,461	2·02	1·28	1·75	0·56	0·59	3·53
	Partick	1902-3	41,924	301,000	342,924	0·61	0·375	0·39	0·35	0·32	1·44
	Nelson	1902-3	..	..	320,463	..	..	0·45	0·1	0·41	1·54
	Mexborough	1903	12,000	120,000	180,000	1·5	0·75	0·82	..	..	..
	Gloucester	1902-3	171,000	142,895	313,875	0·82	..	0·45	0·4	0·41	1·89
	Grays	1902-3	69,200	89,269	108,469	1·04	1·84	1·15	0·86	0·45	2·71
	St. Helens	1900-1	588,736	322,000	910,736	..	..	0·35	0·19	0·25	1·18
	..	1902-3	..	..	1,514,745	..	..	0·21	0·139	0·25	0·95
	Wimbledon	1902-3	..	..	1,011,998	..	..	0·92	0·22	0·84	1·78
	Accrington	1902-3	81,884	94,000	175,884	0·42	0·414	0·42	0·47	0·59	2·04
	Bangor	1902-3	66,200	31,500	97,700	1·68	0·95	1·46			..

TABLE A—FUEL AND WAGES COSTS AT ELECTRICITY WORKS COMBINED WITH DESTRUCTORS.

Fish Shoals Located by Electric Apparatus.

Under date of November 7, 1904, United States Consul E. T. Liefeld, at Freiburg, Germany, reports that a German patent has been taken out for an electrical apparatus whereby the presence and extent of shoals of fish can be ascertained. A microphone, enclosed in a water-tight case, connected with an electric battery and telephone, is lowered into the water. So long as the telephone hangs free no sound is heard, but on its coming into contact with a shoal of fish, the constant tapping of the fish against the microphone case produces a series of sounds which at once betrays their presence. The rope attached to the microphone is marked so that the exact depth of the shoal is designated.

ELECTROLYTIC CORROSION IN UNDERGROUND PIPES.

BY ALEC A. BEADLE.

It may now be taken as a generally accepted principle that the corrosion or deposition of a metal is invariably accompanied by the passage of an electric current, either out of or into the surface which is undergoing change, and thus all metallic corrosion may be termed electrolytic; but, whereas, in most cases the corrosion is the *cause* of the current, there are some cases in which it is an *effect,* notably in gas and water pipes which run in proximity to uninsulated electric tram return rails.

It must, however, be remembered that corrosion takes place independently of any externally impressed difference of potential, and it is therefore unfair to attribute the whole of the damage which is going on in a given pipe to outside causes.

In order to see how far these two results are independent of each other, it is necessary first of all to examine the state of affairs from an electrolytic standpoint.

These pipes, running along the upper soil, usually under roads, are surrounded by the moisture of the ground, which may be looked upon as water containing the following impurities (judging from various analyses given by Sutton):

	From.	To.	Approx. Average.	
Nitrogen as nitrates and nitrites	0	10	0.1	Parts per 100,000
Chlorine as chlorides	0	10	8.0	
Permanent hardness (carbonate of lime)	2°	100°	10°	
Temporary hardness (bicarbonate of lime)	0°	30°	15°	
Total hardness	2°	130°	25°	

These figures would, of course, be subject to much variation, but it may be safely assumed that nitrates and chlorides would be present in fair quantity, on account of the decomposing extraneous matter on the road surface. Other salts might be present, but probably only in inappreciable quantities. Glancing at this list, the first corrosive substance which might be expected to act upon iron is bicarbonate of lime, or so-called temporary hardness. This would be better understood if described as carbonic acid, so loosely attached to carbonate of lime, forming bicarbonate, as to justify being looked upon as free carbonic acid carried in water in solution. This is, therefore, a powerful corrosive substance upon iron, as may be easily shown by placing a nail in such

Digitized by Google

water when it will be corroded even in the cold.

The bicarbonate thus formed may be carried away and deposited as chalybite in the neighboring soil, or part of it left on the iron itself, forming a coat of rust.

If, however, we suppose nitrate of sodium to be the active body according to the reaction:

$$Fe + 2NaNO_3 = Fe(NO_3)_2 + Na_2$$

then just over 2.1 volts impressed externally is required to produce the corrosion of the iron.

Or again, if we consider the action of the chloride of sodium, thus:

$$Fe + 2NaCl = FeCl_2 + Na_2$$

we find 2.2 volts is required to bring about corrosion.

It must not be supposed that free metallic sodium is formed in any of these reactions, it would be converted into soda by the moisture, but the reaction, not being voltaic, would not concern the corrosion voltage.

It is thus seen that, whereas carbonic acid can independently corrode iron, generally speaking, about one to two volts must be externally applied in order to cause the nitrates and chlorides to act corrosively, and it is only at the surface where the current leaves the iron and enters the moist earth that corrosion takes place; that point where it leaves the moisture to enter the iron, serving rather as a protection against corrosion. It is obvious, however, that the acid radical can not always be dismissed so readily, as its corrosive power is dependent upon the base with which it is combined.

In this way, although sodium chloride may be comparatively harmless, some little doubt is attached to magnesium chloride. This salt, upon boiling, or upon evaporation from solution, decomposes into magnesia and hydrochloric acid, and is probably largely responsible for marine boiler corrosion, and it seems reasonable, therefore, to suppose that a similar action may take place in the cold under the slightest provocation.

If the uninsulated rail, upon which an electric car runs, be used as the return conductor, some of the current which is intended to travel along it will leak into the ground, and partly also into any neighboring metallic pipes, the amount of corrosion taking place where the current leaves the rail, serving as a rough guide as to how much damage may be taking place in the neighboring conductors.

Two conditions may exist in the structure of these pipes, they may be run together with lead or in some other way be made to have each section in good metallic contact, or they may be coupled with some insulating material, thus being out of metallic contact with each other.

If each section of the pipe be, for the moment assumed, insulated from the others, then, in order that the current may be able to travel along the length of the pipe, it would have to jump the joints, entering the soil and reentering the pipes; causing corrosion to take place where it leaves one section and possibly cleaning the surface where it enters the next.

In order that the corrosion should be much in excess of that ordinarily produced by the carbonic acid the current would have to overcome the polarization voltages above referred to, so that 1.5 volts would have to be met at each joint, and this would mean many volts over a whole length of line.

If, however, the sections of the pipe be assumed to be in good metallic connection at each joint the pipe would act as a sort of shunt to the return rail, taking in current at one end, and returning it to the ground at or near the other, where the corrosion would be taking place; a difference of potential of two or three volts between the extreme ends of the pipe being sufficient to bring about such a result.

The resistance of a certain return rail in Glasgow, two and one-half miles long, is such that during the full running period the difference of potential between its extreme ends is 5.56 volts. Dr. Fleming has shown that the resistance between two 100-yard lengths of six-inch pipe with conducting joints, laid one yard apart in ordinary concrete, is about one ohm, or in clay a little lower. The resistance of each pipe would also be about one ohm.

Taking these figures into consideration and assuming a length of pipe situated one yard from the above return rail, a shunt current of something like three or four amperes might be expected to flow through the pipe, corresponding to the destruction of, say, 150 to 200 cubic inches of iron annually.

In practice a return rail is in but indifferent connection with the ground, especially in dry weather, consequently this figure is probably too high.

If there is much free carbonic acid in the soil the natural corrosion might, therefore, be in excess of that produced electrolytically. It might be supposed that alkalinity caused by addition of lime might prevent corrosion to some extent by destroying temporary hardness, and also by producing a comparatively non-conducting crust of oxide on the attacked metal, and that, if so, the addition of lime to the soil might help matters in this respect.

Experiments conducted by Mr. Charles Norton ("Corrosion of Steel Frames of Buildings," *Technology Quarterly*, December, 1902) point to this being the case.

Steel was embedded in concrete blocks variously prepared, the surface of the metal being thoroughly cleaned before being run round with the concrete. This investigator showed that neat cement, even in thin layers, is an efficient protection. It is well known that cement is porous and must admit moisture, and it therefore seems as though its alkalinity must serve as an antedote to the corrosive influences of the carbonic acid, thus bearing out the above theory.

Live Third-Rail Protection.

The Board of Trade report, Great Britain, shows the precautions that the Lancashire & Yorkshire and the North-eastern railways are taking to guard against the danger of accident by the third rail. The Lancashire & Yorkshire road has put up warning notices at all level crossings and wherever people are likely to trespass. The line is well fenced, and the company has protected the power-rail wherever the public or the company's servants, other than plate-layers, have any occasion to be on business or duty along the whole of the line worked electrically. At the sides of bridge girders, in stations, and alongside of sidings, signal boxes, etc., protection has been given either by single or double boarding, the total length provided being ten miles of double boarding and six and one-half miles of single boarding, out of a total of single line of forty-seven miles. At level crossings the power-rail ends six feet away on either side, and the current is carried under the wood decking by cables. The ends of the power-rails are protected by double boarding for a length of ten feet. The shovels and other metal tools used by plate-layers have the lower part of the shovel handles insulated. The upkeep of the protective boarding requires much attention, as the clearance between a shoe and the boarding must necessarily be small, and the latter will be liable to get out of place from the action of snow and rain. A contact between a shoe and the board might easily result in a serious derailment. It has not been deemed necessary to provide boarding for the live rail for the whole length of the line in order to protect the men in working traffic, repairing the line, etc., or the passengers.—*Railway Age (New York), December* 23.

Digitized by Google

The New Postal Cars at Paris, France.

The postal and telegraph department of Paris, France, has lately adopted a new type of van for carrying the mail through the city between the central office and the branch post offices. It is in the shape of an electric automobile which is fitted with a large box body in the rear. The driver occupies an elevated seat in front. The engraving shows the appearance of the new car. This system was put in regular operation, after some previous trial trips, on October 24, starting with fifteen cars, of which twelve are to be used regularly and three held as a reserve. They are operated by accumulators which are placed in a tight case inside the main body. The motor and differential mechanism are built together in a somewhat cubical form, placed in the middle of the chassis. From the differential shaft a chain passes to the rear axles on each side.

NEW AUTOMOBILE POSTAL CAR IN USE AT PARIS, FRANCE.

This type of car is designed to replace the old form which was drawn by one horse, and the new vans are considerably larger, containing one-half as much again. They have a capacity of about forty-five cubic feet. The speed is twenty-five miles an hour on the open road, but within the city they will not make more than fifteen miles an hour. This is still very much better than the time made by the horse vehicles. The post office officials are greatly pleased with the new system, both on account of the greater carrying capacity of the cars and the difference in time which is needed to run between the central office and the branch offices for collecting the mail matter, as the new cars arrive much sooner than before which gives a great saving of time and allows of postponing the closing of the mails.

M. Duboys, who has charge of the electric service, has supplied some further information about the new cars. They are constructed by the Ch. Mildé Company, one of the large Paris electrical firms.

As to the weight of the different parts, the chassis, carriage body and motor figure for 2,220 pounds; the batteries, 1,320 pounds; employés, 310 pounds; net load, 1,430 pounds; making a total of about 2.6 tons. The batteries are charged once a day, from 12 to 2 o'clock, and for this purpose a model charging station has been installed in the central post office building.

Bone Fractures Treated by Electricity.

Francesco Blasi, says the *Medical Record,* quoting from the *Annali di Elettricità Medica e Terapia Fisica,* has made interesting experimental and clinical researches on the treatment of cases of fractures, in rabbits and in man, by different forms of electricity, in conjunction with immobilization. Rabbits were placed under the same conditions, and then a fracture of both bones of the forearm produced. This was immobilized, and the electric current was applied to the limb daily. Galvanism, faradism, and static electricity were all tried, and in another series of cases no electrical treatment was given. In the rabbits the galvanic current reduced œdema very rapidly, there were no signs of suffering, and after the apparatus was removed the animal walked and ran well at once. The other forms of electricity seemed beneficial to a less degree, and there was some limping after removal of the bandages. The formation of callus was more rapid and greater under galvanism. Four cases in man were treated, one of over a month standing without any tendency to union. In this case the patient was cured in about three weeks from the beginning of electrical treatment. The other cases all did well. His conclusions are: (1) galvanic electricity is beneficial to fractures; (2) it favors all the conditions necessary to the formation of a callus; (3) it reduces to a minimum the period of functional incapacity; (4) no strong apparatus for immobilization is necessary, simply a temporary splint and bandage. The most noticeable thing was the absence of atrophy and disability after removal of the bandage.

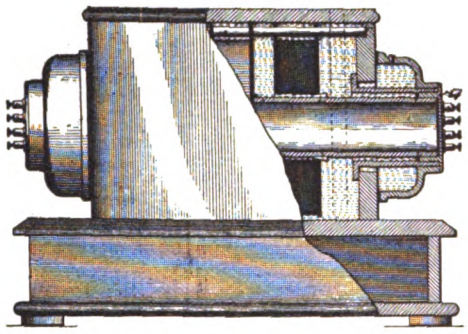
Heating Effect of the γ-Rays of Radium.

A recent copy of the *Physikalische Zeitschrift* contained a description of some experiments by Paschen, which indicated that the γ-rays from radium supplied a large proportion of the total heat emission. These experiments were carried out by means of the Bunsen ice calorimeter. It seemed to Messrs. E. Rutherford and H. T. Barnes that these experiments needed verification by an independent method, and they have determined the heat radiated by means of a differential air thermometer. Radium bromide was enclosed in a small metal capsule supported by a thread. It was inserted alternately into two glass tubes connected together by a manometer tube. The tubes were kept in a constant-temperature room, immersed in water. In one of these tubes a lead envelope absorbed more than half the γ-rays; in the other an aluminum envelope absorbed but a few rays. The experiment was such that a difference of five per cent in the heating would have been detected, but it was found that the γ-rays do not supply more than a small percentage of the total heating effect; while, according to Paschen's results, the heating of the lead envelope should have been fifty per cent greater than that with the aluminum.—*Abstracted from Nature (London), December* 15.

Digitized by Google

Electrical Patents.

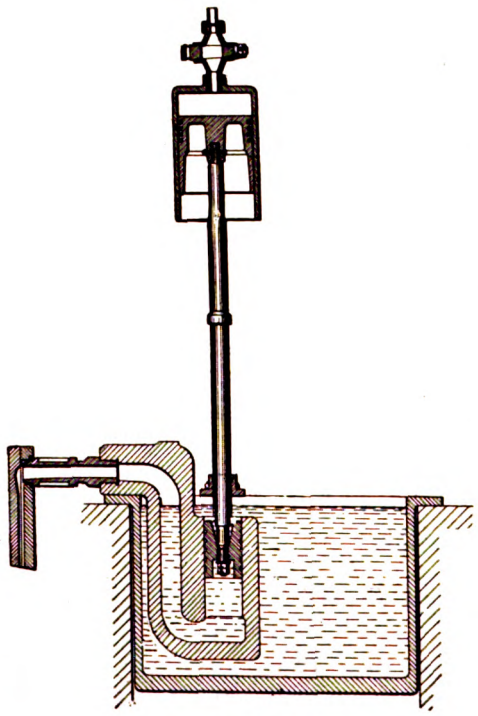
George M. Christoph, of Chicago, Ill., has assigned to the Western X-Ray and Coil Company, a corporation of Illinois, a patent (777,496, December 13) recently obtained by him on certain improvements in induction apparatus. The invention relates more especially to that class of induction-coils employed in producing high-tension currents for X-ray and other



INDUCTION APPARATUS.

like uses, and has for its object to provide a durable and efficient construction and arrangement of parts affording a high degree of insulation for the different windings of the apparatus and an avoidance of any sparking or leaping of the induced currents to near-by conductors, due to imperfect insulation of the secondary windings of the apparatus. A housing is employed having orifices in its end walls, a secondary coil consisting of a series of bobbins being arranged within this housing. A primary coil is arranged centrally within the secondary coil and between the two coils is an insulating sleeve, projecting through the end wall orifices of the housing. Located outside the orifices of the housing are annular cup-pieces which form annular insulating chambers. End heads close the outer ends of the cup-pieces and the insulating sleeve, and means are provided for clamping the parts together. A series of terminal posts on the end heads have connection with the windings of the primary coil.

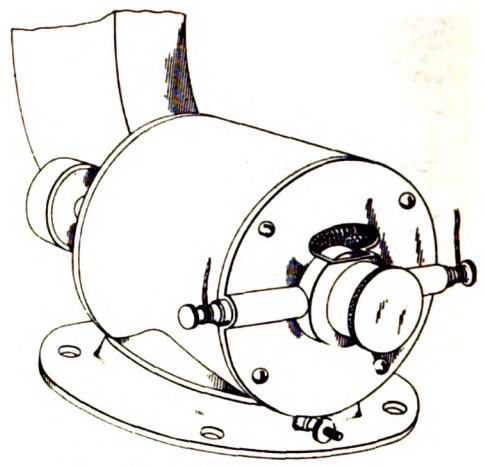
In carrying out the process of casting plates for secondary batteries, the molten lead is ladled into a mould and the resulting plate is liable to several deformations, due to the physical limitations attending the process. In order to overcome these difficulties Carlos Vellino, of Barcelona, Spain, has invented and secured a patent (777,870, December 20) upon a metal pump, the essential feature of which consists in arranging within the vessel in which the lead is melted and below the surface of the molten lead a pump, the cylinder of which becomes filled with lead on the outward stroke of the piston, while upon the return stroke the lead is forced through a pipe ascending from the bottom of the pump cylinder within the mass of molten lead and communicating through its upper end with a nozzle, against which the mould is tightly applied. This nozzle gradually widens toward the mould and is of smaller diameter than the delivery pipe, so that upon the outward stroke of the piston a rupture takes place between the fluid portion of the lead filling the nozzle and the portion which has solidified, which latter portion when the mould is removed forms a casting head some centimetres in length, which is withdrawn from the nozzle and cut off. In order to accelerate the formation of the rupture, the wall of the nozzle is made thinner at the commencement of the flaring portion, so as to effect a more speedy cooling. The capacity of the pump cylinder should be considerably greater than that of the mould. By this arrangement, the molten lead is rapidly acted upon with the pressure of twenty to two hundred kilogrammes per square centimetre, with the effect that lead at a temperature which only slightly exceeds its melting point can be forced so quickly into the mould that completely homogeneous plates are produced. Owing to the combination of high pressure and



METAL PUMP.

low temperature, a very close and amorphous structure is imparted to the plates, which is exceedingly advantageous for the purpose in view. In addition to this, the casting operation is effected practically with the exclusion of air, and transference of oxide from the melting-pot to the mould is prevented. Owing to the close and uniform structure of the plates, their formation takes place slowly and uniformly in all parts, whereby the life of the plates is considerably lengthened. As the formation of cavities is prevented and as the lead is forced, owing to the pressure, close to the walls of the mould, it is possible to cast plates with much narrower ribs or the like than hitherto possible. This process does not necessitate so much labor and its success does not depend upon the skill of the operator, as when the apparatus is once adjusted any number of plates of equal quality may be produced.

The Alamo Manufacturing Company, of Hillside, Mich., is the assignee of a patent (778,146, December 20) recently granted



GAS ENGINE IGNITION DYNAMO.

to John Reek, of Camden, Mich., on a gas engine ignition dynamo. The object of the invention is to so construct the mounting of a dynamo and to so connect it with the source of power by which it is actuated, that it shall produce a substantially constant voltage without employing special governing mechanism. The invention consists of a dynamo mounted upon a roller bearing so as to turn about an axis at right angles to the axis of the armature. A friction wheel is arranged upon the armature shaft, eccentric to the axis about which the dynamo is adapted to turn, the dynamo being so located with reference to the balance wheel of an explosive engine that its turning shall press the friction wheel against the outside of the balance wheel. A spring is adjusted to turn the dynamo so as to hold the friction wheel against the periphery of the balance wheel with a force sufficient to produce the necessary friction at slow speed and that shall yield at a speed of rotation adapted to furnish predetermined maximum current.

Digitized by Google

Proposed Extensions of the New York Subway.

William Barclay Parsons, chief engineer of the Rapid Transit Commission, New York city, has submitted plans for additional lines in Manhattan, the Bronx and Brooklyn. These plans differ in several important respects from any heretofore submitted. The estimated cost of the proposed new lines in Manhattan is about $40,000,000, and the extensions in the Bronx and Brooklyn will cost about $9,000,000.

The proposed routes are as follows: on the east side, beginning at South Ferry, the line will run along South street, across Coenties Slip to Front street, thence under William street, under the Brooklyn bridge, under Park Row to Chambers street, to Broadway, and under Broadway to Union Square; thence passing beneath the subway under Fifteenth street to Lexington avenue, and under Lexington avenue and the Harlem river and private property to a terminal loop under Third avenue to East One Hundred and Forty-second street and Morris avenue, with a branch continuing under Morris avenue connecting with the subway at East One Hundred and Forty-ninth street. From South Ferry to Thirty-fourth street and Lexington avenue there will be two tracks. North of Thirty-fourth street there will be four tracks in two tiers, the local tracks above and the express tracks below. On the west side there will be a four-track line extending south from Forty-second street to some point below Chambers street, and a two-track line from there to the Battery, where it will connect with the proposed east side line. Crosstown lines are proposed under Thirty-fourth street which will provide a terminal for the north and south line on the west side, should it be terminated at that point. This will provide a northerly outlet for that line and will connect with the lower tier of tracks under Lexington avenue.

In Brooklyn a line is proposed extending from Fort Hamilton under Fourth avenue to Flatbush avenue, and thence under Flatbush avenue to and across the Manhattan bridge to the terminus of the bridge in Manhattan. An alternative scheme is to divert from Fourth avenue to Hamilton avenue, thence under Buttermilk channel to Governor's Island, and under the East river to Battery park; and thence, if desired, by a tunnel under Greenwich street to connect with a low-level loop of the proposed west side line at Barclay street.

The proposed extensions in the Bronx are: an extension of the present system from Kingsbridge northerly along Broadway to Van Cortlandt park, and a second line which will be an extension of the present subway from its terminus at One Hundred and Eightieth street and the Boston road to the northerly limits of the city at the Bronx river. Extensions of the present elevated lines are also proposed. These are an extension of the Ninth avenue line from its present terminus at One Hundred and Fifty-fifth street and Eighth avenue across the Harlem river; thence through a tunnel under the ridge at One Hundred and Sixty-first street to Jerome avenue, and thence by an elevated line over Jerome avenue to Woodlawn. Another recommendation is the reconstruction of the Second avenue elevated road with four tracks, so as to provide a continuous express service in both directions. The additional tracks are to be carried over the present elevated system at Chatham Square to the City Hall.

The Pollak-Virag Writing Telegraph.

The Pollak-Virag writing telegraph which was described before the Congress of Electricians in Paris, in 1900, was demonstrated, says *Engineering* (London), for the first time in England to a party of gentlemen interested in telegraphy at the Carlton Hotel on Friday, December 9, 1904. The message is first dealt with by an operator, who records it on a strip of paper by means of an instrument with a keyboard closely resembling that of an ordinary typewriter. Every letter is recorded by a number of holes punched in the strip, the number of holes corresponding to each letter, being in some cases over a dozen, and occupying, with the space before the next letter, about seven-eighths of an inch. The perforated strip is then passed into another instrument, where it runs rapidly over a drum consisting of six insulated discs. Brushes press on the strip above the drum, and make momentary contact with one or other of the discs as each hole passes under them. Intermittent currents are thus transmitted through two line wires to the receiving station, where they pass round a pair of telephone bobbins. The diaphragm of each telephone has a wire fastened to its centre, which is connected at the other end to a magnetized steel plate-spring. The two ends of these springs are situated at the acute angles of a right-angled triangle, the base of which is horizontal, the right angle being defined by a fixed point. A small concave mirror, with an iron back, is held in contact with the three points by magnetic attraction, and it will be seen that it is deflected about a horizontal or vertical axis, according as one or other of the telephone diaphragms is affected by the current. If both telephones are energized simultaneously, the mirror will move about an axis depending on the proportional strength of the two attractions. An incandescent lamp in front of the mirror is surrounded by a hollow rotating cylinder having a helical slot cut through its walls, and this cylinder in turn surrounded by a fixed one, with a longitudinal slot cut in the side facing the mirror. The consequence is that the only light that can escape is a small beam at the point where the helical and longitudinal slots coincide, and this beam will therefore move backward and forward as the inner cylinder rotates. The spot of light falls on the mirror, and is reflected on to a sensitized traveling strip of paper. The to-and-fro movement of the beam, combined with the vertical and horizontal movements of the mirror, causes the reflected spot to trace letters on the sensitized band which passes automatically through developing and fixing solutions, and appears ten seconds afterward covered with a permanent written message. Since a previous description[1] the form of the letters has been very much improved, and the joining-line between the words made to connect them at the bottom, on the line of writing. The written message is at least as clear as the handwriting of most people, and the saving of transcription not only economizes time, but avoids one great chance of errors. The rate of transmission is claimed as from 40,000 to 50,000 words per hour. It is understood that the postmaster-general is now conducting experiments with a view to the introduction of the apparatus into England. The rights for Great Britain are in the hands of the Pollak-Virag Telegraph Syndicate, 120 Bishopsgate street Within, London, E. C.

N-Rays.

By far the greater number of physicists, who have attempted to observe the N-rays, have been unable to detect this effect. However, in a recent issue of the *Revue Scientifique* D'Arsonval states that he has been able to reproduce the effects described. It is also said that Mascart, working with D'Arsonval, has observed the phenomena. Poincaré, although unable himself to observe these radiations, accepts this evidence, and criticises objections recently made to the method of conducting the experiments.

[1] *Engineering*, December 7, 1900.

Digitized by Google

The Ormond-Daytona Beach and Race Meet.

The International Automobile Tournament to be held at Ormond-Daytona beach, Florida, under the auspices of the Florida East Coast Automobile Association, January 23 to 28, 1905, has attracted attention to this remarkable natural race-course. The condition of the

A Line-up of Twenty-two Automobiles Abreast on the Ormond-Daytona Beach, Fla.

Ormond-Daytona beach this winter is magnificent; according to old residents, it was never better. Being entirely different in formation from the northern beaches, or, in fact, any other beach in the world, has been the cause of its great reputation.

Its sand is composed largely of the shells of the coquina clam, peculiar to this part of Florida. This shell is about one-half an inch long and very thin. For ages nature has been rolling them up, washing them back into the surf and pulverizing them. Examined under the microscope each particle is round, unfit for mortar, builders say, because its smoothness prevents it from holding together; yet, strange to contemplate, the very moment a wave leaves the wet, apparently soft beach, these round particles settle down into a cement almost as hard as asphalt, beyond the comprehension of one who has not seen it. Surely it must have been made for the automobile, for, regardless of weather conditions, there is no mud, no dust, tires are never heated owing to the moisture, and an exploded tire is unknown. Here, too, the great dangers of road and track racing are entirely eliminated, and man can never build a road as hard and smooth. Repairs are unnecessary, as twice each twenty-four hours it is entirely rebuilt by the tides. Immense holes may be dug, but the next tide hides every trace.

Being almost level and with an average rise and fall of only two feet nine inches at extreme low tide, this beach is from three hundred to five hundred feet wide and can be used from two hours after until two hours before high tide, thus giving an average of seven to eight hours for automobiling some part of each day.

J. F. Hathaway, the veteran autoist, familiarly called the father of the Florida beach racing, who suggested and organized the Florida East Coast Automobile Association, under whose auspices the Ormond-Daytona beach tournaments have developed a world-wide reputation, is located there for the winter. In 1900 he bought one of the first motor cars ever seen in Florida and had many queer experiences with the native crackers who, at that time, were very much opposed to these "new fangled machines."

Mr. H. M. Flagler became interested in motor cars during the past summer in the White mountains, and has a new steam touring car of a popular make, and has also ordered a heavy gasoline car. Recently while on his way South on a special train, he stopped at Ormond and accepted an invitation to ride down the beach in Mr. Hathaway's automobile, having been promised to beat his train to the Daytona station, which was done by two minutes, notwithstanding the fact that the distance by beach is more than a mile further than by railroad. He expressed himself as having had the most delightful ride of his life and said, "Now I understand why the automobilists are so enthusiastic over the beach."

C. G. Burgoyne of Daytona, who has contributed liberally of his time, means and physical strength to further the interests of the association and who has been indefatigable in his efforts to make the club a success, resigned recently solely on account of his health. Mr. Edward M. Steck, the well-known auto enthusiast of Philadelphia, his successor, has purchased a beautiful winter home in Daytona; and with his family is located here for the season. He owns a fine Mors touring car and has entered his eighty-horse-power Darrac for the races in January. He has also purchased another house on Ridgewood avenue which is being used as an auxiliary club-house by the Florida East Coast Automobile Association until after the race meet. By a singular coincidence the number of the house is "thirty-nine," the figures for the world's mile record made last winter by W. K. Vanderbilt, Jr. Mr. Steck is ambitious to make Florida the winter automobile playground of the world.

Round-up of Automobiles at Club-House, on Bluff Overlooking Ormond-Daytona Beach, Fla.

Great changes have taken place at Daytona during the past five years, and there are more automobiles in Daytona now than in any other town of its population in the world.

During the past summer the Florida East Coast Automobile Association has erected an attractive and commodious club-house on the beach, directly opposite the

Digitized by Google

half-way post of the twenty-mile course. The club has a membership of two hundred and among them many prominent and well-known people—W. K. Vanderbilt, Jr., H. M. Flagler, Howard Gould, John Jacob Astor, and many others.

Daytona has erected two new hotels, and nearly all of the twenty others have made extensive improvements, and all will be filled. At Ormond three hundred men have been busy on the addition to the great hotel and a new railroad bridge across the Halifax river, so the passenger trains can run to the portals of the hotel. A large garage has been erected with all modern conveniences, and a chauffeurs' club-house with a comfortable clubroom and thirty sleeping rooms. At the hotel on the beach substantial additions and improvements have been made in preparation for the rush of the races. First-class hotel accommodations will also be found at St. Augustine's hotels, from which the railroad company will run excursions to Ormond and Daytona during the race meet.

Annual Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers will be given in the ballroom of the Waldorf-Astoria, New York city, on February 8. In view of the recent opening of the subway, thus adding underground traction in America to the domain of electricity; the adoption of electric locomotives for the great Manhattan terminal divisions of the New York Central and Pennsylvania railroads; the equipment of the Long Island Railroad with electricity, and other signal events, the Institute has decided to devote this dinner to emphasizing the triumph of electric traction.

A number of pioneers and leaders will be present. An original menu has been designed, and novel features will be introduced. The list of speakers includes men of national and international reputation.

The dinner will be served for five dollars per cover, without wine or cigars. As is usually the case upon these occasions, ladies will be present.

The committee in charge of arrangements requests an early response from the members of the Institute, in order that proper care may be taken of all applications. It might be mentioned at this time that over 400 had to be seated at the Edison dinner last year, and it is anticipated that the attendance the coming February will be equally large.

The Electrification of the Belfast, Ireland, Railways.

The details of the contract recently secured by J. G. White & Company, Limited, of London, England, for the electrification of the present horse-railway system of Belfast, Ireland, are now at hand. There will be sixty miles of track and paving, and the work includes both overhead and conduit systems. Ten thousand tons of rail will be required, together with 170 complete cars, equipment, cables, etc. The contract price is £543,404, of which £280,000 is for permanent way, £40,000 for overhead equipment, and the remainder for the power-house, cars, etc. The work is to be completed within nine months.

A contract for the electrification of the Montevideo, Uruguay, system has also been secured by this firm. About fifty miles of track will be electrified, and 9,000 tons of rail will be required. The power-house and overhead work will also be supplied. The contract price is about $2,000,000.

Railroad Young Men's Christian Association.

Mr. E. M. Willis, railroad secretary of the international committee, Young Men's Christian Association, is distributing a map of the United States, upon which are designated the establishments of railroad Young Men's Christian Associations throughout the country. This map shows a most interesting exhibit of the growth of this organization. In 1900 there were 150 associations, as against 206 at the present time. In 1900 there were 30,074 members, as against 70,110 at the present time. In 1900 there were seventy-four buildings, as against 130 at the close of 1904. The valuation of buildings at the present time is $2,000,000. The total appropriated by railroad companies toward operating expenses is $260,000, and the sum paid by members toward operating expenses is $390,000 at the present time, as against $190,000 and $160,000, respectively, five years ago.

Hydroelectric Developments at Grenoble, France.

According to the United States Consul C. P. H. Nason, at Grenoble, France, that city is now lighted entirely by electrical energy supplied from a hydroelectric generating station twenty-seven miles away. Handsome poles have been erected along the streets, from which are supported the arc lights.

Revival of American Machine Exports to Germany.

United States Consul-General Mason, located at Berlin, has made a report showing the revival of trade in machinery between the United States and Germany. The exports of American machinery to Germany reached their highest development in 1899-1900. In 1902 they had declined to about one-third of their volume in 1899, owing to a general prostration of manufacturing in Germany, and that the Germans were learning to duplicate American machinery and methods. American manufacturers also established factories in Germany which competed directly with their American shops.

The period of depression now seems to be past, and the exports of machinery from America to Germany in 1904 show a distinct gain over those of 1903. The total exports of several different classes for the first nine months of the years 1903 and 1904 are shown in the following table:

Kind of Machinery.	1903. Metric Tons.	1904. Metric Tons.
Sewing machines	1,570	2,339
Machine tools	724	1,634
Metal-cutting and boring machines	91	206
Pumps	109	142
Typewriters	90	114
Electrical machines	27	63

The value of the exports of the same class to Germany for the year ending June 30, 1904, according to the Department of Commerce and Labor, is:

Article.	Value.
Sewing machines	$906,836
Tools	240,322
Metal-working machinery	886,785
Pumps	73,271
Typewriters	857,989
Electrical machinery	75,682

Northwestern Electrical Association.

The thirteenth annual convention of the Northwestern Electrical Association will be held at the Hotel Pfister, Milwaukee, Wis., commencing on Wednesday morning, January 18, next.

Reports and papers on subjects of special interest to central station and street railway men will be read and discussed. An attractive entertainment programme is being arranged, and a pleasant and profitable time is assured to all who attend the convention. The association extends a cordial invitation to all who are interested in electrical matters. Mr. Thomas R. Mercein, secretary and treasurer, 85 Michigan street, Milwaukee, will furnish further information upon request.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Diesel Engine at Rothesay, England.

The performance of a Diesel engine installed during June, 1903, at the Rothesay (England) electric railway powerhouse is here given. This plant previously contained two steam engines, one set rated at 200 kilowatts, and the other at 150 kilowatts. While these were suitable for operation during the summer, they were not economical for the light winter load, and it was decided to install a Diesel engine so as to economize fuel. The engine has been working without a hitch since it was installed, and it is giving great satisfaction. It carries the entire railway load during the light season, and from the daily records it has been found that the average consumption of oil has been 0.886 pound per kilowatt-hour, making the cost of fuel about 0.8 cent per kilowatt-hour. —*Abstracted from the Tramway and Railway World* (*London*), *December* 8.

The Conical Wind Motor.

The best design of windmill is interesting to the electrical engineer because a general utilization of wind power seems to depend upon its application to driving electrical machinery. In this article Dr. Alfred Gradenwitz discusses several types of windmill which have been tried by the Danish government, dwelling particularly upon the so-called conical wind motor, the design of which is due to a Danish mill engineer named Sörensen. Sörensen found, some years ago, that a windmill of his developed greater power after several of its sails had been broken by a storm. He then found that the power of the motor was considerably increased by using only six sails, and inclining these to the axis of the wheel so as to form a flat cone. These sails curve forward at their outer ends. This wheel develops thirty per cent more power than any other type of wheel having the same said area. Sörensen found also that a sail with a perforated surface developed greater power than one not perforated having the same area. The motors are now constructed with sails built up in sections which can be inclined so as to offer a greater or less surface to the wind. The angle of inclination is controlled by the speed of the motor, and this secures a very nearly constant speed. These motors are being used in place of steam engines for pumping in wood and ironworking shops and in agricultural and milling plants. They do not require any appreciable amount of supervision.—*Abstracted from the Electrical Review* (*London*), *December* 16.

The Influence of Hysteresis upon the Parallel Operation of Alternators.

This is a supplementary note to a recent study of the parallel operation of generators, read before the Société Internationale des Électriciens by M. P. Boucherot. Consider the conditions existing in the alternator when one armature coil lies under two poles. The magnetic flux in which the two sides of the coil lie will not be equal, because of the effect of hysteresis in the armature iron, and the electromotive force induced in the two sides of the coil will not be equal until the coil has passed the central position. This will cause a retardation of electromotive force. Now, the electrodynamic effort resulting from the action of the armature current is exerted on the field flux, and not on that of the armature. This force will be retarded by the hysteresis of the armature. When two machines are operated in parallel, current will circulate through them. If there be no hunting, and the electromotive forces are equal, this current is watted. If the machines hunt, a small supplementary current will circulate, which would do no work if there were no hysteresis in the armature core. The hysteresis, however, retards this supplementary current so that it is partly watted, and the effect of this is to produce a negative damping; or, in other words, it tends to increase the hunting of the two machines.—*Translated and abstracted from the Bulletin de la Société Internationale des Électriciens (Paris), November.*

The Dielectric Strength of Certain Specimens of Mica.

A long series of tests of certain specimens of mica has been made by Messrs. Ernest Wilson and W. H. Wilson. These specimens included various grades of Madras and Bengal mica, Canadian amber mica and two grades of South American mica. The test was made by means of a high-tension alternating-current transformer, operating at fifty-five cycles. The specimens were placed between two bronze discs one inch in diameter and one-sixteenth of an inch thick. Each test was completed as rapidly as possible, but in the case of the micas having a higher dielectric strength there was a slight local heating due to the discharge of the edge of the discs consequent upon the increased density of the electric force produced there. It was found that those micas having the highest dielectric strength when thin are not necessarily the best when thicker layers are compared. The time taken to break down most of the sheets varied from one-quarter of a minute to one minute. In the case of the Bengal ruby mica, when one millimetre thick it was found necessary to replace one of these circular electrodes by a blunt point, in order to prevent an excessive amount of heating. Curves are given showing the relation in different specimens between thickness of the mica and maximum pressure per centimetre. Bengal ruby mica shows the highest dielectric strength. This is followed by Canadian amber mica, and then the Madras green spotted mica. These curves do not show that the specific dielectric strength of an insulator is a variable depending upon its thickness. The potential difference required to puncture a given specimen, when surrounded by air, is a function of the shape, relative size, distance apart and nature of the electrodes. It will be found that if, between two sheets of mica, a sheet of tinfoil be placed, the potential required to puncture the sheets in a given time will be greater than that required to puncture the two sheets when not separated by conducting material. An examination of the brush discharge shows that the greater area of the tinfoil accounts for this, since it reduces the density of the electric force at the edge of the discs. This suggests that slots in which high-tension coils are embedded should be rounded off at the ends or special shields used there to relieve the density. In special cases an intermediate sheet of conducting material might prove beneficial.—*Abstracted from the Electrician* (*London*), *December* 16.

The Electric Lighting of Trains.

In this article M. J. Reyval describes in considerable detail the Aichel system of train lighting, which has been developed by Brown, Boveri & Company, Baden, Switzerland. This is an axle-light system consisting of a small two-horsepower dynamo carried on the car truck, an automatic regulator and switches, and a storage battery. The dynamo is not brought into action until the car has

Digitized by Google

reached a speed of twenty-five kilometres per hour. At this speed the voltage of the machine is sufficient to close an electromagnetic switch connecting the dynamo to the batteries. This brings into action a regulator which automatically regulates the voltage of the dynamo until the battery is fully charged. The dynamo switch is operated by an electromagnet having two windings: one connected in shunt across the machine; the other in series, the latter coil serving merely to hold the switch contacts firmly together. The regulator is a rheostat connected in the field circuit of the dynamo. This is adjusted by a small motor, the field of which contains three windings: one carrying the main dynamo current, one in series with the lamp circuit, and one in series with the armature. The last two coils are opposed to the first coil, and the armature and the coil in series with it are connected across the generator. With this arrangement there is no resultant field when the magnetizing effect of the coil carrying the main dynamo current is just balanced by that of the other two. As soon, however, as this balance is upset, either by a change in the speed of the generator or a change in the load on the machine, a torque is set up in the armature of the motor which, through gears, turns the rheostat handle one way or the other until a balance is again reached. In addition to this regulator there are several other electromagnetic switches which cut out the lamp resistance when the generator is thrown out of service, and provide the necessary safety devices. The dynamo is driven by means of a belt, and the regulator is mounted within the car. Charts which show the regulation of the system are given.—*Translated and abstracted from L'Éclairage Électrique (Paris). December 17.*

Kilmarnock Electric Light and Power Scheme.

The corporation of Kilmarnock, Ayrshire (Scotland), inaugurated on December 10 its electric light and power installation. The generating station is equipped for both lighting and power, and is situated on the north bank of the river Irvine, at Riccarton, a suburb of the town. The building is of red sandstone and white pressed brick. The ground floor is set apart for offices. The engine room is seventy-one feet six inches long, and thirty-seven feet six inches wide, and contains four 200-horse-power Belliss engines coupled to dynamos manufactured by Dick, Kerr & Company. The jet-condensing plant is situated at the west end of the engine room, and there is room left for an extension of the generating set. The switchboard is placed on a gallery about three feet above the engine-room floor level, and is combined for lighting and traction service. The dynamo rheostats are placed immediately under the gallery, and the regulating switches are worked by means of hand-wheels on the switchboard gallery. The battery room is on the north side of the engine room, and contains 254 cells of Tudor type, the capacity of the battery being 360 ampere-hours. Only a few regulating cells are supplied, the booster being kept in circuit practically all the time. The boiler house contains three Lancashire hand-fired boilers, twenty-eight feet by eight feet, which are worked at 160 pounds pressure. The coal supply at present is brought in in carts, but an arrangement is to be made with the Glasgow & South-western Railroad for a siding. The boilers are fed by two "Weir" direct-acting pumps, and water can be taken either from the town mains or from the condenser discharge. The pumps deliver either directly to the boilers or through a Green economizer composed of 192 tubes. On the east side of the engine room is a workshop which is suitable for either car or machinery repairs. A carshed adjoining holds twelve cars. These cars seat fifty-two persons each and have the ordinary type of staircase with extended canopy top. The tramway line consists of half a mile of double track and three-quarters mile of single track. The rails are of the ninety-pound girder type, and the track is bonded with solid-ended bonds, except at the points and crossings, where drift-pin points have been put in. Passing places are arranged about every third of a mile, and the line has been laid so as to allow for double-tracking later. Fifty ten-ampere, open-type arc lamps are used for lighting the town. The total cost of the lighting portion of the scheme is expected to be £37,000, while the cost of the tramways is about £42,000.—*Abstracted from the Electrical Engineer (London), December 16.*

The Future of Electricity in Paris.

The city of Paris is contemplating installing a large municipal electric light and power system, and with this project in view the directors of public works have asked for discussions of this question from a number of eminent engineers and electrical manufacturing companies. Three of these discussions are here given. Professor Eric Gerard takes up the question rather generally. He advises locating two or more generating stations along the river, where fuel is easily secured. Alternating current at 10,000 volts may be produced directly in the generators for transmission to transformer substations, where it will be distributed on a low-tension secondary system. In regard to the form of the secondary currents, the best system will be to transform them into continuous currents in substations provided with batteries, if the principal load is lighting. For more distant sections it will be more economical to distribute currents in the secondary system. If the motor-load is large it may be advisable to distribute for this purpose three-phase currents. Steam turbines should be used in the generating station. The Siemens-Schuckert works estimate that Paris will need a total power of from 70,000 to 80,000 horse-power. This should be furnished by 5,000-horse-power units in two generating stations situated on the Seine. These should generate three-phase current at from 8,000 to 10,000 volts, transmitting this by means of underground cables to numerous static transformer substations. Two cases are considered: the distribution of low-voltage, alternating currents, and the transformation and distribution of low-voltage, direct currents. A number of European cities' municipal systems are described briefly, and the decision reached is in favor of direct-current distribution by means of a three-wire system, with 440 volts between the outers. The advantages of this arrangement are considered at some length. The Allgemeine Elektricitäts Gesellschaft discusses the conditions in Paris in detail, and estimates that the total power used in Paris should be about 300,000 horse-power. This allows for 3,000,000 lamps, or one for each inhabitant, which is the condition existing in Berlin. This company recommends that two large power-houses be erected on the Seine, each rated at 100,000 horse-power. The generating equipment of each should consist of two 10,000-horse-power units and five 20,000-horse-power units. Current should be generated at from 10,000 to 12,000 volts, three-phase. The generators should be driven by steam turbines. The steam equipment is considered in detail. For the secondary distributing circuits the use of alternating currents at 220 volts is recommended. This company also compares the cost of street lighting by means of gas and electricity, the advantage lying with the latter.—*Translated and abstracted from L'Industrie Électrique (Paris), December 10.*

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Portable Wattmeter Calibrators.

The Fort Wayne Electric Works, Fort Wayne, Ind., has placed on the market a line of portable wattmeter calibrators for use in central station practice. These calibrators are designed so that the matter of calibration is rendered decidedly simple, and makes unnecessary the removal of the wattmeter from its circuit. In this way it is possible for one man to perform a large amount of accurate work, and at the same time the supplying company may be assured that its registering apparatus is being properly maintained

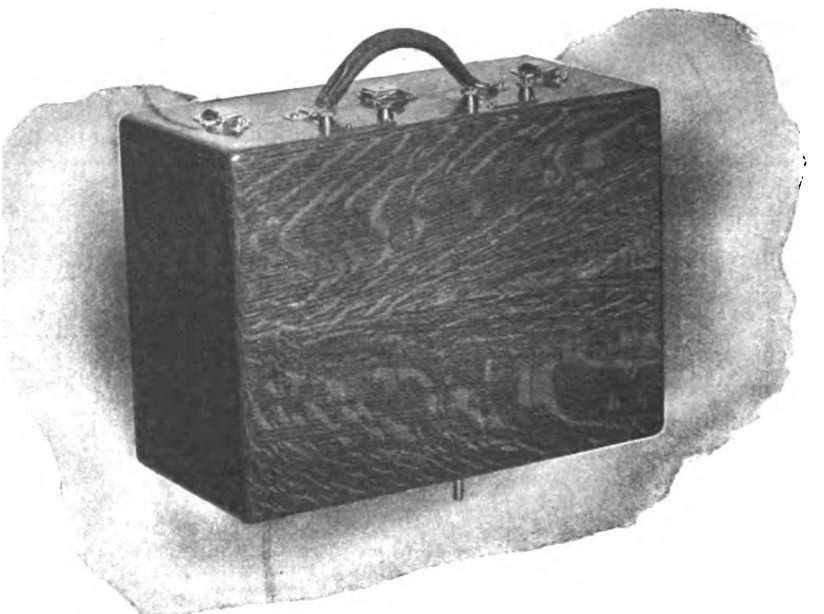
In this new line of apparatus, which is designated as type K portable wattmeter calibrator, there are two forms of instruments, the "ringing" calibrator and the "registering" calibrator.

In the ringing calibrator a standard type K wattmeter of proper capacity, voltage and frequency, but without registering mechanism, is mounted on the inside of a wooden carrying-case. The case is provided with leveling screws and a small spirit level set into the base. In the case beside the meter is a double-pole double-throw switch by means of which the series coils of the standard can be connected either in multiple or in series for double or normal rated current.

For normal calibration of five-ampere-meters with switch down the coils are in series; for double this current or ten-ampere-meters the switch is thrown up. This prepares the calibrator for use with five and ten-ampere-meters by direct comparison without a speed constant, the change in connections making no change in total ampere-turns or speed.

The scope of the calibrator is further magnified by using a speed constant of two for calibrating fifteen, twenty and twenty-five-ampere type K meters. To calibrate fifteen, twenty or twenty-five-ampere-meters the series coils of the calibrator are connected in multiple by throwing the switch up, in which case the calibrator will run twice as fast as these meters when it is in calibration. The calibrator will be accurate under these conditions up to fifteen amperes' load.

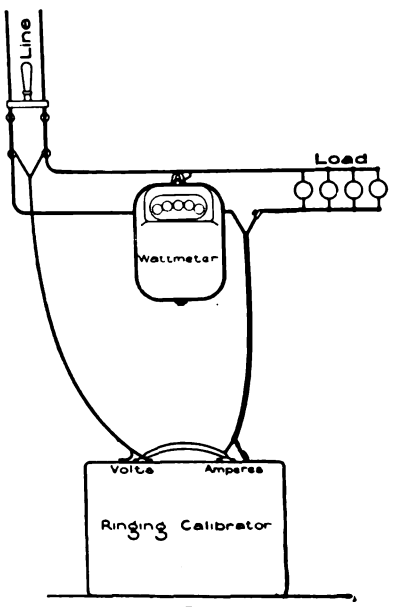
For comparing the speeds of the two meters a bell circuit is connected with the standard through a two-segment commutator on its armature shaft in place of the registering train. At every revolution of the standard armature the bell circuit is closed through a dry cell battery mounted on the left side of the case, thus ringing the bell. This bell circuit may be permanently opened when not in use by a two-point switch to prevent leakage of battery current should the armature come to rest with the commutator closed.



RINGING CALIBRATOR.

In calibrating a meter with the ringing calibrator the following procedure is employed:

1. Level the case with the adjustment screws, noting that the drop in the level is exactly in the centre, as the standard has been leveled in the case in building. This can be checked by placing a light non-magnetic weight on the armature, which will cause no rotation if the standard is level when the case is level.



CONNECTIONS FOR RINGING CALIBRATOR.

2. Connect the current or heavy leads to the binding-posts marked "amperes" on the top of the case, with one lead replacing the load wire in the meter to be tested, and the other lead connected to the load wire thus replaced.

3. Connect the voltage or small leads to the binding-posts marked "volts" with the hooks on the other end connected across the fuse block or the switch on the line or service side of the meter to be tested.

4. If the standard is properly connected in circuit the cup will rotate clockwise from above. Direction of rotation may be changed by reversing the voltage leads at the switch or fuse block. The case should now be closed to shield the armature or cup from air currents.

5. With a heavy load the meter should be adjusted in step with the standard by means of its permanent magnet so that the spot on the meter cup will always come to a certain point every time the standard bell rings for five or ten-ampere-meters or every time for fifteen, twenty or twenty-five ampere-meters. If the meter is slow, the magnet should be lowered, if fast, it should be raised.

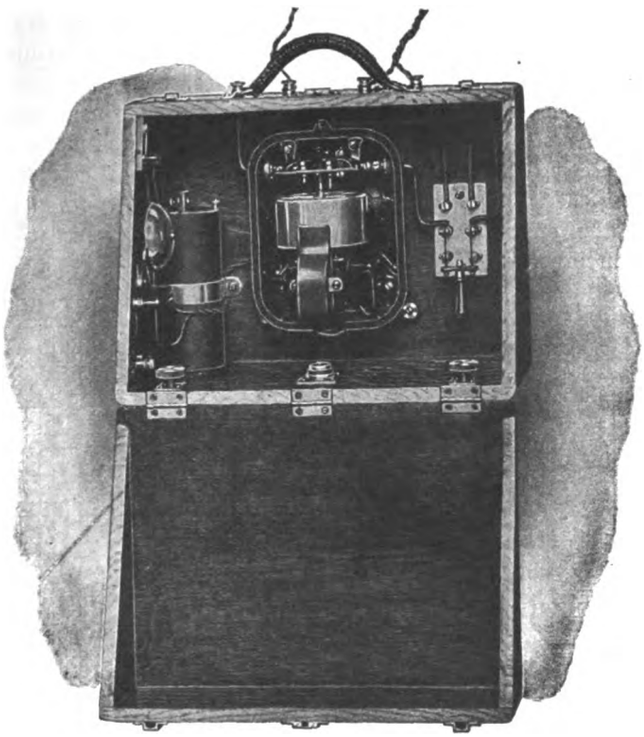
6. For light load or one lamp the adjustment is made with the starting coil arm. If the meter is slow, screw in the left side screw; if fast, screw in the right side screw (when facing meter).

The same precautions should be observed in carrying the calibrating set as for any jewel-bearing meter. The shaft should be raised from the jewel.

The standard type K meter used in

Digitized by Google

the calibrator has a high permanent accuracy and seldom requires adjusting as it will remain accurate for a long time if given considerate treatment. To guard against accidental derangement of adjustments it will not be out of place to occasionally check the standard with indicating instruments if they are available. The speed of the standard is the same as the ordinary type K meter and the same testing constants should be used. When calibrating it for five amperes the constant is nine and when for ten amperes the constant is eighteen.

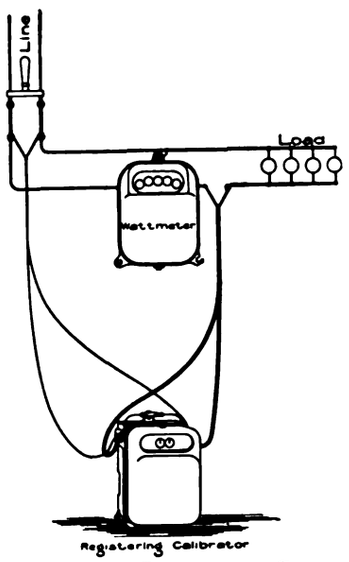


INTERIOR OF RINGING CALIBRATOR.

REGISTERING CALIBRATOR.

The "ringing" calibrator is built for any standard voltage or frequency and will calibrate either five, ten, fifteen, twenty or twenty-five-ampere type K meters of the same voltage and frequency as above described. It is equally suitable for calibrating meters of other manufacture having the same speed or an even multiple of its speed.

The carrying-case is solidly built of quartered oak with mitered joints and highly finished. It is also furnished in other finishes and woods. The overall dimensions are fifteen by eleven by eight inches.



CONNECTIONS FOR REGISTERING CALIBRATOR.

The "registering" calibrator consists of a type K meter having the regular registering train replaced by a double reduction train and two dials instead of five. The dials register revolutions instead of kilowatts. This is a much simpler device than the ringing calibrator, but is much more restricted in its adaptability.

For carrying purposes a handle is attached to the meter frame. Two adjusting screws are provided on the bottom of the frame for leveling it for use, the third support being on the bottom of the case. The jewel-bearing screw is extra long and projects through the case at the bottom so that the shaft can be raised or lowered without removing the case which can be sealed and the adjustment of the standard protected from outside disturbances.

The calibrator terminals can be reached by removing the terminal cap. Line connections are made the same as with the ringing calibrator, the current leads going into the large binding-posts and the voltage leads into the small posts. In use the calibrator is leveled by a small level placed on a milled surface on the top of the base. The shaft is then lowered to the jewel. After the connections are made up and the proper direction of rotation verified through the dial window the calibrator is ready for operation.

The dials of the calibrator will register 110 revolutions, which is equivalent to nearly three minutes running at full load. Therefore, if the revolutions of the meter to be tested are counted and compared with the difference in calibrator readings before and after counting an exact comparison of speeds is obtained. This can be done very handily by one man. For first approximation one-half minute counting is sufficient, but for final accurate adjustment the duration of comparison should be increased to two and one-half minutes.

A Good Business Suggestion.

The firm of W. F. Weiss, certified public accountant, makes a specialty of audits and investigations of commercial and manufacturing business and has an especially extensive practice in the electrical industry; it also makes examinations for the purpose of special and general information, and issues certifications as to earnings and financial condition of firms and corporations, etc. The employment of this firm at this time, the end of the fiscal year of many businesses, will be found advantageous. The examination and review of the various annual statements by certified public accountants are considered good business practice and a measure of safeguard and insurance aside from the valuable suggestions and practicable and profitable advice which accompany such accountants' reports as to most economic and advantageous operation and conduct of the business under review.

Digitized by Google

The Westinghouse No. 93 Railway Motor.

The Westinghouse Electric and Manufacturing Company is placing on the market Westinghouse No. 93 railway motor which is representative of the gradual improvement in design resulting from constantly accumulating data and experience. It supersedes the Westinghouse No. 56 motor.

The armature has been designed with careful attention to every detail. The cooling and circulation are well looked after, without sacrificing the mechanical protection of the coils. Wedges to protect and hold the coils in place; coverings of duck, and an iron flange at the pinion end give further protection, and make a construction well suited to heavy and constant service. Other mechanical details have received the same attention; the bearings are of liberal size, and the arrangement of the housings and system of lubrication has proven reliable by its successful use on many equipments now in service.

The No. 93 motor is designed to meet successfully the increasingly rigid demands of the city, suburban and interurban service to which it is adapted. In city service, a double equipment of these motors is suitable for operating single or double-truck cars of almost any size ordinarily used; that is, cars not exceeding thirty-five to forty feet over all, and weighing without equipment or load from 23,000 to 30,000 pounds. In this service with runs from one-eighth to one-quarter of a mile in length, a two-motor equipment with a gear ratio of 16 to 71 will produce a schedule speed of ten to thirteen miles per hour, assuming a pressure of 500 volts and a straight level track.

In suburban service, a four-motor equipment will operate cars of forty to forty-five feet length over all, and weighing from 30,000 to 35,000 pounds without equipment of load. In this service, the average run being from one-quarter to three-quarters of a mile, the four-motor equipment will maintain an average speed of approximately 17.5 miles per hour with gear ratios of 19 to 68, under the conditions previously stated.

In interurban service, with an average run of from three-quarters to one and one-half miles in length, and with equipment and weight of car as above, schedule speeds of 23.5 to 28.5 miles per hour may be attained.

The general performance of the motor is shown by the curves in Fig. 1. The motor has a nominal capacity of fifty horse-power at 500 volts for one hour. The curve sheets show the speed, tractive effort, and the brake-horse-power which it will develop with currents of from 0 to 200 amperes at 500 volts, also a time-temperature curve.

The motor has a continuous capacity of fifty amperes at 300 volts, or forty-six amperes at 400 volts. Under the usual conditions of railway service, it will carry safely any loads within the range shown on the curve sheets, provided that the integrated heating effect does not exceed the heating effect caused by the continuous application of the above currents at the corresponding voltage.

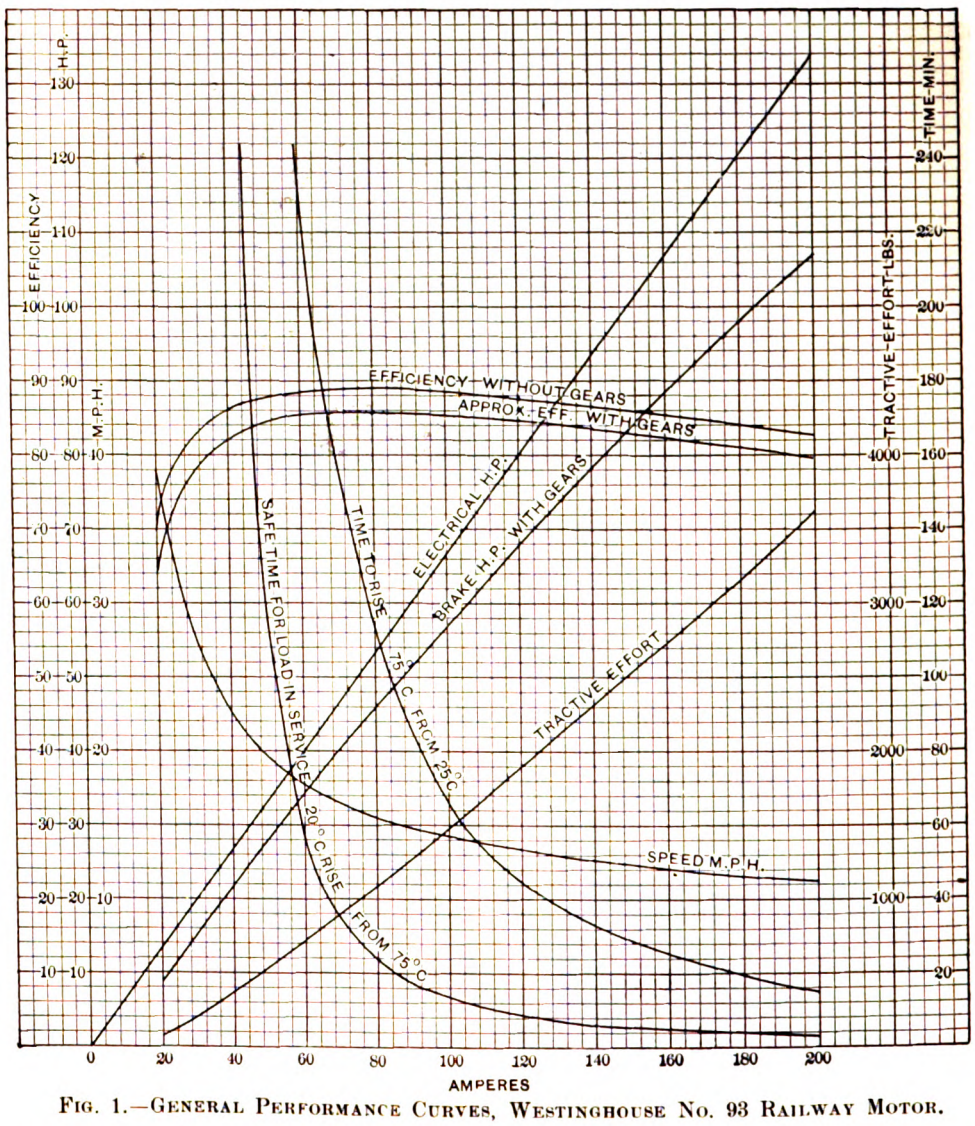


FIG. 1.—GENERAL PERFORMANCE CURVES, WESTINGHOUSE NO. 93 RAILWAY MOTOR.

In a shop test at either of these loads, the rise in temperature of the windings of the motor during an all-day run will not exceed seventy-five degrees centigrade as measured by thermometers. With the motors mounted under a moving car much better ventilation is obtained than in a shop test, and thus the temperature rise in service with the equivalent of these loads should be considerably less, and will usually not exceed fifty-five degrees centigrade. For short periods, such as the rush hours, the motor may be operated with loads in excess of its continuous capacity, and under these conditions it will reach a temperature higher than the above, though still within safe limits.

The time-temperature curve shows the allowable amount and duration of such loads. The curve is based upon a rise in temperature of twenty degrees centigrade in the interior of the coils under service conditions, after the motor is already heated to its ordinary running temperature. Thus, if the motor has been working for ten or twelve hours at a load equivalent to forty-seven amperes at 300 volts, and has attained a temperature of fifty-five degrees centigrade above the air, it may then, as shown by the time-temperature curve, carry loads equivalent to a continuous current of 110 amperes for ten minutes with a further increase of not more than twenty degrees centigrade. If at the end of this period the load is again reduced to the equivalent of fifty amperes, the temperature will then gradually fall off to its former value of fifty-five degrees centigrade above the air.

The frame is of cast steel in two parts;

Digitized by Google

it is roughly cylindrical in shape, and is divided in a plane through the axis of the armature shaft and car axle. The two halves of the frame are hinged together on one side, and are further held together by four bolts. The edges of the castings are carefully milled, so that a good joint between them is secured. All the working parts of the motor are enclosed by the field castings, and so are entirely protected. The hinges are placed on the side farthest from the axle, and the lower frame may be swung downward, to allow of inspection or repair of the field. If desired, the armature may be swung down with the lower frame, or it may be retained in the upper part. This arrangement makes every part of the interior of the motor perfectly accessible. To give access to brushes and brush-holders, there is a large opening in the upper casting over the commutator. This opening is closed by a malleable iron lid, which is made dustproof by a felt washer riveted to its edge. It is held in place by a cam-locking device at each side. This cover may be removed when the conditions permit, and the motor run open, with better ventilation and consequent increase of capacity. For cleaning and inspecting the lower field there is a hand-hole in the lower frame under the commutator, and at the pinion end is a peep-hole for observing the wear of the bearing by noting the clearance between the armature and pole-piece. These openings are covered and made moisture-proof by means of suitable malleable iron covers and rubber gaskets. The field frame, opened, is shown in Fig. 2, and closed in Fig. 3.

A rectangular suspension bar, supported on the truck frame, is bolted to special lugs on the front corners of the upper field frame.

The four pole-pieces are built up of soft steel punchings riveted together between wrought-iron end-plates. They project radially inward, at angles of forty-five degrees with the horizontal, and each is fastened to the frame by two bolts secured by lock washers. These bolts penetrate well into the stampings but do not pass entirely through, thus leaving a smooth, unbroken pole-face.

The poles have projecting tips which serve the double purpose of giving a proper distribution of magnetic field and of retaining the field coils. The coils are held rigidly in place and all vibration is prevented by flat steel springs placed between the coils and the frame. The coils are formed of copper strap wound on the flat, the turns and sections being well insulated from each other by treated asbestos sheets. The coils are heavily taped, and repeatedly dipped and dried, and impregnated with special insulating compounds which make the entire coil moisture-proof and practically indestructible.

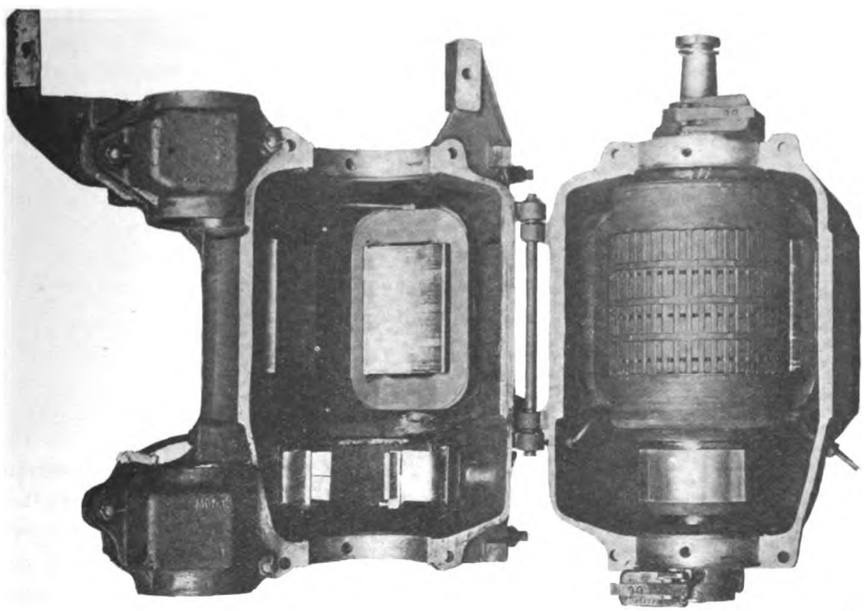


FIG. 2.—RAILWAY MOTOR, FIELD OPEN, SHOWING ARMATURE.

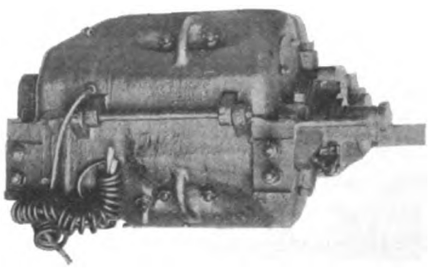


FIG. 3 —RAILWAY MOTOR, FIELD CLOSED.

The armature core is made up of soft steel punchings, carefully annealed and tested, built up on a cast-iron spider. Air-ducts are provided between the punchings, which connect with ventilating spaces in the spider; this arrangement provides an excellent circulation of air, resulting in a uniform temperature, which is the best condition for the radiation of heat. The armature is wound with machine-formed coils, carefully insulated and embedded in the slots. They are held in place by fish-paper wedges forced in between V-shaped grooves near the top of each slot and also by band wires. Canvas caps are fitted over the front and rear ends of the coils, so that the entire winding is absolutely protected from any dust or dirt from the street or other sources. On the pinion end of the armature spider is a bell-shaped flange upon which the windings rest. The entire winding is especially well protected from dirt, moisture or mechanical injury. Wiper rings pressed on the shaft outside of the armature revolve in spaces inside the bearing boxes and prevent oil from working along the shaft to the commutator or winding. The assembled armature is shown in Fig. 4.

FIG. 4 —ARMATURE OF RAILWAY MOTOR.

The commutator is of the straight bar type, without neck. The wearing surface is ten and one-quarter inches in diameter by four and eleven-sixteenths inches long and the wearing depth is about seven-eighths inch. There are 135 bars of hard-drawn copper insulated with specially prepared soft mica and built up and clamped on a cast-steel bushing. The commutator bushing is then forced on the armature spider and securely keyed to it. This arrangement prevents any vibration between commutator and armature core, which so often causes broken leads and short-circuits. It also allows the shaft to be removed if necessary without disturbing the connections or relative position of armature core and commutator.

The brush-holders are of the sliding type with shunts. Two cast-brass arms, well insulated with treated fullers' board, are fastened by insulated bolts to the upper frame. The arms are arranged for

Digitized by Google

radial adjustment to allow for wear of the commutator. Each arm carries two spiral phosphor-bronze bush-springs, each of which bears upon a brush; the two brushes are placed side by side in the slot, each extending half-way across the commutator. This arrangement reduces the inertia of each moving element and allows it to follow the surface of the commutator very closely, avoiding any sparking due to "chattering." The brushes are of copper-plated carbon and each is connected to the holder by a shunt of braided copper, thus preventing any heating of the springs and consequent variation in pressure, such as would occur if the current passed through the spring. The brushes are one-half inch by two inches in section and two and one-quarter inches long.

The leads are of flexible rubber-insulated cable, and are brought out through insulating bushings of semi-soft rubber, set in the frame. All outside connections are made with knuckle joints.

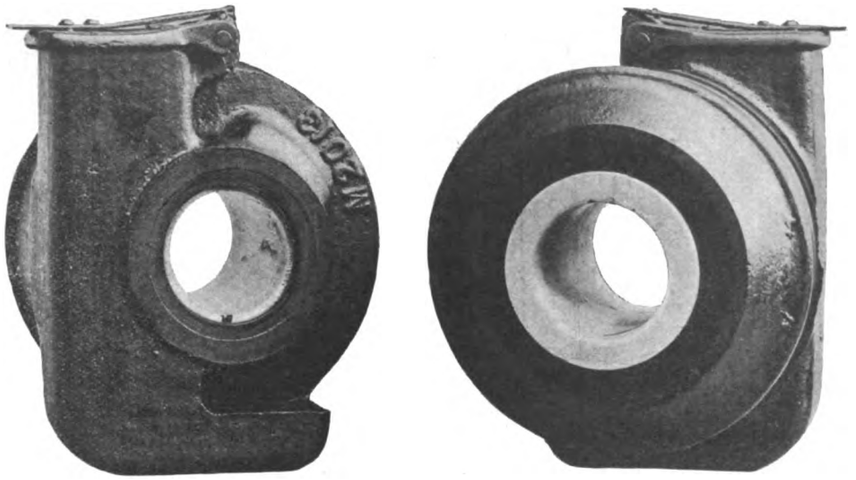


FIG. 5.—BEARINGS AND HOUSINGS OF RAILWAY MOTOR.

The bearings for the armature shaft consist of solid cast-iron shells lined with babbitt metal. Experience has proved that this type of bearing is the best which has ever been used on a railway motor. The bearings are carried in housings of cast iron, which are of cylindrical form and are held between the halves of the frame. The housings have finished flanges on their inner ends which are clamped between finished surfaces on the field frames; they are held from turning by tap bolts in both the upper and lower frames.

The method of lubrication is by means of oil and waste. The bearing housings contain oil and waste reservoirs which extend around one side and below the armature shaft and allow the saturated waste to come in contact with the shaft through large openings in the low-pressure side of the bearings. Separate oil wells are provided, so that oil can be added in quantities to the bottom of the waste. The free oil can also be gauged. This method of lubrication is similar to that used in car-journal boxes in interurban and steam roads; the bearings are thoroughly lubricated and the amount of oil used is extremely small.

The inner ends of the housings are extended to include the wiper rings, so that oil thrown off by these rings is drained directly into separate wells at the bottom of the housings. The housings are shown in Fig. 5.

The bearing surfaces are very liberal; the armature bearing at the commutator end is six and eleven-sixteenths inches long with a three and one-half-inch bore, and at the pinion end eight and seven-sixteenths inches long, bored for a three and three-quarter-inch shaft.

The armature shaft is made of medium grade open-hearth steel, and is unusually strong and heavy.

The axle bearings consist of cast-iron bushings in halves, lined with babbitt metal. They are eleven inches long and may be made for a shaft of any diameter not exceeding five and one-half inches. These bearings are held between projections from the upper frame and caps of cast steel bolted to these projections. These caps may be taken off, and the axle and wheels easily removed. Lubrication of the axle bearings is by oil and waste, as in the armature bearings. A large reservoir with an opening through the upper frame is located in each axle cap and feeds the axle through an opening in the lower half of the bearing.

The pinion is of forged steel, with machine-cut teeth, and is taper-bored to fit the shaft. It is held in place on a tapered seat by a special two and one-half-inch nut and lock washer and is secured by a steel key. The pinion is countersunk to receive the lock washer, so that the end is flush. The gear is of cast steel, in two parts, which are bolted together and keyed to the axle. The face is five inches wide. Gear ratios of 16:71, 19:18, 24:63 and 30:57 are standard.

The gear case is made of malleable iron in two castings, divided in a plane passing through the axes of armature shaft and axle. The two parts are fastened together by lugs and bolts, and at the front and rear ends to extension lugs in the upper field frame. This arrangement is particularly good, as no strains can be thrown on the gear case by vibration between upper and lower castings, the case being fastened to only one-half. The supporting lugs are especially strong and heavy.

The whole gear case is carefully constructed and will bear very hard service. The gears may be run in oil if desired.

Every part of each motor is rigidly tested for faulty material or workmanship while in process of manufacture. After being assembled, a run under full load is made on every motor, as well as a "breakdown" test of the insulation, at an alternating potential of 3,000 volts.

The approximate weights are as follows:

Motor, without gears and gear case, 2,975 pounds.

Motor, complete with gears and gear case, 3,335 pounds.

Armature, complete with commutator and shaft, 1,005 pounds.

The approximate weight of a two-motor equipment with two controllers and the usual details is 7,870 pounds. A corresponding equipment of four motors, controllers, etc., will weigh approximately 15,940 pounds.

The Williams Electric Clutch and Safety Device.

The Williams electric clutch and safety device for electric motors, manufactured by the Williams Electric Machine Company, Akron, Ohio, was described in the issue of the ELECTRICAL REVIEW for December 24 last. In this description it was stated that the insulation of the actuating coil of this apparatus was given a breakdown test of 200 volts, alternating current, for 110 and 220-volt work, and 500 volts, alternating, for 500-volt service. This should have been 2,000 volts, alternating current, and 5,000 volts, alternating current, respectively, for the breakdown test figures.

Digitized by Google

The Blake Electric Railway Signal.

The Blake Signal and Manufacturing Company, 246 Summer street, Boston, Mass., manufactures a signal system, which enables the car despatcher to communicate with the crews of the various cars at any

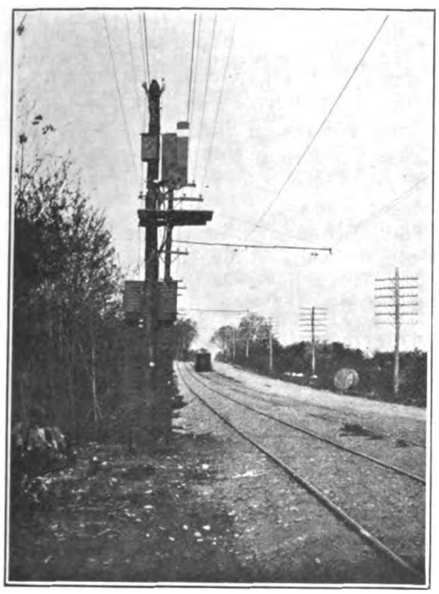


FIG. 1.—ELECTRICALLY OPERATED SEMAPHORE SET TO "CLEAR."

time. The system consists of semaphores which can be operated from the despatcher's office and which call the attention of the crew, and a telephone by which they communicate with the despatcher. The system is employed on the Boston & Worcester Street Railway and operates as follows:

The entire line is covered by a first-class telephone. At all important operating points or turnouts a Blake signal has been installed. All telephone and signal stations are furnished with an autographic register which renders in triplicate the orders received at the station. If the despatcher wishes to communicate with a car crew approaching any particular station, he picks up a three-inch toothed disc, numbered to correspond with the signal which he wishes to set, and slips it on a constant-speed, motor-driven shaft located directly at hand. This throws a four-foot semaphore to a "stop" position at the station required, at the same time illuminating a red lens for a night signal.

As soon as the semaphore is properly set at "stop" the despatcher is automatically notified of this fact by the operation of a magnetic sounder in his office. The car arrives at the station, the conductor unlocks the booth and calls the despatcher by telephone, saying, "Brown and Hayes at No. 9 for orders." The despatcher then transmits his orders to the conductor who writes them on the autographic register, repeats them back to the despatcher, takes one written copy for himself, and hands one to his motorman. The third copy is wound on a roll within the register where it is accessible only to the management. The conductor then pulls a cord which sets the semaphore at "clear" position ready for future operation. Fig. 1 shows the semaphore set at "clear," Fig. 2 at "stop" position and Fig. 3 shows the interior of the booth with the telephone on left, autographic register on right, and the cord suspended over telephone for resetting of the signal.

A detailed description with a diagram of connections (Fig. 4) is as follows: the basic principle of the signal depends on the fact that the period or time of vibration of pendulums of certain lengths is always the same. Each signal box upon the line contains an electromagnet and a pendulum. The electromagnets are all in series on a single wire, ground return being used preferably, though a metallic circuit could be employed. The pendulums for each signal are of different lengths and receive impulses from the electromagnets which may be energized at various intervals to correspond with the periodicity of their respective pendulums.

The despatcher, either by the use of

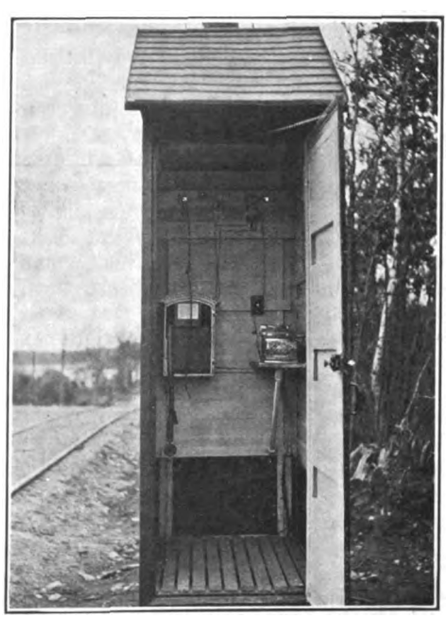


FIG. 3.—TELEPHONE BOOTH AND AUTOGRAPH RECORD APPARATUS.

a constant-speed shaft on which he places toothed wheels for making and breaking contacts at various intervals corresponding with the periods of the various pendulums, or by means of setting in motion a pendulum corresponding in length and consequently synchronous with the pendulum of the signal which he desires to set, sets up impulses at certain intervals in all the electromagnets. These impulses are felt by all the pendulums, but are only cumulative in increasing the arc of vibra-

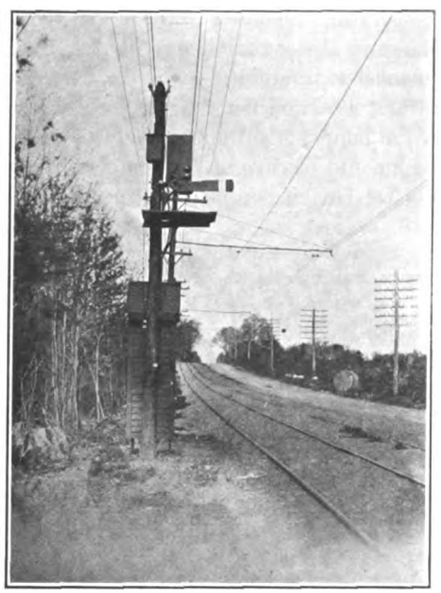


FIG. 2.—ELECTRICALLY OPERATED SEMAPHORE SET TO "STOP."

tion of that pendulum whose period is synchronous with the predetermined period of electromagnetic impulses. After ten or twenty seconds, the pendulum swings through an arc of sufficient length to trip the lock holding the semaphore in a vertical or "clear" position and the semaphore at once falls to a horizontal or "stop" position. When the semaphore reaches the horizontal position it automatically closes a lamp switch which gives the illuminated signal needed for use at night. Each signal is equipped with two incandescent lamps so that in the event of one lamp being burned out when the semaphore is set at "stop," the other lamp is automatically connected to a periodically interrupted circuit and gives a flashing danger signal. When in a horizontal position the semaphore also automatically closes a circuit which gives a magnetic sounder signal to the despatcher, notifying him that the signal has been set as desired. The difficulty of maintaining a motor at constant speed with the widely varying voltages of electric railway circuits has been successfully overcome by the use of a governor placed on the motor shaft.

The use of the master pendulum, instead of a motor, removes the necessity of using current to operate the motor and is besides absolutely positive in action and more quickly and easily operated.

There is no reason why the Blake signal

Digitized by Google

with certain modifications should not be applicable to steam roads, especially on single-track branch lines where traffic is insufficient to warrant the expense of maintaining a force of telegraph operators. In such service, since there would probably be no electric current available for operating the motor in the despatcher's office and the signal lamps on the line, the master pendulum could be used in the first case and batteries at each signal for the lamps, or oil lamps could be used. The amount of current used in energizing the electromagnets and operating the signals is 0.08 ampere with a voltage of 650, equivalent to fifty-two watts for the few seconds necessary to operate the signal, or an average of about 0.000217 kilowatt-hour for each time a signal is set.

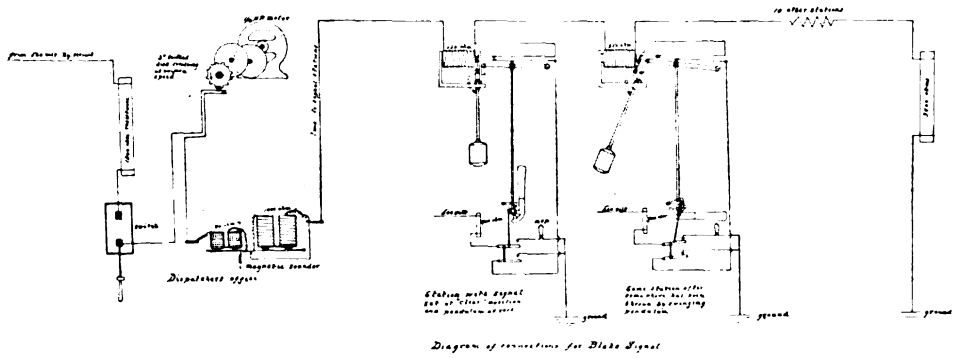


FIG. 4.—DIAGRAM OF CONNECTIONS FOR BLAKE SIGNAL SYSTEM.

A one-sixth-horse-power motor is sufficient for revolving the toothed disc in the despatcher's office, and is in operation only while signal is being set. The signal should be installed preferably entirely independent of the telephone, a single No. 10 galvanized iron wire with ground return being sufficient for line connections.

An Interesting Exhibit.

During the recent convention of the Interstate Independent Telephone Association held at the Auditorium Hotel, Chicago, Ill., a number of interesting and novel telephone systems and devices were displayed by the Ericsson Telephone Company, 296 Broadway, New York city. The exhibit was shown in room No. 618 of the Auditorium Hotel. A great deal of interest was taken in the exhibit by the visiting members of the convention, especially in the new four-party-line selective system and the non-interfering, central-calling, rural-line equipment. These systems have been recently patented by the Ericsson Telephone Company, and their practical operation was shown for the first time to the general public.

The four-party, selective system possesses a number of important features, one of which is that when central is called, none of the other subscribers is disturbed, and this is also the condition when the ring-off signal is given.

Another advantage is, that at all times a perfect balance is preserved, but a heavy ground on one of the wires will not prevent the subscriber from reaching central. It is economical to install, as one generator at central office will furnish current for ringing the party calls, as well as the regular calls.

The new rural-line equipment eliminates any disturbance from central when a subscriber wishes to call another party on the line, as the drop at central only responds when central is wanted.

Apparatus was connected up in the exhibit, demonstrating both of these systems, and it was demonstrated that these appliances would do all that was claimed for them.

The 200-line, self-restoring indicator-jack switchboard was also admired by many of the visitors. This is a most compact, quick-operating and efficient switchboard, and for small exchanges it is extremely economical, as one operator can easily handle 200 lines.

The switchboard is handsomely finished in mahogany and details show fine mechanical and electrical design and construction.

The exhibit of "Echophones," while not pertaining directly to exchange equipment, showed the development of low-priced apparatus intended for short-distance work. The construction and general make-up of these instruments are stated by the maker to be equal to that of the regular long-distance telephone for exchange use.

A "phantom circuit" was connected, showing the use of four Ericsson duplex transformers, thus making three complete non-interfering circuits from two pairs of wires. These transformers are so constructed that when a line is properly balanced there is no interference whatever between the several circuits, and the voice and ringing current passes over the phantom circuit equally as well as on the regular circuits.

The piece of apparatus which attracted the most attention was an Ericsson relay such as is used in connection with the company's common battery system. This was mounted on a panel, connected to two handles, the circuit being closed through the human body when a person grasped these two handles. Each time the circuit was closed in this manner the lamp would light, also several persons in series could light the lamp by grasping each others hands. By a switching device, a "howler" was connected to this apparatus in place of the lamp, and when the circuit was closed through the handles and body, a loud, clear tone emanated from a receiver on the panel.

The "howler" is another ingenious patented device of the company and is used very successfully in notifying careless subscribers who have left their receivers off the hook. The sound is carried to the receiver by an induced current and whether the circuit be of low resistance or high resistance, the volume of sound is always the same.

The exhibit was in charge of J. H. Montague, assisted by George H. Peirce and A. B. Chance.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED AT DIRECTORS' MEETING, NEW YORK, FRIDAY, NOVEMBER 25, 1904.

Spencer Adams, Lima, Peru.
Albert Mark Allen, New York city.
George Randall Alexander, Sacramento, Cal.
Anton R. Beaujon, West Palm Beach, Fla.
Maxwell Rufus Berry, Connellsville, Pa.
Henry Harcourt Carter, Barbados, B. W. I.
Herbert Almyr Clarke, Philadelphia, Pa.
Harry Hamilton Cochrane, Ithaca, N. Y.
John T. Cowling, Mt. Vernon, N. Y.
Wilfred Augustin Daly, Wilkinsburg, Pa.
Francis S. Denneen, Brooklyn, N. Y.
Francis Barrett De Gress, New York, N. Y.
Arthur St. John Dunstan, Auburn, Ala.
Luther Lee Emerson, Pittsburg, Pa.
Alex Fredrik Enström, Stockholm, Sweden.
Theo. J. V. Feilden, London, W. C., England.
Alan Estis Flowers, Columbia, Mo.
Siegfried George Freund, New York city.
Louis René Gaiennie, St. Louis, Mo.
Joseph L. Gensler, New York city.
Gehrard M. W. Goettling, Boston, Mass.
Robert Hammond, Westminster, England.
William Woodson Harris, St. Louis, Mo.
Thomas Hesketh, Folkestone, England.
Lucien Hill, Connellsville, Pa.
Ralph Goodrich Hussey, Newport, R. I.
Theodore Inslee Jones, Newark, N. J.
L. Frank Kohler, New York city.
Thomas B. Lambert, Chicago, Ill.
Felix Levy, New York city.
Hans Julius Meyer, Shreveport, La.
Wallace D. Moore, Lima, Ohio.
David King Morris, Birmingham, England.
Leopard G. E. Morse, London, England.
Rufus Page Moses, Taylor, Cal.
Jorge Newbery, Buenos Aires, A. R.
Llewelyn Owen, Peoria, Ill.
Warren Partridge, Orange, N. J.
Arthur Joseph Quigley, New York city.
Jonas Alfred Renström, Pachuca, Mexico.
William Henry Reynolds, New York city.
Charles Emery Robertson, Buffalo, N. Y.
Charles J. Russell, Philadelphia, Pa.
Warren Bixby Sanford, New York city.
Elliot Matthews Sergeant, Boonton, N. J.
William E. Skinner, Winnipeg, Manitoba.
Hartley Le Huray Smith, Brooklyn, N. Y.
Harry Ray Snyder, St. Louis, Mo.
Edward Wadsworth Stone, Asheville, N. C.
Tom Percival Strickland, Sydney, N. S. W.
Ira Guy Walborn, Provo, Utah.
Arthur Clement F. Webb, Sydney, N. S. W.
Ernest A. Wolfe, Pittsburg, Pa.

TRANSFERRED FROM ASSOCIATES TO THE GRADE OF MEMBER.

Harry P. Gibbs, Province Bangalore, India.
Douglas Burnett, Baltimore, Md.
Arthur Clarke Eastwood, Cleveland, Ohio.
William Amzi Dick, Pittsburg, Pa.
Edward Jerome Cook, Cleveland, Ohio.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TELEGRAPHY BETWEEN GREAT BRITAIN AND ITALY—It has been announced that negotiations between Mr. Marconi and the Italian government for the installation of the wireless telegraph system between Italy and England have been successful. Stations will be established at Bari and Poldhu.

WATER-POWER PLANT IN HONDURAS—The New York & Honduras Rosario Mining Company, 40 Broadway, New York city, intends to establish an electrical power plant and erect a seventy-five stamp mill at San Juan Cito, Honduras. There are at present several small water-power plants on the company's property, which are to be dismantled when the new power plant is established. Contracts for the new plant have not yet been given out.

ELECTRIC LIGHTING PLANT FOR NINGPO, CHINA—Ningpo, China, is soon to have an electric lighting plant which will supply about 4,000 lights. A company has been floated, half of the capital of 100,000 taels being represented by the International Commercial Company, and the other half by Chinese investors. A building is now in course of erection, and the machinery has been purchased. The work, it is expected, will be completed by March 1, 1905.

NORTHERN INDIANA TRACTION COMPANIES CONSOLIDATED—Papers have been filed at Laporte, Ind., showing that the Indiana Railway Company, operating between South Bend, Mishawaka, Goshen and Elkhart, has consolidated with the Indiana Western Railway Company, which is constructing an electric line westward from South Bend through Laporte County. The directors of the merged corporation were authorized to issue $3,000,000 in forty-year five-per-cent bonds.

ELECTRIFYING THE CRIPPLE CREEK RAILROAD—The Cripple Creek Central Railroad Company, owning the Florence & Cripple Creek road, will commence to electrify its suburban system early in the new year. The company now owns and controls the La Bella power plant, situated at Goldfield, Col., and it is from this point that the power will be obtained. The company expects to run somewhere between a twenty-minute and one-hour schedule during the day and night. The system is to be extended to reach every town in the district.

SANTA CLARA INTERURBAN ROAD INCORPORATED—Articles of incorporation of the Santa Clara (Cal.) Interurban Railroad Company have been filed. The capital stock is $5,000,000. The following are directors: J. C. Campbell, J. F. Parkinson, Frank D. Dorman, W. H. Metson and E. M. Rea. The proposed line is as follows: from the city of San Mateo to Alum Rock park in Santa Clara County, through Redwood City, Menlo Park, Palo Alto, Mayfield, Mountain View, Sunny Vale, Santa Clara and San Jose. The length of the projected line is given as forty miles.

ELECTRIC POWER PLANT IN MICHIGAN—The Alpena Power Company has been formed to control all the water privileges of the Thunder Bay river in Michigan. Cheap electric power will be supplied to Alpena. Frank W. Fletcher, George P. Smith and other capitalists control the Alpena Electric Light Company, the Alpena Water Company and the Thunder Bay Boom Company, which companies will be merged into the new company, whose capital is $500,000. Hubbard lake, of which Thunder Bay river is the outlet, will be raised six feet to increase the water power of the river.

NEW POWER COMPANY TO BUILD POWER DAMS—The Grand Rapids-Muskegon Water Power Electric Company has been organized under the laws of Maine with a capital of $1,000,000. It will build one or more dams on the Muskegon river to generate into electric current for commercial purposes in Grand Rapids, Muskegon, Big Rapids and other places. The first dam will be built at Rogers bridge, about six miles below Big Rapids, and will be thirty-eight feet high, and capable of developing 3,000 horse-power for twenty-four hours at low water. With the transmission line to Grand Rapids the cost of the work is estimated at $400,000.

BOSTON ELEVATED TAKES POSSESSION OF EAST BOSTON TUNNEL—The East Boston tunnel was formally leased on December 24, 1904, to the Boston Elevated Railway Company for a term of twenty-five years, beginning June 10, 1897. The annual rental is to be three-eighths of one per cent of the company's gross receipts from owned or operated lines. In addition the company will act as agent to collect the tunnel toll of one cent per passenger, or whatever sum shall be fixed from time to time. The rental and toll go to the city of Boston, to redeem the tunnel bonds and to pay the interest upon them. On December 16 the directors of the elevated road authorized President Bancroft to execute such a lease of the tunnel as the executive committee might approve. On December 22 the executive committee approved the lease outlined above, and the transit commission voted to execute a lease and deliver the same in exchange. The tunnel was opened to the public on December 30, 1904.

CITY OF CHICAGO DEMANDS AN ACCOUNTING FROM TELEPHONE COMPANY—The city of Chicago has begun a campaign to force the Chicago Telephone Company to open its books for inspection. The circuit court has been asked to compel an accounting with the municipality. It is alleged that since 1889 the corporation has withheld between $350,000 and $500,000 which should have been paid into the treasury under the three per cent gross receipts compensation clause. The dispute is over the receipts in the districts annexed to Chicago since 1889, including the towns of Hyde Park, Cicero and Lake. The opinion of the company's counsel is that the ordinance of 1889 did not extend outside of the old city limits. For the last fifteen years the city has denied to the company the exercise of any privileges in the annexed territory under the ordinance containing the agreement to pay three per cent upon gross receipts from telephone business within the city. The company has made low rates in several exchanges in this annexed territory, and in doing so has given the residents the full benefit of the percentage.

PENNSYLVANIA RAILROAD EXTENDS ITS TELEPHONE SYSTEM—The Pennsylvania Railroad Company has closed an important contract with the Bell Telephone Company which will mean a considerable extension of the private telephone system of the railroad. It is understood that the Pennsylvania company will not operate any of its trains by means of the telephone, but will send important instructions by telephone that were heretofore telegraphed. It will also bring many of the out-of-the-way offices and stations in direct communication with the general offices of the road in Pittsburg. Three new private exchanges will be established at important points on the Pittsburg division. From the Uniontown exchange the entire Connellsville region will be brought under the direct supervision of the Pittsburg headquarters. An exchange at Scottsdale will cover the Emerson and Youghiogheny regions. The operation of the southwest branch of the road between Scottsdale and Connellsville will also be done through the medium of this exchange. An exchange at Youngwood will connect all the railroad offices and stations in that locality.

SOUTHERN TELEPHONE EXTENSION—Within the next few months the Cumberland Telephone and Telegraph Company will expend not less than $125,000 for new work in Memphis, Tenn. The improvements will consist of a number of new cables for local use, and also of a pole line around the outskirts of the city, to be used as an accessory to the present long-distance equipment. This latter line is intended chiefly as a precaution against interference to long-distance service. Two principal new lines are also being constructed in Mississippi. One of these runs from Tupelo to Meridian by way of Aberdeen, West Point, Starkville and Amory. The other follows the line of the Yazoo & Delta branch of the Y. & M. V. Railroad from Memphis to Vicksburg. The longest of the projected new lines is that between Shreveport and New Orleans, along the right of way of the Texas Pacific. The length of this line will be 315 miles. A telephone line 150 miles long is being built between Baton Rouge Junction down the west side of the Mississippi river to Memphis. The line from Tupelo to Meridian is 100 miles long. Another line between West Point and Durant is 100 miles long.

Digitized by Google

TELEPHONE AND TELEGRAPH.

CHESTER, PA.—The Bell Telephone Company will erect a new exchange in this city.

PARKERSBURG, IOWA—The Farmers' Mutual Telephone Company is seeking a franchise.

MOULTON, IOWA—The Farmers' Mutual Telephone Company has been voted a franchise.

HOBART, O. T.—Hobart has the application of a Washita valley telephone company for a franchise.

SANTA MONICA, CAL.—The Home Telephone Company has men at work constructing a local line to Sawtelle.

CENTERVILLE, IOWA—The Mutual Telephone Company is considering improvements and extensions to its plant.

WATERVLIET, MICH.—The Spinks' Corners Telephone Company has arranged for some important extensions to its lines.

OAKLAND, CAL.—The telephone company has shipped material for the construction of a telephone line from Livermore to Tesla.

SEATTLE, WASH.—Seattle has been connected with Port Townsend, Fort Casey, French Harbor and Victoria by wireless telegraph.

SALT LAKE CITY, UTAH—The Independent Telephone Company is making extensions in the direction of Bingham, Provo and Park City.

ALLENTOWN, PA.—The residents of Layfield, Sassamansville and Congo intend to build a telephone line from these towns to Boyertown.

ESTHERVILLE, IOWA—The Emmet County Telephone Company is making plans for the construction of a city exchange and rural lines in the spring.

CHARLESTOWN, W. VA.—A mutual telephone company is being organized in Jefferson County. Lines will be extended to all principal points in the county.

VILLA RICA, GA.—The Gainesboro Telephone Company is extending its lines to several sections of the county. Already a number of Carroll County farmers have telephone service.

BELLEVILLE, ILL.—The St. Clair & Eastern Telephone Company has filed for record an assignment of its franchises in St. Jacob, Marine, Alton and Godfrey to the Kinloch Long-Distance Telephone Company.

FORT WAYNE, IND.—George W. Beers, of Fort Wayne, has bought the Leavenworth (Kan.) telephone plant. It has 700 subscribers and two toll lines twenty-six miles long. Mr. Beers will at once modernize the plant at a cost of $150,000.

DILLON, MONT.—The Bell Telephone Company has a large force of men at work on the various improvements the company has undertaken at Dillon. New forty-foot poles are to be placed all over the town, and 2,500 feet of cable are to be laid.

WICHITA, KAN.—A force of men is at work installing the switchboard and battery plant at the new building to be occupied by the Missouri & Kansas Telephone Company. It will require about two months' time to complete the installing of the board.

WARREN, OHIO—The Phalanx & Leavittsburg Telephone Company has extended its lines to Baptist Hill, in Southington Township, an extension of six miles, and thereby secures thirty-one new subscribers, who are reached by the Warren, Niles and Phalanx exchanges.

ANADARKO, OKLA.—The business men of Apache, eighteen miles southwest of Anadarko, and farmers living between the two towns, have organized a stock company to build a telephone line between Apache and Anadarko. The stock has all been taken and work will begin shortly.

SALEM, OHIO—The Salem Township Rural Telephone Company, which was organized some time ago for the purpose of giving the farmers residing south of Leetonia telephone service, has its lines completed. The company has made arrangements with the Columbiana County lines for interchange of service.

SALT LAKE CITY, UTAH—The Rocky Mountain Bell Telephone Company is preparing to spend more than $200,000 in enlarging its exchange in Salt Lake and building and equipping exchanges in Utah and Idaho. Early in the spring it expects to add two stories to its headquarters and will build a three-story addition, fifty by fifty feet, to the same.

CANASTOTA, N. Y.—The Central New York and Farmers' Telephone companies have entered into an agreement for a period of two years whereby the lines of the two companies are to be connected and both operated from the Bell company's central office. The Bell company furnishes the telephones of the Farmers' company with receivers and transmitters for which a rental of $1 per year is to be paid.

SHAMOKIN, PA.—The Mahantongo & Mandata Telephone Company, recently organized, has been consolidated with the Pennsylvania Telephone Company and will soon be in operation. Connection with the Mahanoy lines will be of great convenience to the Bell subscribers at Shamokin. They will be able to reach Gratz, Berrysburg, Pitman, Herndon, Fishers' Ferry, Dalmatia, Georgetown, Leck Hill and other towns in that vicinity.

NEW ALBANY, KY.—Farmers and business men of Harrison and Washington counties have organized the Fredericksburg & Ramsey Telephone Company and will build a line between the two towns. The line will have connection at both Ramsey and Fredericksburg with the large telephone systems running into New Albany. Officers have been elected as follows: F. L. Craydon, president; Edward McKinster, secretary; G. R. Durnill, treasurer.

COUNCIL BLUFFS, IOWA—The Nebraska Telephone Company has announced the completion of its new line to Yorkshire, Portsmouth and Panama, which towns are now in telephonic communication with the Council Bluffs central office. Persia will soon be added to this list, giving the Nebraska company four new towns on its long-distance lines in the Council Bluffs territory. Toll stations have already been established at Yorkshire, Portsmouth and Panama.

CUMBERLAND, MD.—The Maryland Telephone Company has completed the work of stringing long-distance wires near Cumberland, and now has connection with the long-distance line through Pennsylvania. The Maryland company's wires pass through eastern Cumberland and connect with the Pittsburg & Johnstown Company's wires at the state line. The Western Maryland Telephone Company, of Cumberland, expects to have connection with the Maryland company in a few weeks, thus assuring independent long-distance service to Baltimore and Philadelphia.

HONESDALE, PA.—The Northeastern Pennsylvania Telephone Company has entered into an agreement with the York State Telephone Company, of Binghamton, N. Y., whereby the stockholders and subscribers of the Northeastern will be enabled to talk to Binghamton and Lestershire for ten cents. A through metallic copper circuit is to be run from Forest City to Great Bend. The Northeastern has also contracted with the Lester Telephone Company for connections at the state line between Great Bend and Lester, N. Y. All of the subscribers of the Northeastern system will have free use of the wires of the Lester Telephone Company.

MINNEAPOLIS, MINN.—A syndicate of Minneapolis capitalists, headed by S. S. Thorpe, has purchased the Mississippi Valley Telephone Company's Iowa properties and will proceed at once to put the several plants in first-class shape by the expenditure of a large sum of money. Five large exchanges, covering the cities of Muscatine, Burlington, Keokuk, Madison and Wappelo, were taken over recently, the purchase price being about $400,000. The exchanges were formerly the property of J. C. Hubbinger, who installed the Mississippi Valley company, which was later reorganized under the name of the Twin City Telephone Company.

BUXTON, N. D.—At the annual meeting of the Red River Valley Telephone Company the following officers were elected: president, T. J. Smith; vice-president, P. M. Paulson; secretary, treasurer and general manager, F. H. Hagen. Directors: T. J. Smith, S. K. Knudtson, O. J. Sorley, Theo. E. Ostlund, C. G. Thoreson, D. M. Paulson, S. H. Hagen, Lewis Thompson, Walter Christen. The company declared a dividend of twelve per cent. It has a paid-up capital of $65,000. There are 1,050 telephones in use among farmers and business men in Grand Forks, Trail, Steele and Nelson counties, North Dakota, and Polk County, Minnesota.

Digitized by Google

ELECTRIC LIGHTING.

YAZOO CITY, MISS.—The new electric light plant has been placed in operation.

MONTROSE, MISS.—An electric light plant has been installed and is now in operation.

CONNELLSVILLE, PA.—Steps are being taken here toward the formation of an independent electric lighting company.

MARTIN'S FERRY, VA.—The board of public service has closed a contract for a new engine for the electric light plant.

MACKINAW, ILL.—The funds have been subscribed for the new electric light plant at Mackinaw, the capital necessary being $10,000.

DUNDEE, N. Y.—At the coming village election to be held in Dundee a proposition for a combined system of waterworks and electric lights will be submitted to the voters.

TROY, N. Y.—The contract for lighting the state armory at Glens Falls has been awarded to the Hudson River Electric Company at the rate of 2.7 cents per kilowatt-hour.

MENOMONEE FALLS, WIS.—The Wisconsin Sugar Company is now lighting the city streets with fifteen arc lights of 2,000 candle-power. The city pays $72 per light per annum.

DENVER, COL.—The Denver Gas and Electric Company has arranged to extend its lines to Englewood. The company also contemplates the construction of a line that will reach Littleton.

ROANOKE, VA.—At a special election the citizens of Martinsville, Va., voted a bond issue of $60,000 for an electric light plant. It is expected that the plant will be in operation within sixty days.

JACKSONVILLE, TEX.—F. K. Nance has purchased the plant of the Jacksonville Electric Company for $5,500 and will expend $5,000 in improvements, changing the system from direct to alternating current.

LOCKPORT, N. Y.—The American District Steam Company, of Lockport, has made application to the common council for a franchise to use the streets for transmitting electricity for light, heat and power purposes.

LINCOLN, NEB.—G. L. Shumway, of Scotts Bluffs, has organized the Pathfinder Electric and Water Power Company. It is proposed to develop about 400 horse-power from the North Platte river. The plant will cost $85,000.

DEADWOOD, S. D.—The Black Hills Electric Light Company has been granted a new franchise by the city council. The minimum monthly rate has been reduced from $2.50 to $1.60, and the city reserves the right to buy the plant at any time.

COOKEVILLE, TENN.—The election in Cookeville upon the proposition to issue $25,000 worth of municipal bonds for the purpose of erecting electric light and waterworks plants and for street improvement recently resulted in a victory for the bond issue.

ST. ALBANS, VT.—The electric power from Fairfax falls, eight miles distant, is now in use. In the construction of this plant about $125,000 has been expended by the Vermont Power and Manufacturing Company. The stock is owned principally in Philadelphia, Pa., and Pittsfield, Mass.

YOUNGSTOWN, OHIO—At a meeting of the special committee of the city council it was decided to recommend the issue of $100,000 of bonds for the purpose of building a municipal electric lighting plant. According to the estimate of P. P. Evans, of Cleveland, the city will save $29,000 a year by owning its own plant.

SHENANDOAH, PA.—The borough council has approved of the contract awarding the privilege of street lighting to the People's Light, Heat and Power Company, of Mahanoy City and Shenandoah, at $63.50 per lamp of 2,000 candle-power. The contract became operative January 1, 1905, to continue for three years.

NEWARK, N. J.—The common council of East Newark has agreed to accept a contract submitted by the Public Service Corporation to supply light to the borough at the rate of $100 a year for each lamp. The contract is to run for five years, beginning July, 1904. The company also agreed to a rebate of seven dollars on each lamp from July, 1903, to July, 1904.

PALMYRA, N. Y.—The trustees of Palmyra have ordered a special election to decide the question of the purchase by the village of the electric light plant at a cost not to exceed $12,000, and a further appropriation for improvement of the same.

CRAWFORD, GA.—At a meeting of the citizens of that place it was decided to light the town by electric lights. Plans and prices were submitted and a contract closed for the installation of arc lights at an early date.

WALLA WALLA, WASH.—A deed has been filed at Pendleton, Ore., conveying all the real property, including power plants, electrical lines and twenty-four deeds of right of way, of the Washington & Oregon Power Company to the Northwestern Gas and Electric Company.

GRAND RAPIDS, MICH.—Charles A. Floyd and B. Van Raalte, Jr., of Holland, who have secured a franchise to establish an electric light and gas plant at Saugatuck, have executed a contract with that village to furnish street lights for $600 per year. The company will be incorporated under the name Saugatuck Light and Power Company.

JERSEY CITY, N. J.—The North Jersey Light, Heat and Power Company held its organization meeting recently in Jersey City and elected Thomas J. Maloney, president; M. T. Connolly, vice-president; Christopher P. Smith, secretary and treasurer, and the following board of directors: T. J. Maloney, M. T. Connolly, C. P. Smith, William J. Dynan and Charles Wagner.

EL PASO, TEX.—A deed has been executed by the El Paso Gas, Electric Light and Power Company, through Z. T. White, conveying to the El Paso Gas and Electric Company all of the property of whatsoever description belonging to the former in this city. The grantee is the new company that was recently organized, and which obtained a franchise for forty years from the city council.

ENGLAND, ARK.—A committee consisting of T. J. Hudson, J. L. Jeffries and J. L. Hagler has been appointed by the England city council to superintend the construction of an electric light plant. G. W. Morris has donated the use of the boilers in his gin for five years to furnish power for the plant. The city will erect a building and install a complete plant, with the exception of boilers.

NEW BRUNSWICK, N. J.—Stockholders of the New Brunswick Heat and Power Company have accepted the offer of the Public Service Corporation to lease the plant for 900 years, with the understanding that the Public Service Corporation shall pay a rental equal to a dividend of two per cent for the first two years, 1905 and 1906; two and one-half per cent for the next two years, three and one-half per cent for the next two years, four per cent for the next year and five per cent for the next and each succeeding year.

ROCK ISLAND, ILL.—The directors of the People's Power Company have elected the following officers: president, H. A. Ainsworth, Moline; vice-president, Phil Mitchell, Rock Island; treasurer, C. H. Deere, Moline; secretary and general manager, S. S. Davis, Rock Island. This list represents a reelection of all the old officers, with the exception of Mr. Ainsworth, who succeeds the late Mr. C. O. Nason as president. The directors awarded contracts for a 2,500-horse-power engine, with electric generator, boilers, pump, etc.

SPOKANE, WASH.—Contracts for the electric and hydraulic machinery in the new plant to be built by the Washington Water Power Company at Post Falls, Ida., have been let. The electrical work is to be done by the General Electric Company, of Schenectady, N. Y., while the contract for the hydraulic work was let to the Flat Iron Works, of Dayton, Ohio. Work has already been started on the buildings, but the main work will not be commenced till about February. It is thought that everything will be in running order by September, 1905. The cost of the total machinery, warehouses and mills is placed at about $500,000. The immediate installation will be about 9,000 horse-power, with a capacity in the near future of 18,000 horse-power.

Digitized by Google

NEW INCORPORATIONS.

SALEM, IND.—Blue River Telephone Company. $1,200.

LIBERTY, IND.—Liberty Telephone Company. $20,000.

VAN WERT, OHIO—Farm City Telephone Company. $20,000.

OKEMOS, MICH.—Mason & Okemos Telephone Company. $2,000.

GUTHRIE, O. T.—Grand Valley Cooperative Telephone Company. $2,600.

INDIANAPOLIS, IND.—Uniondale Telephone Company. Increased from $1,300 to $13,000.

HOUSTON, TEX.—Houston-Galveston Interurban Railway Company. Increased from $250,000 to $500,000.

CHESTERHILL, OHIO—The Chesterhill-Elliott Telephone Company. $3,000. Incorporators: H. Hart and others.

ST. PAUL, MINN.—St. Cloud Public Service Company. $300,000. Incorporators: E. E. Clark, Robert L. Gale and George W. Stewart.

ST. LOUIS, MO.—Southwestern Electric Company. $1,500. Incorporators; Dudley J. Pine, James C. Knight and David B. Stinson.

COLUMBIA CITY, IND.—Huntington, Columbia City & Northern Railway Company. $25,000. A. H. Weist, Jr., is general manager.

AMBOY, IND.—Amboy Telephone Company. $20,000. Incorporators: N. W. King, William Myers, B. F. Miller, Noah Schrock and A. D. Hensler.

KENOSHA, WIS.—The Park City Electric Railway Company. $25,000. Incorporators: John M. Kehlor, Levi C. Graves and Chester D. Barnes.

FREDERICTON, N. B.—St. John Auer Light Company, Limited. $10,000. Incorporators: John Hayward, R. K. Jones, G. S. Fisher, F. C. Jones and others.

RIVERSIDE, CAL.—Indio Light, Water and Ice Company. $30,000. Directors: W. F. Everett, H. Kuhl, H. E. Tallent, Marshall Lewis and J. S. Hunter.

NASHVILLE, TENN.—Boardman Electric Company. $3,000. Incorporators: F. E. Boardman, H. B. Hart, G. B. Thornton, Jr., R. M. Ellett and W. J. Jones.

WILLIS POINT, TEX.—The Farmers' Telephone Company. $10,000. Incorporators: I. F. Callee, John E. Owens, of Willis Point, and A. M. Herrin, of Stone Point.

CHARLESTON, W. VA.—Ohio Valley Electric Company. $50,000. Incorporators: W. H. Snyder, Charles Schad, Robert Newton, Michael F. Dugan, of Benwood, and S. E. Dorsey, of McMechen.

CHICAGO, ILL.—Chicago & Southwestern Traction Company. $400,000. Incorporators: William P. Kopf, Charles A. Newton, Albert J. Claussen, Frederick W. Hill and Horace W. Nichols, Jr., all of Chicago.

LINCOLN, NEB.—The Nelson Light, Power and Heating Company. $50,000. Incorporators: R. L. Smith, J. C. Smith, Harold G. Smith, C. E. Hobbs, William A. Voight, George Yyon, Jr., and F. E. Zettenfield.

NEBRASKA CITY, NEB.—Palmyra Telephone Company; to connect with the independent lines of Nebraska City and Lincoln. $4,000. Incorporators: L. E. Jones, A. R. Maiben, W. H. Epley, T. L. Stewart and O. M. Merwin, all of Palmyra.

PEORIA, ILL.—Springfield, Sweetwater & Peoria Electric Railway. $2,500. Incorporators: Thomas H. Alkire, John W. Terhune, James E. Culver and Augustus K. Jones, all of Sweetwater, and George W. Hatch, of Greenview.

ALBANY, N. Y.—The Manhattan & Bronx Electric Company; to furnish the boroughs of New York city with light, heat and power. $10,000. Directors: Willis B. Richards, New Rochelle, and John S. Clark and James C. Stafford, Brooklyn.

INDIANAPOLIS, IND.—The Lebanon-Thornton Traction Company; to build a road connecting Thornton and Lebanon. $150,000. Directors: Howard M. Atkinson, of Indianapolis; Robert P. Woods, of Indianapolis; F. M. Read, of Indianapolis, and others.

ST. PAUL, MINN.—The Cambridge Telephone Company of Isanti County; $50,000; incorporators: Godfrey G. Goodwin, A. C. Bowe, G. K. Carlson and R. B. Hixon. Nicollet County Telephone and Telegraph Company; increased from $50,000 to $100,000.

WHITE PLAINS, N. Y.—Northern Westchester Lighting and Power Company; to furnish light to the towns of Cortlandt, New Castle, Ossining and Mount Vernon, and the villages of Croton, Pleasantville, Briar Cliff, Mamaroneck, Scarborough, North Tarrytown and Tarrytown. $5,000. Directors: Ralph S. Hull, of Brooklyn; John Larkin, of Flushing, and Alexander S. Andrews, of New York city.

LEGAL NOTES.

SUITS FOR INFRINGEMENT OF INCANDESCENT LAMP PATENTS—Suits have been filed entitled "The Edison Electric Light Company *versus* the Tri-City Electric Company," and "The General Electric Company *versus* the Tri-City Electric Company," for infringement, respectively, of patents No. 444,530 and No. 532,760. These patents were issued to Edison and Branin in the order named. The defendant is engaged in business at Davenport, Iowa, and is sued for dealing in lamps infringing these patents. The suits were commenced on December 19, 1904.

LIABILITY OF A PASSENGER RIDING ON A RUNNING-BOARD—Chief Justice Gummere, of the New Jersey Supreme Court circuit, has rendered a decision to the effect that a trolley company is not liable for injuries received by a passenger riding on the running-board of an open car. Suit was brought against the North Jersey Street Railway Company by a resident of Vailsburg for injuries received last summer when he was thrown from the running-board of a car. The justice says: "I can see no liability on the part of the company. If a passenger elects to ride on the running-board of a car or in violation of any of the regulations of the company, he assumes all the risks and dangers that such a course would involve."

RIGHT OF INTERURBAN ROAD TO MAINTAIN HIGH SPEED—An opinion handed down by Judge Ryan in the case of William Farrance against the Auburn & Syracuse Electric Railroad Company states that interurban electric roads are governed by the rules of steam lines, rather than those of city trolley systems. Farrance was injured at a crossing five miles from the city of Syracuse, N. Y., and brought suit against the railroad, claiming that the cars should stop or slow down at crossings. The attorneys for the defendant held that regulating interurban systems by the same rules that hold good on city systems would work hardship and would soon destroy their usefulness, as they are in direct competition with the steam roads. The judge concurred in this opinion.

DECISION IN FAVOR OF THE NEW YORK TELEPHONE COMPANY—In the suit of the people of the state of New York, *ex rel* James B. Weston, relator, against the New York Telephone Company, respondent, in the New York Supreme Court for New York County, Mr. Justice MacLean handed down, on December 28, a decision denying the application of the relator and upholding the action of the New York Telephone Company. The application by Weston was for a peremptory writ of mandamus requiring the telephone company to place and establish a telephone station at the relator's premises. In the opinion the justice holds "that the premises sought to be equipped for telephone communication have come and are under the constabulary classification of 'suspicious' because of construction rendering access difficult to the unadmitted because of being fitted up as a poolroom, and because the police have found there persons engaged in conducting the business, illicit, but still a business, of pool selling."

Digitized by Google

PERSONAL MENTION.

MR. RUSSELL ROBB has become a partner in the firm of Messrs. Stone & Webster, Boston, Mass., associated with Mr. Charles A. Stone and Mr. Edwin S. Webster.

MR. EDWARD E. BAKER, expert electrician in the office of the building inspector, Baltimore, Md., has resigned. Mr. Baker leaves Baltimore to accept a position in York Haven, Pa.

MR. CHARLES BERRY, formerly of the Union Traction Company, has been appointed superintendent of the city electric light station at Anderson, Ind., superseding Mr. Addington, who retired on January 1.

MR. O. E. TURNER has succeeded Mr. H. L. Monroe as manager of the Dallas, Tex., office of the General Electric Company. Mr. Turner was formerly in charge of the Oklahoma City office of the same company, and is succeeded there by Mr. A. N. Fieneman.

MR. O. W. RUGGLES, general passenger and ticket agent of the Michigan Central (the Niagara Falls Route), is delivering the season's message as follows: "Cordially, the season's greetings. May the new year bring happiness and prosperity to you and yours."

MR. W. A. PIXLEY has been appointed auditor of the Nebraska Telephone Company. Mr. Pixley has been with the company fourteen years, and has worked his way up from a clerical position to that of the third highest office of the company. His headquarters will be at Omaha, Neb.

MR. H. L. MONROE, manager of the Dallas, Tex., office of the General Electric Company, has been promoted to the position of western manager of the railway department of the company, with headquarters in Chicago. He was in charge of the Dallas office for ten years, and assumed his new position on January 1.

MR. ELMER M. WHITE has been appointed secretary of the Street Railway Accountants' Association of America. This appointment has been made by the executive committee in accordance with the resolution of the eighth annual convention. Mr. White is cashier of the Hartford Street Railway Company, Hartford, Ct.

MR. JOHN W. LIEB, JR., vice-president of the New York Edison company, and president of the American Institute of Electrical Engineers, has been presented with an order by the King of Italy. The jewel is in the shape of a Maltese cross, ornamented with white enamel; on one side is a representation of the crown of the kingdom and on the other the royal coat of arms.

MR. W. S. MONTGOMERY, who was for many years sales manager for the Conover Condenser Company, and for the past year New York manager for the Payne Engine Company, has severed his connection with the latter concern and formed a partnership with G. M. Rogers under the firm name of Rogers & Montgomery, and with offices at 147 West Twenty-third street, New York city. The new firm will deal in a general line of small labor-saving tools and hardware specialties, and are the exclusive United States sales agents for the new line of patented hand and press punches lately brought out by the Gem Tool Works, of Brooklyn.

MR. E. S. LEA, who is widely known as an authority on the subjects of turbines and centrifugal pumps, has resigned his position as sales manager for the De Laval Steam Turbine Company, and has opened an office at 42 Broadway, New York, as consulting engineer. Mr. Lea, prior to his four years' connection with the De Laval company, had a wide experience in the designing and construction of power plants and waterworks and in the manufacture of general machinery. The recent development in the uses of the steam turbine and the centrifugal pump seem to assure a large measure of success to Mr. Lea, who is among the first to enter this important field as an independent consulting expert. Mr. Lea is a member of the American Society of Mechanical Engineers and an associate member of the American Institute of Electrical Engineers and of the American Society of Naval Engineers.

OBITUARY NOTICE.

MR. WILLIAM HENRY BALDWIN, JR., president of the Long Island Railroad, died at his residence, Locust Valley, L. I., on Tuesday, January 3. Mr. Baldwin was born in Boston, February 8, 1863. Representing the most aggressive and enterprising type of railroad men, he has been more uniformly successful in upbuilding the interests with which he has been associated than probably any other man. Besides his activity in railroad administration he was a practical philanthropist and a benefactor of many worthy charities. The inauguration of many improvements in the service of the Long Island Railroad was due to his energy and wisdom, and he had entered heartily into the work of electrification but recently outlined.

ELECTRICAL SECURITIES.

Last week the stock market made further recovery. During the preceding week there had been considerable fluctuation, with a decline here and there. For the first half of last week, however, there was a decided rally, with two days' sessions clearly over the million-share mark. At the end of the week there were several declines, probably in anticipation of a strong bear attack. So far as the industrial and financial outlook is concerned there has developed nothing to indicate a change in the prospect of further expansion and prosperity. While there is some disappointment over the failure of negotiations at Fall River, and the determination of the operators to maintain the strike, this has become so small a matter in considering the whole situation that it will have but little effect upon the course of events in general. Last week's dividend increases, particularly that of the Pennsylvania Railroad Company, are being accepted as an indication of what may be expected in other industrials. The high price of copper, which at this time of the year has reached fifteen and one-quarter, gives a notable strengthening to this feature of market values, and this is all the more significant because of the heavy pressure which has been brought to bear upon the most prominent of the copper stocks. The recent slight reaction has brought values more nearly to a normal value, and even though there should be a further bearing down, it is unlikely that much liquidation will take place. The comparative ease of the money market also lends the hope that there will be ample funds for the carrying out of the purposes of those who maintain that at this time of the year a higher-priced security market in general is necessary.

ELECTRICAL SECURITIES FOR THE WEEK ENDING DECEMBER 31.

New York:	*Closing.*
Brooklyn Rapid Transit	61¼
Consolidated Gas	198
General Electric	187
Interborough Rapid Transit	163½
Kings County Electric	194
Manhattan Elevated	165
Metropolitan Street Railway	120½
New York & New Jersey Telephone	166
Westinghouse Manufacturing Company	194

The New York & New Jersey Telephone Company has declared a regular quarterly dividend of 1½ per cent and an extra dividend of 1 per cent, payable January 16.

Boston:	*Closing.*
American Telephone and Telegraph	146¼
Edison Electric Illuminating	255
Massachusetts Electric	59
New England Telephone	138
Western Telephone and Telegraph preferred	99

The statement of instrument output of the American Telephone and Telegraph Company for the eleven months ending November 30, 1904, is the best ever issued for a similar period. The net output amounted to 628,660 instruments, nearly equaling the output for the entire twelve months of 1903, and exceeding that of any previous year.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	79
Electric Storage Battery preferred	79
Philadelphia Electric	10⅜
Philadelphia Rapid Transit	17½
United Gas Improvement	105½

Chicago:	*Closing.*
Chicago Telephone	145
Chicago Edison Light	170
Metropolitan Elevated preferred	62½
National Carbon common	43½
National Carbon preferred	110
Union Traction common	8
Union Traction preferred	38

Digitized by Google

ELECTRIC RAILWAYS.

MARION, IND.—Capitalists of Van Buren have asked for a right of way for a traction line between Van Buren and Warren.

HENDERSONVILLE, N. C.—An electric railway will be built from Hendersonville to Laurel Park. W. A. Smith is the chief promoter.

JACKSON, MISS.—The mayor and board of aldermen of Yazoo City have instructed their clerk to advertise for bids for installing an electric railway system.

GLENS FALLS, N. Y.—The village trustees have granted to the Hudson Valley Railway a franchise to build and operate a freight line in Glens Falls.

MUSCATINE, IOWA—George M. Snyder, of Noblesville, Ind., and others are interested in a projected electric railway from Muscatine to Cedar Rapids, Waterloo and Waverly.

ROCKLAND, MASS.—The request for a franchise in Kingston for the proposed electric road to go from Rockland, through Hanover, Pembroke, Marshfield and Duxbury, has been granted.

SACRAMENTO, CAL.—The Santa Fe Railroad Company has filed articles of incorporation for a new electric line to run from Richmond, Contra Costa County, to Santa Fe, four and one-half miles.

HOBOKEN, N. J.—By a vote of six to three the Harrison town council passed an ordinance granting to the North Jersey Street Railway Company a perpetual franchise to build a trolley line on Fourth street.

YORK, PA.—With a view of extending the York trolley system W. H. Lanius, president of the York County Traction Company, has purchased a controlling interest in the Littlestown Turnpike Company.

SPRINGFIELD, MASS.—The petition of the Springfield and Holyoke street railway companies to act as common carriers of baggage and freight in the city of Chicopee has been approved by the board of aldermen.

STREATOR, ILL.—The principal public utilities of Streator, consisting of the Streator gas light plant, the electric railway and electric light plant, have passed into the possession of a Chicago syndicate headed by W. J. Ferris.

ABILENE, TEX.—The city council has granted Fred Cockrell and several associates a franchise for fifty years to build and operate an electric street car line in all the streets of Abilene. Work will begin within ninety days.

ST. LOUIS, MO.—It is expected that the line of the Alton, Granite City & St. Louis Electric Railway will be opened from Alton to St. Louis within sixty days. The first division, from Alton to Glasboro, is now in operation.

DENVER, COL.—The Denver Tramway Company is forwarding a project for the immediate construction of an extension of its electric line from Leyden junction to Boulder, to make connections with the Colorado & Northwestern.

MUNCIE, IND.—A franchise for fifty years has been granted by the Delaware county commissioners to E. P. Ice, promoter of the Muncie & New Castle traction line, which gives the company the use of the public highways in the county.

INDIANAPOLIS, IND.—At a meeting of capitalists and electric railway men, held for the purpose of organizing a company to construct an electric railway from Terre Haute to Vincennes, it was determined to capitalize for not less than $1,500,000.

PAOLI, IND.—A survey is to be made for an electric road from Bedford to French Lick Springs. The proposed road will be by way of Mitchell, Orleans, Paoli and West Baden Springs, and will cover a distance of thirty miles, running parallel with the Monon.

NEW CASTLE, PA.—The mayor has signed the bill granting a perpetual franchise to the Pennsylvania & Mahoning Valley Street Electric Railway Company to run its interurban cars from Youngstown, and those of the New Castle & Sharon electric line, into New Castle.

LITCHFIELD, ILL.—The city council has granted the St. Louis & Springfield Traction Company a franchise to build and maintain an electric railway on certain streets of Litchfield. A deposit of $5,000 was made to ensure its being built. The company will build a line between Staunton and Litchfield, and Hillsboro and Litchfield.

PITTSBURG, PA.—Announcement was made recently by the directors of the Port Vue Bridge Company, at McKeesport, that they expected to have McKeesport and Port Vue connected by a new street car line within a short time. At present there is no line nearer Port Vue than the Pittsburg, McKeesport & Connellsville line.

SYRACUSE, N. Y.—A franchise has been granted to the East Side Traction Company by the trustees of the village of East Syracuse. The company, which is a part of the rapid transit system, asked for the right to build and operate a trolley line from the present terminus of the East Syracuse line to the village of East Syracuse.

SEDALIA, MO.—A franchise has been given the Sedalia & Warrensburg Interurban Electric Railroad through Sedalia. The road will be thirty miles in length and is to be operated between Sedalia and Warrensburg. W. E. Winner, of Kansas City, is among the incorporators. The line must be finished and operated within two years. A right of way has been secured.

FAIRMONT, W. VA.—A charter has been issued to the Grafton Construction Company, with a capital stock of $25,000, to do a general contracting business. The incorporators are W. E. Harton, G. W. Powell, Thomas F. Jobe, T. E. Bradshaw and W. E. Hildebrand, all of Pittsburg. The company will build a street car line in Grafton at an early date, and a survey has been made for a bridge over Tygart's Valley river.

COLUMBUS, OHIO—The Toledo, Columbus & Cincinnati Electric Railway has been financed by W. H. Luchtenberg, of Columbus, E. C. Schiness, of Toledo, and others. From Columbus to Bellefontaine it will follow the roadbed of the Toledo & Ohio Central Railroad, and from Bellefontaine to Lima it will go *via* the Lewiston reservoir. From Lima to Toledo the road will follow the Cincinnati, Hamilton & Dayton Railroad.

LEWISTON, ME.—An arrangement has just been effected between the Lewiston, Brunswick & Bath Street Railway and Libbey & Dingley, proprietors of the power at Deer Rips, by which the road from Lisbon Falls and projected connections may be run by electric power from Deer Rips. The project is to build at an early day the road from Lewiston to Mechanic Falls. The road to Turner will probably be running by midsummer of this year.

GENEVA, IND.—The Geneva Traction Company, at a recent meeting, named William Heeter manager, and H. H. Hosford assistant manager. This company is preparing to begin active work on its line from Celina, Ohio, to Marion early in the spring. The right of way is about all obtained, and little but actual work remains to be done. The company will make Geneva the central point, and also establish a city electric light plant.

LA GRANDE, ORE.—A franchise has been granted the Eastern Oregon Development Company for rights of way into all the principal towns in Union County, including Union, Cove, Summerville, Island City, Elgin and La Grande, for an electric belt railway throughout the Grand Ronde valley. The company says it will have the road built through from La Grande to Cove by early in September, 1905, and that the entire route will be completed within two years.

KENOSHA, WIS.—Steps have been taken for the incorporation of a company which will be in charge of the building of the proposed electric railway between Kenosha and lake Geneva. The company is backed by Kenosha capitalists, and will have a nominal capital of $25,000. The charter will give the company the right to do a general railway business, both freight and passenger, in all the counties in Wisconsin. The central office of the company will be located at Kenosha.

GLENDIVE, MONT.—A petition asking that a franchise be granted to the Glendive & Lower Valley Rapid Transit Company for the construction of an electric railroad from Glendive to Buford, N. D., a distance of eighty miles, has been presented to the board of county commissioners. The company will be capitalized at $1,000,000. The following names were signed to the petition:

Digitized by Google

E. S. Baer, J. R. Widmyer and H. J. Haskell, of Glendive, and B. S. Adams and John O'Brien, of Newlon.

INDIANAPOLIS, IND.—The Huntington, Columbia City & Northwestern Railway Company has been incorporated with a capital stock of $25,000. The line will run between Huntington, Columbia City, Syracuse, North Webster, Vawter's Park, Goshen, South Bend and Lagrange. The general offices will be at Huntington, and the articles of the company provide that it may furnish light, heat and power in the cities through which it passes. The incorporators are Huntington and Columbia City men.

INDIANAPOLIS, IND.—The county commissioners have granted the Indianapolis & Cincinnati Traction Company a nine months' extension of time in which to complete its line to Indianapolis from the southeastern county limits. The original charter and franchise secured by the company provided for the completion of at least one line of trackage by January 1, 1905, and a bond of $1,000 to secure compliance with the franchise requirements was furnished. Representatives of the company offered evidence to show the physical impossibility of the road's completion by the time specified.

IOWA FALLS, IOWA—The stockholders of the Des Moines, Iowa Falls & Northern Railway have directed an extension of the road north in the spring. The board of directors will select the route, the objective points being Charles City and Mason City *via* Hampton. The following members of the directory board have been elected: E. S. Ellsworth, William Welden, J. H. Funk, W. H. Woods and W. V. Shipley, of Iowa Falls, and G. A. W. Dodge and George A. Fernald, of Boston. The officers elected are: president, E. S. Ellsworth; vice-president, William Welden; secretary, J. H. Funk; treasurer, W. H. Woods.

NEWARK, N. J.—All but $5,000 of the $114,000 outstanding bonds of the Orange County Gas and Electric Company, of Middletown, N. Y., which corporation was bought by Philip N. Jackson, of Newark, under foreclosure proceedings in November last, have been deposited with the Fidelity Trust Company, together with the sum of $100 in cash for each $500 in bonds, the cash payment being made for a new issue of $100 capital stock of the new Orange Lighting Company, at the rate of eighty cents on the dollar. Bonds of a similar amount as those deposited bearing five per cent will be issued.

TUSCUMBIA, ALA.—A certificate of incorporation of the Sheffield Company has been filed in the office of the probate judge of Colbert County. The incorporators are George Parsons, Henry Parsons and J. W. Worthington. The capital stock of the company is given at $1,000,000. The company was originally organized under the laws of New Jersey, and the new incorporation is in compliance with the Alabama laws. The corporation built the interurban electric car line between Sheffield, Florence and Tuscumbia, and established an electric light plant and constructed waterworks in the three towns.

WHEELING, W. VA.—The City Railway Company will extend its traction line to Martin's Ferry and Bellaire. Martin's Ferry will be reached over the Terminal bridge, Bellaire over a bridge to be constructed for that purpose. The stockholders of the company, at a recent meeting, voted to increase the capital stock from $400,000 to $1,000,000, and to issue bonds to the amount of $500,000. The increase in the capital stock, and the money derived from the sale of bonds, are for the extensions referred to, and the actual work is to commence at an early date. The extensions constitute a link in the chain of traction lines connecting Wheeling with cities east and west.

NAUGATUCK, CT.—It is announced that work on the construction of the street railway which the Naugatuck Valley Electric Company purposes to build between Naugatuck and Seymour will be commenced next spring. The route runs through Beacon Falls. At both Naugatuck and Seymour the line will connect with the Connecticut Railway and Lighting Company's system. The Naugatuck Electric Company is closely affiliated with the Railway and Lighting Company. The line will form a connecting link by which Waterbury and Naugatuck will have trolley communication with Ansonia, Bridgeport and New Haven. The preliminary surveys have already been completed.

MARYSVILLE, OHIO—The city council has passed a resolution extending the time of a franchise granted to the Columbus, Marysville & Bellefontaine Electric Railroad from July 1, 1905, to July 1, 1906. Thomas H. Thackara, of Columbus, who secured the right of way through Union County, states that the road has been financed by New York capitalists and will be built next summer. This line, when completed, will connect Toledo with Columbus, running by way of Columbus to Marysville, Bellefontaine, Indian Lake and Lima to Toledo. From Columbus to Bellefontaine the line will practically parallel that of the Toledo & Ohio Central Railroad, and from Lima to Toledo will parallel the Cincinnati, Hamilton & Dayton Railroad.

NEW COMPANIES.

NEW YORK, N. Y.—The Textile Improvement Company has been incorporated with a capital of $50,000 to manufacture automatic belt shippers. The incorporators are F. E. Saunders, J. O. Lauterjung and M. U. Ely, of New York.

LOS ANGELES, CAL.—The Electric Surgical Appliance Company has been incorporated by C. R. Harris, M. Reynolds, E. G. Haynes and W. J. Hayden, of Los Angeles, and Charles Dunlap, of Hollywood. The capital stock is $100,000, fully paid.

BROOKLYN, N. Y.—The Jacques Ochs Company has been incorporated with a capital of $5,000. The company will make arc and incandescent lamps. The directors are Charles Werthein, Brooklyn; Max Holtzer and Jacques Ochs, New York city.

WASHINGTON, D. C.—Articles of incorporation have been filed for the Telegraph and Telephone Auxiliaries Company, with a capital stock of $300,000. The incorporators are Frederick R. Austin, Oswald N. Burke, Frank S. Bright, F. C. Osborn and S. J. Wilson.

GOSHEN, IND.—Articles of incorporation of the Automatic Switchboard and Telephone Manufacturing Company have been filed. The company is capitalized at $10,000, and will buy and sell automatic switchboards, telephones and other electrical apparatus.

SPRINGFIELD, ILL.—The Western Telephone and Telegraph Company, of Chicago, has been incorporated to manufacture telephone and telegraph instruments. The capital stock is $60,000, and the incorporators are R. P. Jack, H. W. Danforth and W. T. Irwin.

NEW PUBLICATION.

TRANSACTIONS OF THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA—The transactions of the eighth annual convention of the Street Railway Accountants' Association of America have been issued. The frontispiece is an excellent photogravure of Mr. F. E. Smith, auditor of the Chicago Union Traction Company, Chicago, Ill., president of the convention. The transactions include a verbatim report of the sessions held on October 13, 14 and 15, 1904, at the World's Fair grounds, St. Louis, Mo. Since its organization the Street Railway Accountants' Association of America has produced a considerable variety of literature, which has been of great value to street railway operatives. The work is carried on with great system, and is presented in such shape as to be of the most assistance to those engaged in the street railway field. The report of the committee on "A Standard System of Electric Railway Accounting," covering the classification of construction and equipment accounts and classification of operating expense accounts, is rendered complete and is a valuable portion of this publication. There is also the report of the committee on "A Standard Form of Report for Electric Railways."

AUTOMOBILE NOTE.

AUTOMOBILE CLUB OF AMERICA—A special meeting of the members of the Automobile Club of America has been called for Tuesday evening, January 10, 1905, at nine o'clock, for the purpose of receiving the report of the governors in regard to the proposed new club-house and garage, and for taking action thereon. The plan suggested for the building of a club-house and garage calls for the expenditure of approximately $420,000. It is proposed to raise among club members $150,000 of this amount by issuing second-mortgage four-per-cent bonds, in denominations of $500 and $1,000 each, the balance being taken care of by money on hand and a first mortgage. The governors have secured the underwriting of more than $100,000 of this second-mortgage bond issue. The meeting will be held at the club headquarters, 753 Fifth avenue, New York city.

Digitized by Google

INDUSTRIAL ITEMS.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, manufacturer of electrical machinery, is distributing a handsome calendar for 1905. This consists of a reproduction in colors of Asti's "Marcelle," mounted on an embossed brown mat.

THE INTERNATIONAL BRASS AND ELECTRIC COMPANY, 76 Beekman street, New York city, is distributing its 1905 catalogue. This catalogue describes and illustrates various forms of small electrical apparatus, including induction coils, automobile coils, vibrator sets, wire connectors, switches, and pole-changers, batteries and binding-posts.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is distributing a series of leaflets for additions to its perpetual catalogue. This includes "Compound" starting and regulating rheostats, "C. & H." self-starters, "Compound" reversible slate-front-type machine tool controllers, enclosed resistances, non-reversible controllers, and indexes and ratings of motors.

THE WIRT ELECTRIC COMPANY, INCORPORATED, Philadelphia, Pa., announces that its New York city office has been moved to 15 Cortlandt street, where it will carry a complete stock of rheostats, dimmers and brushes. There will always be found in attendance a man capable of handling any business in this line, no matter how special it may be. The New York telephone is No. 3504 Cortlandt.

THE KUSEL & KUSEL COMPANY, Monadnock Block, Chicago, Ill., is offering to independent telephone exchanges a new storage battery system which it claims is economical to install and maintain, and does not require a dynamo for charging. This storage battery system is well adapted to the purpose of furnishing current for the operation of switchboard operators' transmitters or for flashlight switchboard trunking. The company furnishes this switchboard battery regularly on its switchboard installations. Full information will be gladly furnished by the company upon request.

THE PEIRCE SPECIALTY COMPANY, Chicago, Ill., chartered under the laws of the state of Illinois, has taken over the electrical construction material business of C. L. Peirce, Jr. This has been the result of the very remarkable growth of the latter's business. The officers of the new company are as follows: C. L. Peirce, Jr., president; H. H. Titsworth, secretary; R. A. Peet, treasurer; C. M. Crapo, general manager. The company has moved into larger quarters at 105-107 South Jefferson street, where it will carry a complete stock for the prompt filling of orders of any magnitude.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., is distributing a reprint of an article by Mr. Fritz Lubberger, giving a technical description of the automatic telephone system manufactured under the Strowger patents. This article is probably one of the most complete that has ever been printed, taking up the history and development of the automatic system. Details are given of the assembly and operation of the various parts, and the illustrations and diagrams are carefully selected so as to render more intelligible the text of the article. This reprint will be sent to any one interested upon request.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has favored some of its patrons with what is probably the most useful pocket diary in existence. This diary, in addition to having all the possibilities of a diary journal, with a cash account section, contains a sectional map of the United States and of the West Indian and Philippine islands. Besides this valuable material, however, there is a large amount of engineering data for mechanical and electrical engineers. The diary contains a complete calendar for 1905 and 1906 and is tastefully and substantially bound in black seal leather.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through the office of Mr. George H. Daniels, general passenger agent, has issued two new books of the *Four-Track* series These are designated as No. 5, "America's Winter Resorts," and No. 9, entitled "Two Days at Niagara Falls." No. 5 contains a mass of information in regard to where to go, what it would cost, and something about what will be found there, accompanied by maps showing the various routes. This is a valuable folder for any contemplating a winter trip, be it short or long. No. 9 is a valuable guide to parties who contemplate a visit to Niagara Falls. A series of trips has been worked up, and the conditions obtaining at Niagara Falls carefully analyzed. Either of these books may be obtained on receipt of a two-cent stamp.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has secured an order from the California Gas and Electric Corporation, of San Francisco, Cal., for two frequency-changing outfits of 5,000 kilowatts capacity each. This amounts virtually to 20,000 kilowatts capacity, divided between four machines operated as two motor-generator sets. The outfits are for use in connection with the contract which the California Gas and Electric Corporation has secured from the San Francisco Street Railway Company. The apparatus will change the sixty-cycle current from the Bay Counties long-distance line to twenty-five cycles for further distribution among the substations of the street railway company. The contract awarded the Stanley company also includes transformers of 12,000 kilowatts.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has opened new sales offices in Philadelphia, Pa., in the Land Title Building. The offices heretofore maintained by the electrical department of the company—the Bullock Electric Manufacturing Company—in the North American Building have been removed also to the Land Title Building, where they have been consolidated with those of the parent company. The new offices are under the charge of Mr. W. A. Wood, who will look after each of the interests of the company. These interests include the power department, electrical department, pumping engine department, hydraulic department, saw-mill machinery department, flour-mill machinery department, and others which produce rock-crushing machinery, cement-making machinery, wood-preserving machines and plants, mine hoists and machinery of all other kinds for mining and recovering gold, silver, copper and other metals.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, Hartford, Ct., has favored some of its friends and customers with a serviceable pocket cigar case as a souvenir of "Femco" incandescent lamps and the holiday season. The company has recently published an elaborate catalogue descriptive of "Femco" lamps. These lamps are regularly supplied in three grades of efficiency: 3.1 watts per candle, 3.5 watts per candle, and 4 watts per candle. In addition to the standard styles of incandescent lamp, the company makes a tubular or candle lamp which takes forty-five to sixty volts for the single-loop filament, and 60 to 130 volts for the oval filament. There are also lamps with spherical bulbs and bulbs of the pineapple pattern. A specialty which this company manufactures is the reflector type of lamp. This lamp is made with both single and double-coil filaments, and produces a remarkable amount of illumination.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, has ready for the trade a new catalogue of Sachs "Noark" fuses and fuse devices, for all voltages. It has been endeavored in this new catalogue to classify the fuses and fittings for the various voltages and types which it manufactures in such a manner as to greatly facilitate the selection of a device to fill the existing requirements. It will be found, upon perusing this new catalogue, that all commercial and technical data pertaining to the articles listed therein can be obtained with very slight effort. Each particular form of fuse or fuse device is shown on a separate chart, on which the catalogue number, code word, standard package, carton quantities and list prices are given, also general information for their use. The chart also shows in red print all the dimensional information descriptive of the charted devices. Particular attention is drawn to the very complete line of "National Electric Code Standard" fuses and fuse devices, which are listed in this catalogue in their proper place according to voltage, type, contact, etc., and also to the fact that they embody in this catalogue a variety of "Noark Standard" fuses, fuse blocks, fuse and service boxes and other fittings. The list prices in this catalogue are subject to discount which will be quoted on application.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 2. NEW YORK, SATURDAY, JANUARY 14, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Lines of Progress in Engineering 43
Electric Lighting During Fogs 44
The Electric Arc 44
The Advantages of Electric Coal-Cutting Machines 45
Electricity in 1904 46
The Electrification of Trunk Lines, by W. Caryl Ely 48
The Growth of Philadelphia Rapid Transit 48
Electrical Transmission of Power 49
Electric Lighting in New England, by C. L. Edgar 49
Recent Improvements in Telegraphy, by J. C. Barclay 50
The Electric Railway Situation, by Dr. Louis Bell 51
Progress in the Electrochemical and Electrometallurgical Industries in 1904, by John B. C. Kershaw 52
Progress in Electric Lighting, by J. H. Hallberg 54
Electrical Theories, by Dr. John Trowbridge 55
Patent Progress During the Year, by E. G. Siggers 56
Review of the Year in Great Britain and the Continent of Europe, by C. L. Durand. 57
The Designing of Fixtures for Modern Lighting, by A. H. Patterson 59
Some Continental Central Stations Operating with Gas Engines, by Franz Koester. 60
Early Cable Work 65
Steam Turbines for Driving Dynamos 65
Electrolytic Preparation of Tin Plate, by F. Gelstharp 66
Utilizing the Magnetic Pull of Dynamos for Adjustment Purposes 66
A Review of the Storage Battery Situation for the Year 1904, by Lamar Lyndon .. 67
The Regulation of State Protection for Central Stations, by Ernest H. Davis 67
Telephony in 1904 68
New York City Telephone Service 69
The Faraday Society 70
The Bradford, England, Breakdown 71
London Tramways 71
A New Tunnel Construction Company in New York City 72
The National Electric Light Association 72
New York Electrical Society's 271th Meeting 72
The Wire Situation in the Dominion of Canada 72
The United Engineering Building 72
Electric Supply in the Gate City, by Alton D. Adams 73
Automobile Shows in New York 77
Texas Telephones 77
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 78
INDUSTRIAL SECTION:
Electric Heating and Cooking Apparatus 80
Marshall Sockets 80
The Warner Arc Lamp 80
A Constant-Potential Inverted Arc Lamp 80
A New Form of "Arc-Burst" 81
The "Reco" Electric Sign Flasher 81
Subway Station Panels 82
Large Flashed Sign at the St. Louis Exposition 82
The Baikal Lake Section of the Siberian Railway 82
The Duncan Direct-Current Wattmeter 83
Direct-Reading Bond Tester 84
The Hancock Valves 85
Flywheel Accidents and Their Prevention 85
The "Pen-Dar" All-Steel Locker 85
A New Single-Phase Integrating Wattmeter 87
The Hartford Time Switch 88
The Blake Insulated Staples 88
A New "Sarco" Specialty 89
The "Interpole" Variable-Speed Motor 90
The Electrical Department of the Allis-Chalmers Company 90
A Double-Speed Telegraph Key 90
CURRENT ELECTRICAL NEWS 91

LINES OF PROGRESS IN ENGINEERING.

At a recent meeting of the American Association for the Advancement of Science Professor C. M. Woodward, president of section D—mechanical science and engineering—addressed the section upon "Lines of Progress in Engineering." He spoke of the necessity of pushing forward in all lines of work, of solving every problem as it comes up, and never retreating.

Taking up in detail some of the lines along which progress should be made, Professor Woodward spoke first of the utilization of waste energy, having particular reference to waterfalls. While at present at every vantage ground the work of utilization has begun, it should not stop here, for we should turn to the smaller streams and mountain torrents. Mountain reservoirs would serve the triple purpose of preventing destructive floods, saving the energy for useful work, and aiding irrigation. While no one can see far into the future, it is thought that the dawn of a new era of energy-saving is in sight.

Mr. Woodward then turned his attention to what he termed the clumsy steam engine. While, as is well known, the efficiency of the steam plant as an energy transformer is low, we can hardly agree with him in terming it clumsy. The great loss here is due to the system, not to the machine. The engine itself is a model of engineering design and construction. The boiler, too, taken as an absorber of heat, is an efficient device. The chief loss is not through the chimney as stated, but through the exhaust pipe, and this loss can not be prevented as long as we adhere to the steam system, which is somewhat roundabout, it is true, but we would hardly call it clumsy.

Professor Woodward anticipates great progress in prime-mover development, both in the construction of gas engines which burn fuel in the cylinder, but do not explode it, or even in the successful production of a gas turbine. In the latter direction a great step forward would be taken if some one would design an engine which would consume continuously oil and compressed air, and thus maintain a high pressure in a suitable reservoir.

Another important opening for future enterprise is thought by Professor Woodward to be the establishment of artificial centres of power, where large and efficient generating stations will be erected, from which power will be distributed for great distances in all directions. Such undertakings would have beneficial effects in more ways than one, for besides decreasing the cost of power and economizing fuel, they would remove from the cities the chief source of smoke and air contamination.

Other directions in which progress may be expected were outlined, but these are of only general interest to the electrical engineer. These include purification of rivers, tubular construction of machines, the increased use of concrete, and

Digitized by Google

aerial navigation. Under the latter head it may be said that advance is anticipated by a process of eliminating the gas bag. Aeronauts will first learn to control their machines by providing some support in the nature of a balloon. As they gain skill in this they will diminish the buoyancy of their gas bag until possibly they will be able to leave it out altogether.

Under the heading of fundamental principles, great stress is laid upon the necessity of thorough drill in these. However complete an engineering course may be, if it does not send its men away with a good grasp of the underlying principles upon which their profession is founded, the course is a failure.

Of the future, Professor Woodward takes a hopeful view. He thinks that there is a glorious and splendid era opening, and that the young engineers with clear heads and skilled hands, who are now coming to the front, are fortunate. Indeed, all who are in any way helping on the higher education, which good engineering makes possible, should be happy.

ELECTRIC LIGHTING DURING FOGS.

One of the advantages claimed for the gas-lighting system is its excellent load-factor. The plant is operated night and day at an average rate, and hence, under the most economical condition. What gas is not used during one part of the day is stored up for use when the demand increases. In fact, a gas-lighting plant has an accumulator system which smooths out all peaks, gives a high load-factor, and holds a fair reserve for unforeseen demands.

On the other hand, the electric lighting plant can store only to a limited extent the electrical energy which it is able to generate at times of light load, for use when the demands increase. While a storage battery may be used to cut off a portion of the peak, as regards the total output of the station its capacity is small; hence, the electric lighting station is under the necessity of having machine generators of sufficient capacity to supply the maximum demand which may come upon it, and it is usual to have, in addition, a certain amount of reserve to provide against accident. This necessity has been something of a drag on electric lighting installations, because of the increased expenditure for expensive machinery which will be run a short time only during the day. The average load on an electric lighting station is only about a quarter of the total available supply.

But it is, indeed, a great disadvantage which does not bring some compensation, some time or somehow. During the recent heavy and long-continued fog in England the demand for street and house lighting was so great that in certain towns the storage of gas was not sufficient to carry the gas companies over this period, and they were forced to reduce the pressure in their mains, thus, of course, decreasing the amount of illumination at the very time it was most needed. With the electric lighting companies the condition was otherwise, for what had formerly been considered as a hardship now stood them in good stead, and they were able to meet all demands, and had it not been for the arc lamps, several cities would have been practically without lighting. It is thought that this experience will result favorably for the electric lighting companies, and that electric lights in streets will be used in England much more than is now done. Even the worst fog benefits some one, for these lighting plants broke all records for daily outputs, for which, of course, they will be well paid.

THE ELECTRIC ARC.

Mr. W. Duddell, who is so widely known from his researches with the oscillograph, has been making a study of the reactions going on in the electric arc, and has come to certain conclusions which differ from those heretofore accepted.

It has been thought that there was a back or counter-electromotive force in the arc of considerable magnitude, which accounted for nearly all the drop of potential across the arc. This, Mr. Duddell finds, is not the case—that is to say, this counter-electromotive force is smaller than has been supposed. With solid carbons it amounts to about twelve volts, but with cored carbons it rises to seventeen volts or thereabouts. These figures depend, to a considerable degree, upon the kind of carbon used. For instance, with a steady arc carrying but ten amperes, the carbons being eleven millimetres in diameter, this counter-electromotive force varies between twelve and eight volts, and rises to fifteen volts if the carbons have been soaked in a solution of potassium carbonate and dried. The conductivity of the vapor column depends largely upon the impurities present. Indeed, it is supposed that if absolutely pure carbon could be obtained, its vapor would have a very high specific resistance.

To explain this counter-electromotive force, Mr. Duddell believes that it is a thermoelectric effect, and takes place at the junction of the carbon and the vapor column. There are two electromotive forces in the arc—one occurring at each contact of the carbons and the vapor column. The one nearer the positive electrode is the greater. This is the true counter-electromotive force, since it acts in opposition to the current. The smaller one is the negative electrode, and acts with the current.

The objection to this explanation is that it calls for a thermoelectric power of the junction which is twenty times as great as that between bismuth and selenium at the same temperature.

It is interesting, in this connection, to note the similarity of this conclusion to the explanation offered by the action of the Jacques cell. In this attempt to produce electrical energy by the direct combustion of carbon, a rod of carbon was immersed in molten sodium hydrate contained in an iron vessel. An electromotive force of 0.9 volt was developed. This was first supposed to be due to a direct reaction between the carbon rod and the air which was forced through the molten salt. Reed showed that this was not the case, and offered the suggestion that the action was thermoelectric. His position was apparently upheld by the fact that the oxygen could be replaced by a neutral gas without affecting the action. This, however, called for a thermoelectric force much greater than anything that had been known before. This explanation was

Digitized by Google

pretty generally accepted until last summer, when Dr. F. Haber, in a paper before the International Electrical Congress, showed that the electromotive force given by the Jacques cell is due to chemical action, but as a method of producing electrical energy, the cell is bad.

May it not be possible that there is some such action going on in the electric arc which sets up these electromotive forces? Not only is there chemical action going on in the arc, but there are violent physical changes taking place, either or both of which might be sufficient to account for these electromotive forces. The evidence, so far as presented, seems hardly sufficient to warrant the assumption of a thermoelectric action.

Mr. Duddell finds that the resistance of the arc may be considered as consisting of several components. There are the resistance of the vapor column and the resistances at the two points of contact between the vapor and the carbons. The first of these—that of the vapor column—depends upon the impurities present in the carbon, and decreases with an increase in these impurities. In addition to these three resistances, which cause a fall of potential, are the two electromotive forces at the contacts between the carbon electrodes and the vapor column, so that there are altogether five factors acting against or with the flow of current. These electromotive forces of contact increase with increasing impurity, so that while impregnated carbon gives off a vapor of high conductivity, and hence operates with a long arc, it also increases these contact electromotive forces, so that a gain in one part of the circuit is partially compensated for by the loss in the other. The contact resistance which is met by the current in passing from carbon to vapor, or vapor to carbon, is high, and it is these resistances, which in the case of the positive carbon act with the contact electromotive forces, and at the negative carbon are opposed by the action of the electromotive force, that cause the high temperature of the arc. It is interesting in connection with Mr. Duddell's results to refer to a paper by Mr. William S. Weedon, presented at the fifth general meeting of the American Electrochemical Society, which dealt with arcs drawn between metallic electrodes.

The existence of these contact electromotive forces of any arc suggests the possibility of utilizing this action to produce electrical energy directly from carbon. If, on the passage of current through the arc, an electromotive force is developed, it would seem that if the proper conditions are obtained, this electromotive force will be produced and will cause a current to flow. It is true that this reaction could not take place without the production of heat, but unless the electromotive force is a true thermoelectromotive force, the efficiency will not depend upon the second law of thermodynamics, and the production of a high temperature need not necessarily mean an inefficient process, since by proper insulation this temperature could be maintained without much radiation. Dr. Haber's paper showed pretty conclusively that the methods adopted by Jacques and others offer but little hope of success, so that it would seem worth while trying other plans. The problem here presented is somewhat similar to that undertaken by Faraday, who, knowing that an electric current would set up a magnetic field, undertook to reverse the process, and, given a magnetic field, sought to produce by means of it an electric current.

THE ADVANTAGES OF ELECTRIC COAL-CUTTING MACHINES.

In the second report of the British royal commission on coal supplies some valuable information respecting the use of coal-cutting machines is given by Mr. G. E. Stringer. This report discusses at some length the use of electricity and pneumatic coal-cutting machines in two of the Yorkshire collieries, comparing their performance with hand-working, and then comparing the electric and the pneumatic machines with one another.

Taking up first the comparison of machine and hand-working, the cost of getting the coal was less with the machine than by hand. The difference in cost per ton varied between five and one-half and fifteen cents, depending upon the kind of coal mined and the depth of the seam. These costs include every kind of labor, even to filling the tubs. Where the coal is harder and the seam thinner the difference in favor of machine-cutting is the greater, because work by hand there is more difficult. These figures, however, do not include interest on capital or cost of repairs.

Another advantage of machine-cutting is the greater percentage of large coal obtained. This varies from eleven to twenty-nine per cent, according to the quality of the coal.

Comparing hand and machine-working in another way, it is stated in the report that the cost of driving headings by means of a machine is from sixty cents to one dollar less per yard than for hand-driving, and, at the same time, the coal taken at headings by the machines has a higher percentage of large coal.

Comparing the pneumatic and electric machines, Mr. Stringer says that the latter is more efficient, since the losses in generating and transmitting electrical energy are less than those when transmitting air. It should be said, however, in this particular comparison, that the electrical machinery is newer and better than the air-compressors, but, whereas the latter machines required 5.76 pounds of coal burned in the station for every superficial foot of work, the electrical system required only 0.81 pound. This difference can not be due entirely to the superior quality of the electrical machinery, but must be credited, in part, to a better system. The conclusion is drawn that there will be a considerable saving in the use of electricity, as compared with compressed air, for coal-cutting, wherever the former can be introduced.

The advantages claimed for coal-cutting machines are: the greater safety for the men, less damage to overhanging seams, the working surfaces are more easily ventilated, and the workings are more easily superintended, while the attack is more regular. The chief difficulties experienced when coal-cutting machinery was introduced arose more from the men than from the machines, due principally to the fact that the system was entirely new to the men. The chief disadvantage is the cost of the installation, repairs and renewals. This is largely offset, however, by the decrease in the cost of working, increased output of the mine, and the ability to work economically seams too thin to be worked by hand.

Digitized by Google

Electricity in 1904.

A Review of the Substantial Progress Made in Electrical Science and Arts During the Past Year.

IN REVIEWING the progress in electrical matters which took place during the past year, there are several features which are impressive. For some years past certain branches of the electrical industry have been marked by an almost feverish activity in extension and construction. Some of this work, it is true, was greatly needed, yet, on the other hand, a certain amount was more or less speculative. In contrast with this the record for the past year stands out sharply, for the work which has been done—and there has been a great deal—is notable for its value as an investment. In all branches of the industry there has been substantial growth and development, which has been necessitated by the increasing demand for electrical apparatus and power. This increase in the use of electricity has been brought about by the demands of those who wish only a few incandescent lamps or a small motor, as well as by those who require large blocks of power, either for lighting important places or for operating large motors. In fact, one of the noteworthy features of the year has been the increasing demand for electric light and power for small places of business.

There were no startling discoveries in electrical science announced during the year, nor have there been any particularly remarkably new applications. In certain branches new types of machines have been put upon the market or applied in commercial service for the first time, but these machines, in nearly all cases, have been described before, the work of the past year being mainly that of testing and improving them. These developments, as well as the growth of the various branches of the electrical industry, are reviewed more at length in the signed contributions which follow. It is intended here to take a more general view of this progress, and to touch upon the advance of the electrical industry as a whole.

TELEGRAPHY.

By virtue of its seniority the electric telegraph demands first consideration. The Morse system still holds its own as the simplest and most satisfactory for all purposes, but much skill has been expended in improving the apparatus and in simplifying the carrying in and arrangement of the wires in important offices. Outside, the tendency is toward more substantial construction of overhead lines and toward underground wires in cities.

During the year announcements were made of two important telegraphic inventions. The first made public was the statement that Mr. Stephen D. Field has brought to a satisfactory state his telegraphic amplifier, which, while primarily intended for application to cable work—enabling such messages to be taken down by a Morse receiver—can also be used as a relay, receiving the cable message and relaying it to a land line, thus taking the place of the operator at that point. A description of this device was not given, but Mr. Field says that it is so delicate that it will respond also to wireless messages, and hence can be used as a wireless receiver or relay.

The second announcement was not made until December. It was to the effect that the printing-telegraph system upon which Mr. John C. Barclay, assistant general manager of the Western Union Telegraph Company, has been at work for the past five years, had been brought to a satisfactory point of development and was put into service on certain of the Western Union lines. This is a page-printing system, the operator merely spelling out his message, as it were, on a typewriter keyboard, the message being reproduced at the other end in page form. The speed is limited only by the skill of the operator. In fact, by means of a Wheatstone transmitter, and by the use of punched tapes, messages can be sent at the rate of 100 words per minute.

The business of the two large telegraph companies made a substantial increase during the year, but statistics for the twelve months ending December 31 are not available at this time. However, as an indication of what this increase will be, the annual report of Colonel Robert C. Clowry, the able executive of the Western Union Telegraph Company, for the year ending June 30, 1904, shows that during the preceding twelve months nearly 68,000,000 messages, not including those sent over leased lines, were transmitted over the 1,155,000 miles of wire operated by the company.

The Postal Telegraph-Cable Company during the year added substantially to its business and to its equipment. This company is now operating approximately 282,000 miles of wire, including the submarine cables operated by the Commercial Cable Company. The number of messages handled by this company during 1903 was 21,600,000. Figures for the last year have not been made public as yet. The growth of the company has been rapid and continuous, and not a little of this healthy development is due to the energetic management of the president, Mr. Clarence H. Mackay, and his associates, Vice-Presidents W. H. Baker and E. C. Bradley of the telegraph company, and Mr. G. G. Ward, general manager of the cable company.

In the field of wireless telegraphy much skill and energy have been expended in improving and perfecting the various systems. There was little of a sensational nature, as efforts have been expended rather toward developing a thoroughly reliable and practical system, for which there is a wide field of usefulness. The employment of this method for communicating with ships has gone on steadily, but transatlantic communication is not yet in sight. The confusion resulting from the adoption of different systems by the various departments of the government at Washington has been eliminated by placing all government wireless stations under the control of the navy, and steps are now being taken looking toward preventing interference and the disastrous conditions which might result from indiscriminate operation of stations along the coast. Considerable progress was made in sending wireless messages over land.

TELEPHONY.

The steady and rapid increase in the use of the telephone which has taken place during the past ten years has continued during the last year. Indeed, the rate of increase is itself increasing, and the most troublesome problem confronting the large telephone companies is to provide for the new subscribers. The Bell companies to-day have not far from 2,000,000 subscribers, while it is estimated that the independent companies have 2,500,000. The number of telephone messages transmitted by the Bell companies alone is probably approximately 8,000 per minute, and, assuming the same ratio, the number of independent messages per minute would be 10,000. This is a good illustration of the important position filled by the telephone. In construction work the tendency, as in telegraphy, is toward more substantial overhead lines, and toward underground lines in cities. The

Digitized by Google

manufacturers are giving much attention to improving the apparatus, with a view of facilitating quickness of service; and with the same purpose in view, the operating companies are doing much to improve the service by careful training of their employés.

The extension of the telephone, taking all things into consideration, is far greater in the United States than in any of the countries of Europe. Statistics covering the year 1903 show that Great Britain and Ireland at that time had in service only a little over 300,000 telephone stations. In Germany the number was somewhat greater, being almost 400,000; while in France it was considerably less, being but a little over 100,000 stations.

The expansion of the telephone service is not limited to city and suburban service, for an important part is now being played by it in country and even in frontier life. Lumber camps which were formerly isolated during the winter, except for an occasional messenger, are now kept in communication with the main office by means of the telephone. Our forest preserves are being protected against fire in a similar way, and, as has frequently been noted, the farmer finds the telephone service of inestimable value in ordering supplies and disposing of his stock. In city offices the telephone service is being carried to its logical end, for placing an instrument on every desk, with a local operator in the office. Thus each business house becomes practically a branch exchange.

ELECTRIC LIGHT AND POWER.

Of the other applications of electricity, electric lighting may be considered first. In this branch of the industry the past year showed a good increase, and it is in the use of electric lights and power that the smaller user figures most importantly. It is possible that this phase of the development may have resulted from the fact that the large users of electrical energy, both for lighting and for power, had already adopted this system, and the supply companies therefore devoted their efforts toward interesting the smaller consumer. However this may have come about, the fact remains that no shop can be considered modern to-day unless it is lighted electrically and even ventilated by electric fans.

The incandescent lamp has been standardized for many years, and as yet efforts to improve its efficiency by using special kinds of filament have not been altogether successful. The most noteworthy attempt of this kind was the bringing out of the osmium lamp. This lamp has been applied in Europe for use on fifty-volt circuits, but in this country it is as yet a curiosity. The use of the Nernst lamp is increasing for the lighting of large interiors, for which purpose it is so admirably adapted.

In arc lighting the most important event was the announcement of the successful development of the magnetite lamp, brought out by the General Electric Company. This is a long arc lamp, and gives a white light which is well distributed. It has a high economy, and is said to be unsurpassed for street lighting. A number of these lamps have been in operation for some time past, and it is stated that they have given entire satisfaction. The other types of flaming arc lamps, such as the Blondel, have shown a high efficiency in the laboratory, but have not been accepted in this country, though it is reported that several cities in Europe have adopted them.

The Cooper Hewitt mercury vapor lamp has been accepted as a standard illuminant for photographic purposes, and in this use it has given excellent service.

The important problem of improving the efficiency of electric lamps has not been neglected, but there has been no unusual development during the year in this direction.

The tendency in central station design shows the effects of the steam turbine. The practice now is to divide the generating equipment into a number of independent units, bringing them together only at the switchboard. Thus each of the turbines has its own boiler plant, its condensers, pumps, and drives its own generator. This type of design it is anticipated will add greatly to the reliability of the service and promote economy of operation.

ELECTRIC RAILWAYS.

In the electric railway field the record of the year shows that there has been less building and planning for new roads than usual. There has been rather a pause which is allowing the business of those companies already in operation to catch up with the transportation facilities offered. This is, on the whole, a good feature, for there has been a tendency to overwork the railway field.

During the year several important electric railway events took place. The first of these was the opening of the New York subway. This magnificent underground system, which has cost the city of New York $35,000,000, and which has been building for the past five years, was thrown open to the public in October, and it immediately settled down to its work. While there have been a few hitches in its operation, these have been of small consequence, and, taken as a whole, the ease with which the new road was put into service has been remarkable. It has brought to the city much-needed relief, but it is having a greater influence than had been anticipated in educating the city to its needs, and as a result of its first few months of operation there are now in contemplation plans for several new lines, and the removal of the elevated roads, and their replacement by subways, is being urged.

Another important event was the testing of the new electric locomotive for the New York Central & Hudson River Railroad Company. This locomotive, which has been constructed by the General Electric Company and the American Locomotive Company embodies certain departures in design from which much is expected. The test was pronounced a success in every way, and it is thought that this new machine will meet satisfactorily every requirement in handling heavy through trains operated over the electrical division of this road.

Many of the large railway systems are now studying the adoption of electric traction for their suburban lines. The Pennsylvania Railroad is at work on its New York terminal, which is to be reached by tunnels under the Hudson and East rivers, and it was announced during the year that the other large roads in the vicinity of New York would adopt electric traction on their suburban systems.

Much progress has been made in the building of an alternating-current railway motor. There are now a number of types offered, but the large companies of this country have decided in favor of the series type. In Europe the more complicated compensated types are much in favor. As yet there is no railway operated entirely by single-phase, alternating-current motors, though both the Westinghouse Electric and Manufacturing Company and the General Electric Company have had car equipments of this type in use for some time. The feeling seems to be that while this motor may give the service that is expected of it, there are few places to-day where the direct-current motor is not satisfactory, and there is as yet no need to scrap the old equipments in favor of something thus far untried.

POWER TRANSMISSION.

High-tension electrical transmission is passing out of the stage of pioneer work,

Digitized by Google

and is now becoming standardized. Sixty thousand volts seems to have been decided upon as a satisfactory working limit, and energy is being directed toward rendering this thoroughly reliable in service. There are a number of such systems now in operation on the Pacific coast.

In other sections of the country the water powers are being developed and utilized for operating factories and for city lighting. At Niagara Falls, where the largest work in this direction is going on, there are to-day two companies in operation on the American side, and three companies on the Canadian side at work on power-houses. The total output of these plants, when completed, will be in the neighborhood of 530,000 horse-power. At other points of Canada, particularly Montreal, important work in power transmission is also going on.

ELECTROCHEMISTRY AND ELECTROMETALLURGY.

In electrochemical and electrometallurgical circles the year has been a quiet one devoted, as in the other branches, to developing and improving existing methods. There have been no important announcements. Possibly the most significant incident of the year was the report of the Canadian committee appointed to investigate the electrical manufacture of iron and steel. This committee, after an extended tour in Europe, during which important tests were conducted, reported that, at the present time, it is entirely practicable to manufacture steel in the electric furnace, but the conditions are not favorable to the production of iron in the same way. The object of this investigation was to see whether it would be practicable to develop the valuable ore deposits of Canada, utilizing for this purpose her numerous water powers.

STORAGE BATTERIES.

The developments of the year in storage battery construction and utilization have brought forth nothing of unusual interest. An accumulator auxiliary is now recognized as an essential part of the equipment of every important generating station. The use of storage batteries for automobile service is limited almost entirely to heavy trucking in cities, in which service the advantages of the electric motor count most, and where the limited range of action is of little importance.

ELECTRICAL SCIENCE.

The energies of those upon whom we are dependent for our scientific advance have been directed along many lines, but that which has attracted the most attention has been in exploring the fields of radioactivity and atomic physics and in elaborating the new hypotheses suggested the year before.

There were two events of importance to all branches of electrical arts and science. These were the International Electrical Congress, held at St. Louis, Mo., in September, and the electrical exhibit at the Louisiana Purchase Exposition. At the first of these a large number of valuable papers were presented, the effect of which, however, could not be felt during that year. On the other hand, it is probable that the unsurpassed exhibit of electrical machinery and systems, brought together at the exposition through the efforts of Director W. E. Goldsborough, will have more immediate results. Never before has such a large and varied exhibit of electrical appliances been assembled. This section was certainly one of the most important of the entire fair, and, in fact, it is not too much to say that, taking everything into consideration, the most influential factor in the success of the fair was electricity.

It will be seen that, as a whole, the year brought substantial progress along many lines, and there is much cause for satisfaction for the character of the progress.

From present indications it is thought that the activity of the year just opening will be greater than that of the one just closed, and should this prove to be the case the conservative development of 1904 will be an important factor in the new work.

The Electrification of Trunk Lines.

By W. Caryl Ely, President American Street Railway Association.

DEVELOPMENTS in the electric railway field during the past year have been very marked.

The New York Central & Hudson River Railroad Company has completed plans for the electrification, within the thirty-five-mile limit, of its trunk lines entering New York city; the Pennsylvania Railroad Company has determined to electrify its New York city terminals; the subway of the Interborough Rapid Transit Company has been successfully opened for traffic; several of the leading steam roads have purchased electric street and interurban systems for operation in connection with their existing lines, thus marking the demolition of the old lines of antagonism between the two systems of propulsion; the single-phase alternating-current motor has been perfected and put into successful operation and there has been completed and successfully tested an electric locomotive of sufficient size, speed and power to meet the requirements of trunk line railroad passenger service—a tremendous spurt of activity, after a considerable period of seeming lethargy.

It is difficult to anticipate what may take place during the coming year, but it would seem to be safe to say that the time is not far distant when electrical power generated from the waters of the Hudson, the St. Lawrence and the Niagara will be freely used in the operation of cars and the furnishing of light in the city of New York. And further, that the interval to elapse before main trunk lines of railroads, in New York state at least, may be successfully operated by electricity has been, and will be, materially shortened.

The Growth of Philadelphia Rapid Transit.

In 1898 the Philadelphia Union Traction Company had in operation 448 miles of track. The Philadelphia Rapid Transit Company, which now leases the Union Traction Company, operates 545 miles of track. In 1902 the rapid transit company had a surplus over all charges of $405,888, and in 1903—the second year of its operation—the surplus was $220,849. In 1890 the net earnings of the system were $2,465,194, against $8,103,048 in 1904. The ratio of operating expenses to gross earnings in 1890 was sixty-three per cent, and in 1894 it was forty-nine per cent. The growth of the system's business is measured by the number of passengers carried. In 1890 there were 143,885,816. In 1902 there were 325,801,963, and in 1904 there were 390,532,689.

Digitized by Google

Electrical Transmission of Power.

THE past year has done much toward crystallizing practice in the electrical transmission of power. Until recently 40,000 volts was considered the safe limit, but there are to-day several plants operating at practically 60,000 volts. Transmission engineers seem to have decided that at the present time this is a satisfactory limit, and they are, therefore, devoting their attention toward improving construction. A feature of this is the more substantial method of erecting lines, and many are now in favor of steel towers in place of the old wooden poles. The difficulty of securing a satisfactory insulator, which until recently limited the operating potential, seems now to be overcome—at least for 60,000 volts. The insulators are now made in sections, vitrified independently and assembled on the ground.

The greatest development in long-distance transmission at the present time is taking place on the Pacific coast, where coal is expensive. The California Gas and Electric Corporation, the largest company in that section, has now in continuous operation 700 miles of high-voltage lines. By this is meant lines on which the voltage is 40,000 or over. This company is transmitting power regularly a distance of 200 miles, and on one occasion, for a week or more, power was transmitted about 300 miles, the necessity being due to the temporary disablement of one of the stations. This company is distributing in the neighborhood of 45,000 kilowatts.

Another important centre is at Niagara Falls, though here the conditions existing are somewhat different. The distances to be covered are not so great—at least, the district which is at present served and that in contemplation will not be as far from the power stations as is true in California. This, of course, is due to the establishment of large manufacturing companies near the power-houses, which absorb practically all the output of the American stations. The stations on the Canadian side are not yet in operation, though the Canadian Niagara Power Company tested two of its large 10,000-horse-power generating sets the first of the present year. The generating stations now in operation and those being constructed will, when completed, have an aggregate output of 530,000 horse-power.

Much engineering ability has been directed toward improving and simplifying the methods of carrying and controlling high-tension circuits within buildings. A practice much in favor is that of isolating, as far as possible, the separate appliances by means of fireproof partitions, and of grouping different devices on the different floors of a switch-house. It is recognized that as each device or instrument is in itself a source of weakness, the fewer of these installed the better for the reliability of the station.

In Europe the practice in long-distance transmission is naturally somewhat in the rear of that of this country, but one system, put into service some months ago in Italy, is now operating at 40,000 volts. In England the highest voltage at the present time is about 10,000, though voltages of about 30,000 or 40,000 are planned for on systems now in course of development. One feature of the English work in this line is the supplying of large districts, such as South Wales, from two or three advantageously located generating stations. This power is used not only for lighting towns and for operating railways, but for driving the mills and for doing the work in the mines. These stations are in general operated by steam. The water power used in England for generating electricity is not more than 10,000 horse-power.

In other countries there is a healthy growth of long-distance transmission. In France, Switzerland and Italy there is a good deal of activity in developing the many waterfalls and transmitting the power thus obtained to towns and manufacturing centres. India is, as well, carrying out important work in hydro-electric developments and transmission, and Canada is following close on the footsteps of this country. It is estimated that the total development of water powers throughout the world used in producing electrical energy is between 1,500,000 and 2,000,000 horse-power, all of which has taken place during the past fifteen years or so.

The experience of the year has shown that it is practical to transmit large amounts of power very great distances by means of high voltages, but as yet conditions do not seem to warrant any unusual attempts in this direction. There are few, if any, large water powers which could not dispose of their entire output within a radius of 100 miles, and 60,000 volts is high enough for transmitting this distance. On the other hand, there is the problem of supplying the needs of large industrial centres situated more than 100 miles away from an important water power. Whether this will be met by high-voltage transmission or by local generating stations can not be foreseen, but except under unusual conditions the advantage will probably rest with the local station for some time at least.

Electric Lighting in New England.

By C. L. Edgar.

The principal development in electric lighting matters in New England during the past year has been the completion of the Boston Edison Company's large turbine station. This is notable in two ways. First, in the installation of very large, four-stage turbines, with condensers in the base, being the first installation of its kind. This station was started so late in the year that up to the present time no exact data whatever have been obtained as to the economy, except the very general one that the station operating only one shift is somewhat more economical than the old station operating three shifts. By the end of this year we ought to have some very valuable data regarding this installation.

The second thing to note in connection with this completion is the long-distance transmission, running from this station into the surrounding towns. To those engaged in electrical work in the West, our use of the words "long distance" would be considered somewhat ridiculous. Having in mind the one hundred and two hundred-mile distances to which electricity is transmitted in the western states, our little transmission of thirty miles seems very insignificant. It has, however, been quite a problem here, owing to the settled territory through which the lines have had to run, and we have had innumerable obstacles to overcome in getting 7,000-volt transmission lines distributed over a territory twenty-five miles square. Our difficulties, of course, have not been electrical but structural.

As far as I can see, the year 1905 is going to be very largely a routine one. We will, during the year, perfect our organization and get more fully than before the benefits of the shutting down of twenty suburban stations and the starting up of one large water-side station to take their places.

Digitized by Google

Recent Improvements in Telegraphy.

By J. C. Barclay.

WITH one or two exceptions, to be hereinafter noted, the improvements effected in telegraphy during the past year have not been of a character that would individually call for more than passing notice, but taken in the aggregate, they represent an advance in this particular field of industry that has had, and will continue to have, a most important bearing upon telegraph interests generally.

It is well understood by those "versed in the art" that improvements, as a rule, are brought about not so much by the brilliant discoveries made, as by that close attention to little matters of detail in every branch of the service without which the art of telegraphy could never have attained its present high standard of efficiency.

In the matter of line construction, for instance, the number of poles per mile has been considerably increased, large and substantial structures having been recently erected by the Western Union Telegraph Company and guyed at certain intervals by a series of stranded galvanized wires capable of withstanding a breaking strain of 10,000 pounds, which have solidified its pole lines to such an extent that storms, which but a short time ago would have laid them low, have now practically little effect upon them. When this system of construction shall have been extended to all the principal telegraph points, it is hoped and believed that nothing short of a cyclone or other untoward event will destroy the communication between such points.

The use of hard-drawn copper of great conductivity and durability in place of the more highly resisting and perishable iron wire formerly employed has been enormously increased and is being rapidly extended in all directions.

Dynamo machines and storage batteries in great numbers continue to replace the inefficient and space-occupying chemical batteries.

The immense volume of business now handled by the various telegraph organizations could only be successfully accomplished by the use of machinery and appliances of the most varied and up-to-date character, hence, every office is now equipped with apparatus representing all the latest improved methods of telegraphic transmission and reception.

The changes made in the ocean cable equipment consist principally in the substitution of automatic transmission for the ordinary method of hand-signaling previously in vogue. The precise and uniform character of the currents transmitted by these automatic machines not only makes the work of transcription less difficult, but enables the cables to be operated at a higher rate of speed. An innovation of considerable practical importance has been recently made in connection with this particular branch of the Western Union service by the employment of an exceedingly simple and efficient electrical perforating machine which admits of the slip being "punched" with a degree of ease not heretofore attained, and at a rate of speed greatly in excess of that possible with the ordinary style of punching apparatus. The cable interests have been closely considered in various other ways, but mainly in the direction of reducing the K.R. value of the conductors, and in trying new systems, of which one at least bids fair to attain considerable increase in the speed of signaling, with the additional advantage of being able to utilize the ordinary Morse in place of the present recording apparatus.

Direct communication between the most distant points on land lines is one of the highly important practical results of the use of a repeating relay which the writer had the honor of first introducing upon the Western Union lines some two years ago. It is a device that admits of the direct reception and transmission of currents from one line to another, differing in this respect from the ordinary repeater arrangement, which can only affect the necessary work through the interposition at each repeating station of certain local apparatus having a penchant for "getting out of order," and whose instability of working seriously limited the range of long-distance transmission. It is now possible to work direct over practically unlimited distances at increased speed, the received signals being much more clear than any heretofore obtained under such conditions, and circuits from New York to San Francisco, Cal., Cuba, Galveston, Tex., Heart's Content, N. F., and a host of other places far and near are already equipped with the new repeating device.

Perhaps the greatest achievement in the way of telegraphic development, and one calculated to bring about radical changes in existing methods of working, is that connected with the printing-telegraph art, which for years past has been struggling hard to find favor with the telegraphing public, and to firmly establish itself among the various systems employed in ordinary commercial telegraphy.

A great number of printing-telegraph systems have been tried and found wanting. Two or three have gained a foothold by proving more or less successful in experimental work or under actual working conditions, but all have grave defects that seriously impair their usefulness, and under such circumstances nothing in the way of a rapid extension of such systems could be looked for. A system involving essentially the use of a typewriter for transmitting, and another for receiving the messages, was found to be highly desirable, not only because such an arrangement would practically double the carrying capacity of wires over which the system was operated, but the use of high-skilled labor and complicated machinery could be more or less dispensed with, incidental advantages being gained in the way of securing a perfect record of all desirable characters, and in less time withal than that possible through the medium of any system in which a perforated tape forms part of the transmitting arrangement.

Such a system as that above outlined has been developed by the author and is now in practical operation over the Western Union lines between New York and Buffalo, with results so entirely satisfactory that as soon as the necessary arrangements can be made circuits in various other directions will be equipped with the new printing mechanism.

The above rough sketch, which but lightly touches upon a few of the more important features of telegraphic development so far as the Western Union is concerned, will very inadequately convey an idea of the vast number of changes—both great and small—which are constantly taking place to the betterment of the telegraph service, the enormous interests of which may be indicated by the statement that the above-mentioned company alone embraces in its system no less than 1,089,212 miles of wire, with 196,517 miles of poles and cables, over which nearly 80,000,000 messages—not including those sent over leased wires and under railroad contract—were transmitted during the year 1903.

The progress made in telegraphy during the past year has, to say the least, been quite considerable, and in every way calculated to increase the efficiency of an art, the needs and necessities of which are thoroughly understood and appreciated by those whose aim and object must ever be to keep pace with the times, and thus fully meet all the demands and requirements of a modern telegraph service.

Digitized by Google

The Electric Railway Situation.

By Dr. Louis Bell.

THE year just passed has seen few sensational developments in any of the electrical arts, and electric railroading has been no exception to the rule. Activity has been mainly in interurban lines of which there has been much building, none of it of a specially striking character. There has been, too, quite a bit of consolidation of various interurban properties and some extension of power transmission to large railway systems from consolidated central stations. In the writer's judgment there is more danger of overdoing than underdoing this particular feat of engineering.

The greatest novelty of the year has been the steady heralding of a new era in which alternating-current series motors shall reign magnificent. The preliminary tuning up and the premonitory blasts came last year. All this year we who wait have been hearing the fanfare echoing among the distant hills, but the head of the procession is not yet in sight. It has been announced repeatedly, but seems to be still marking time somewhere in the about-to-be. To those who, like the writer, have been eagerly awaiting an alternating traction system, the delay is a keen disappointment. The conviction is growing in the engineering profession that Dr. Finzi's announcement forced the hands of the American manufacturers to a very embarrassing degree, and that while from a purely engineering standpoint some very admirable results have been reached, a policy has been inaugurated of side-stepping the issue whenever possible. There is little use speculating on the cause of this attitude, which may result from some trivial "bugs" which still have to be exterminated, from sharp differences of opinion in the engineering staff or merely from the desire to avoid the undeniable difficulties of badly mixed production. The fact, however, remains that while alternating railway motors are apparently all ready for the market and are cordially recommended in cases suited to their use, such cases seem suddenly to have become most extraordinarily scarce. Why we shall soon know, for the situation is too absurd to persist for any considerable length of time.

The most important enterprise inaugurated during the year is the New York subway, of which one can hardly speak too enthusiastically. It has been a splendid feat of engineering and has resulted in a brilliant operative success. It is one of the rare cases in which a great work seems to have been carried out with adequate thoroughness. The Subway will relieve the rapid transit situation in the metropolis for some time to come, although if the present rate of growth is kept up there will be need for auxiliary work perhaps sooner than one thinks, to open new fields, however, rather than to give added facilities along present lines. The gain in speed of transit has been all that was hoped for, and is certain to produce a very material redistribution of population until, at least, tunnels under the rivers are completed.

A potent factor in the same problem of population is likely to be the electrical equipment of the New York Central's terminal and suburban system now near at hand. The locomotive for this work recently tested is, by the way, one of the most interesting electrical machines yet devised. The escape from the usual dilemma between gearing and the difficulties of direct driving was very cleverly contrived. By making the truck frame part of the magnetic circuit and getting the necessary mechanical play in the pole-gaps, the weight carried dead upon the axles is actually brought below that necessary in a steam locomotive of equal power, with the advantage of the abolition of hammering due to reciprocating parts. With the fast suburban service now possible the subway and the New York Central should be able to push the metropolis far up the Hudson in an almost continuous stretch.

The effects of this innovation will be closely watched by railroad men, for while there are many cases in which electric suburban work would be desirable, all eyes have been turned on New York, where the main issue was forced, and all hands are waiting for the results. The introduction of electric suburban service is a thing which may be so far-reaching in its consequences that railway men generally have been disposed to hold back and probably will still do so until compelled to move. Pressure will soon be applied by the growth of interurban systems as competing lines. Until very recently interurban systems have been run with very little regard for through traffic, much as railway lines were run half a century ago. There are now signs that consolidation will bring with it some appreciation of an interurban network as a whole. Steps have recently been taken on one of the largest of this class to push the through business by improving connections, selling through tickets and other obvious means. The more this sort of thing is done the sooner will the steam roads take off their peanut trains and put in a business-like suburban system. There is a tremendous future in the interurban business, but until the managers appreciate the importance of through cars, through schedules and through tickets, that future will be dwarfed.

In one thing, however, the spirit of progress is very conspicuous, and that is in the improvement of rolling stock. A very large number of fine cars have been put into service this year all over the country, big fellows with cross-seats, and every improvement in construction to give convenience and easy riding. This is the first step toward the through service just mentioned, and a most important one.

It is unfortunate that equal improvement has not been made in safety appliances. Although the electric railway record for the year has been far less sanguinary than the general railroad record, it is still bad enough. There has been a long list of more or less serious accidents, mostly chargeable to the same fundamental cause—an attempt to run heavy cars at high speed on a single track without any, or adequate, safety devices. Operating a single-track road is no easy matter, even under the most favorable conditions, and with a comparatively small number of trains. When one tries to increase the number of trains, retaining nearly the same speed, the difficulties are very greatly enhanced. The state of things is getting serious and it is up to the interurban lines to work out an adequate system of safeguards unless they wish to foster public opposition to their further extension.

In apparatus and methods, generally speaking, changes have been small. In railway power stations there has been increasing use of steam turbines wherever the output has been alternating current. The ease with which these machines put up an excellent performance at varying load-factor is a strong point in their favor. If they were equally well fitted for direct coupling to direct-current generators their usefulness for railway purposes would be

Digitized by Google

greatly increased, since they would then be convenient for the small systems in which the load-factor is particularly bad. Some recent tests abroad of a 500-kilowatt turbine set (of American make, it is pleasant to note) gave decidedly encouraging results. In very large stations in which the load-factor can be kept high, turbines must depend mainly upon their other advantages.

In this connection one should note the radical innovation about to be made in San Francisco, where the California Gas and Electric Corporation has just ordered three 4,000-kilowatt, three-phase generating sets, each driven by a 6,000-horse-power gas engine. These are stated to be for operating the street railways of the city. All sorts of reports are current about the performance of the big gas engines now used in this country, the majority of them rather unfavorable, but the engineers of this large corporation seem to have been convinced that the gas engine is all right. It has been looming large in the background for some time and its appearance at the front of the stage will be watched with the greatest interest. The writer is not prophet enough to proclaim the result, but our friends on the coast have a cheerful way of going ahead and doing the impossible that makes one very cautious of adverse predictions. If they succeed in this instance the battle of the engines long impending will be on in deadly earnest. Taking a broad view of the situation it looks as though the coming year might be decidedly interesting. Things have been very slow in getting ready to happen in electric traction, but there surely are signs that something will soon be doing.

Progress in the Electrochemical and Electrometallurgical Industries in 1904.

By John B. C. Kershaw.

ALTHOUGH no striking discovery or invention in the development of the electrochemical and electrometallurgical industries has marked the year 1904, considerable progress has been made in the case of new industries, especially in connection with the electrical processes of iron and steel production, and with the methods for fixing the nitrogen of the air either in combination with oxygen or with carbon. The importance of these methods for drawing upon the almost limitless supplies of nitrogen in the atmosphere, in view of the decreasing reserves of naturally occurring nitrates in the earth's crust, has been emphasized already more than once in the columns of the ELECTRICAL REVIEW; and there is little doubt that in time the supply of combined nitrogen required for support of the world's cereal crop will be drawn from this source.

Some details of these processes, and of the position in the older industries, are given under the respective headings in the following review:

ALKALI AND BLEACH.

The electrolytic alkali and bleach industry is advancing in America, but is practically stationary in Europe, owing to excessive production of chlorine products, and to the low prices which can be obtained for these in the open market. During 1904 the position in England and Germany has been slightly improved by the renewal of the agreement as regards production and sale of bleach between the Le Blanc and electrolytic manufacturers, but the price of this chemical has not yet advanced to its former level, and it remains at about twenty-one dollars per ton, f. o. b., Liverpool.

In France and Italy the managers of the electrolytic alkali works are seeking to use their chlorine in other manufactures; and carbon tetrachloride and pure hydrochloric acid are being produced in these works. Attention is also being given to the great waste of hydrogen gas which at present occurs in all electrolytic alkali works, one ton of this gas being liberated at the cathode for every thirty-five tons of chlorine produced; and in some of the German works the hydrogen is being collected, purified, dried and compressed in steel cylinders for sale to various users. Electrolytic chlorine is also being used extensively in some of the German color and pharmaceutical chemical factories for producing the intermediate chlorination products and changes in these manufactures. The electrolytic alkali industry in America is more progressive.

ALUMINUM.

The aluminum industry is slowly advancing both in America and in Europe; but as none of the companies engaged in the industry is now willing to publish figures for their annual production, this statement can not receive statistical support.

The Massena plant of the Pittsburg Reduction Company has been in operation during 1904, and should have materially augmented the American production—the total power available in the three plants of this company being now raised to 22,000 horse-power. In Europe, both the Neuhausen Aluminum Company and the British Aluminum Company have been increasing their power plants in Germany, Austria and Scotland, respectively. The first-named company has now 24,000 horse-power available for electrometallurgical purposes in its four works, but other manufactures than aluminum are carried on, the Heroult steel process being the last to be taken up.

An Italian company for carrying on the manufacture of aluminum from native bauxite has been promoted in Rome. The works are to be situated in the valley of Pescara, but they are not yet erected.

As regards utilization, Dr. Goldschmidt's "thermit" process for production of high temperatures in metallurgical and fusion operations has received the most notice during 1904; and the consumption of aluminum powder for manufacture of "thermit" must be increasing rapidly.

The use of aluminum wire for electrical transmission lines continues to extend in America, but makes little headway in Europe; expert opinion in England and Germany, based on actual trial, being that for such purpose aluminum is not sufficiently resistant to weather influences The electrodeposition of aluminum has attracted much attention during 1904. McDermott has stated that he can obtain dull deposits, which can be brightened by burnishing, from a basic sulphate solution; while Patten has obtained bright deposits from an ethyl bromide solution. Two Sheffield artisans have also discovered a solution and method by which silver can be satisfactorily plated on to aluminum. This process is considered to be of value since it will enable aluminum

Digitized by Google

(a cheaper metal than German silver) to be used as the base metal of all plated goods. Hambuechen and Burgess have also published details of a valuable research on this subject.

CALCIUM CARBIDE AND ACETYLENE.

The writer has no new facts or figures to report concerning these two industries in America. As regards Europe, although the calcium carbide and acetylene industries have not yet recovered from the unwise company promotion and speculation which occurred in the years 1899-1900, a large number of new works have been planned and in some cases brought into operation during 1904. Possibly these may prove remunerative where the position has been wisely chosen, and a market exists for this product in the immediate vicinity of the works. The works at Kerka, Dalmatia, promoted by an Italian company, and at Hafslund in Norway, promoted by a Swiss company, with Schuckert & Cie. behind it, are the most important of these new ventures.

As regards use, the central installations of acetylene gas as a lighting agent are increasing in number both in the United Kingdom and on the continent of Europe; and these installations when erected and worked under "expert" control appear to give complete satisfaction. A novel use of calcium carbide is in the manufacture of arc-lamp carbons, which when made from a mixture containing fifty per cent carbon and fifty per cent calcium carbide are said to emit a much more brilliant light. A French patent has been granted to Jay & Company, of Paris, for the production of alcohol from acetylene, but it is doubtful if this will be worked upon an industrial scale. The use of acetylene in blow-pipe work (in conjunction with oxygen) for metallurgical operations involving a very high temperature is believed to have a future, if the difficulties regarding storage and transport of this gas can be overcome.

CHLORATES AND HYPOCHLORITES.

There is nothing new to report concerning the electrolytic chlorate industry, which, like the electrolytic bleach industry, is suffering from the low prices ruling in the open market for its chief products. With regard to hypochlorites, some progress is believed to have occurred during 1904—and in America especially a large number of electrolytic plants are in operation producing hypochlorites of lime solutions for bleaching purposes, the caustic alkali produced at the cathode in such plants being run to waste. Kellner has just introduced a similar process in Europe for obtaining an oxidizing solution for the treatment of wood-pulp. The use of electrolyzed sea-water for sterilizing sewage is also again receiving attention, notwithstanding the failure of the Hermite process and cell ten years ago; and an installation of this type is being operated in America. Two companies are exploiting hypochlorite cells in England, namely, the Electrical Bleaching Company and Oxychlorides, Limited; the first having control of the Vogelsang patents, and the second of the Atkins patents. In Germany a large number of similar cells are patented, and are securing industrial trial, the chief of these being the Schuckert cell and the Haas and Oettel cell.

IRON AND STEEL.

The most striking progress of the year 1904 in the electrochemical and electrometallurgical industries has occurred in connection with the development of electrical methods of steel production. The earlier attempts to apply electrical heating to the reduction of iron ores have mostly given way to the more rational application of electricity to the manufacture of special alloys of iron and of steel from pig and scrap iron; and in this direction considerable success has been attained. A large number of patented processes and furnaces for carrying out this conversion of scrap iron into special varieties of steel are now being exploited in Europe and America, and there seems little doubt that this innovation in the steel industry will be permanent and will have an important future before it.

Limits of space will not permit of any detailed description in this brief summary of progress in 1904 of the different types of furnace and process now being used for this purpose in Europe and America. It must suffice here to state that furnaces with both arc and resistance heating are in use, and that France is leading in this new development of electrometallurgical industry. A scientific commission of investigation has been, during 1904, in that country on behalf of the Canadian government, and the report of this commission (recently published) recommends the introduction of the new methods of steel production into Canada. It seems highly probable, as the writer has before indicated, that in time the blast furnace will produce both pig iron and the necessary electrical power (by means of the waste gases and gas engines) for converting this pig into high-class steel; the pig iron being run direct from the blast furnace into the electrically heated refining furnaces, without any preliminary cooling and loss of heat. It is yet too early to say which steel-producing country will be the first to adopt this improved method of production, but it is reported that a German company has already such a plant designed and in course of erection.

NITRIC ACID FROM THE AIR.

The fixation of atmospheric nitrogen by spark discharges through air, and by formation of cyanogen compounds in the electric furnace, has continued to be the subject of a large number of laboratory and large scale investigations during 1904, and more than one of these processes may develop into a commercial success of some magnitude. The most extended trials with the method of spark discharge are occurring at Niagara Falls, where the Bradley & Lovejoy process is being operated by the Atmospheric Products Company; but Muthmann & Hopfer and Kowalski, in Germany, von Lepel, in Austria, and Birkland & Cyde, in Sweden, are experimenting with similar processes for nitric acid or nitrite production.

As regards cyanides, the Ampere Electrochemical Company, of Portchester, N. Y., claims to have solved the problem of the continuous production in the electric furnace, barium carbide being first formed; while Siemens & Halske, in Germany, have patented and are operating a process for producing calcium cyanamide in the electric furnace, from which compound potassium cyanide can be obtained by double decomposition. All of these processes can produce the desired chemical with more or less efficiency; the only question to be solved being that of their economic value and profit-earning capacity, in competition with the cyanides, ammonium sulphate, and nitrate of soda obtained from the more usual sources of supply. It would seem probable that until the natural deposits of nitrate of soda are exhausted, there will be little chance for the electric method to produce nitrates at a profit.

Limits of space will not allow of any detailed treatment of the electrochemical methods of producing ozone, oxygen and hydrogen, nickel, tin and zinc, or with the electric furnace processes for obtaining ferrosilicon, ferromanganese, ferrochromium, etc., and the similar processes for extracting copper, nickel and zinc from their ores. In all of these industries some progress has occurred during 1904.

Digitized by Google

Progress in Electric Lighting.

By J. H. Hallberg.

THE electric lighting industry of the United States has enjoyed marked advance and prosperity during the past year and several branches of the art have been subject to important developments—the close cooperation of manufacturers, engineers and central station managers, through the National Electric Light Association, being largely responsible for this rapid progress. The efficient generation and distribution of electric power and the establishment of proper and uniform rates have enabled the central stations to reduce their cost of production and the consumers have consequently benefited by a lower rate and a more prompt and reliable service.

INCANDESCENT LIGHTING.

The manufacturers of electric lighting appliances have introduced many new specialties, and the development of artistic candelabra, portable lamps and other fixtures for decorative purposes, which can now be bought at very reasonable prices, have materially increased the demand for incandescent lamps. The rapid introduction of electric signs and other advertising devices which require incandescent lamps has also increased the demand, and it has been observed that incandescent lamps, fitted with modern reflectors, have in many instances replaced the enclosed arc lamp, operated by isolated plants. The better distribution of light possible with the incandescent lamps, notwithstanding their lower efficiency, may, to a certain extent, account for this, but it is more probable that the general results from arc lamps operated by some isolated plants have not been satisfactory because of troubles experienced with the arc lamps, some of which may be of poor design and others not receiving proper care.

The incandescent lamp has also prominently entered the street lighting field, inasmuch as it is admirably adapted to operate in series with constant-current inductive regulators from constant-potential high-voltage alternating-current systems. The close regulation possible with inductive regulators permits the use of high-efficiency incandescent lamps, and central station managers are now wide-awake to this fact, and municipalities are realizing the advantages of small electric light units for certain classes of street lighting.

MERCURY VAPOR LAMPS.

This type of lamp has been installed in large numbers for photographic and similar purposes, to which it is particularly adapted. The color of the light from this type of lamp is, however, not suitable for general illumination, excepting in very few cases. The Hewitt mercury vapor lamp has been widely adopted for photoengraving purposes, being placed on the market in a number of practical forms. This type of lamp has also been recently installed for the illumination of large enclosed areas.

The vacuum tube lighting system invented by D. McFarlan Moore has now been installed in several places, and the practical results of this type of lamp will be followed with interest during the coming year.

THE NERNST LAMP.

During the past year a large number of Nernst lamps have been installed by many central stations and by several isolated plants, where there has been a demand for a lamp that would take the place of a very small arc lamp or a large incandescent lamp.

The Nernst lamp gives a beautiful steady light, and, on account of its high degree of perfection, it is now considered a very satisfactory and profitable lamp to the central stations.

It is to be hoped that the demand for this type of lamp will increase during the coming year, permitting it to be made in large quantities, so that it can be sold at a lower price than at present. This would undoubtedly be the means of a general adoption of this lamp on alternating-current systems. Several large manufacturing establishments have installed alternating-current generators and motors for driving the machinery in their plants, and they have found the Nernst lamp very useful and satisfactory.

As a general rule, street-lighting systems are now operated by alternating-current generators, and a comparatively small number of Nernst lamps are in use for street lighting, on account of the fact that they have to operate in multiple. It is to be hoped that some form of Nernst lamp may be developed which will operate satisfactorily in series on alternating current in connection with inductive regulators or constant-current transformers.

ARC LIGHTING.

The most important development in arc lighting during the past year is the perfection and practical application of the magnetite arc lamps for street lighting. As this lamp has a comparatively long flaming white arc it distributes a powerful light in a horizontal direction, which makes this lamp particularly suited to street lighting.

The efficiency of the lamp is also comparatively high, inasmuch as it is claimed by its manufacturers that 300 watts at the terminals will produce as much light as the ordinary arc lamp at 450 watts. The magnetite arc lamps operate in series on direct constant-current generators, which are preferably wound for about four amperes, and each lamp requires about eighty volts. Whether or not the higher efficiency and better quality of light from this type of lamp will offset the use of the constant-current series arc generator, as compared with inductive regulators or constant-current transformers for series alternating arc lighting remains to be seen. The central stations that have tried this system speak favorably of it, and if the arc is not subjected to side draughts, due generally to cracked or broken outer globes, the system operates very nicely.

There have been practically no new developments in the regular line of arc lamps for street and commercial purposes, although many important improvements in the details of the various lamps and systems have been made which contribute to increased economy and more reliable service.

One of the most important improvements which makes the closed base inner globe safer for series and high-voltage arc lamps is the development of a new trim, in which the arm which supports the lower carbon inside the inner globe is insulated from the upper globe support and the lower carbon-holder. The supporting arm is hollow, and the conductor which supplies current to the lower carbon-holder passes through this arm, but is insulated from it by small glass beads. Central station managers who have had much trouble with the arc jumping from the upper carbon to the frame which supports the lower carbon, thus destroying the entire upper globe support and the gas valve, will find that this new form

Digitized by Google

of construction will altogether prevent this kind of trouble, and the maintenance expense of arc lamps fitted with the closed-base inner globe will be materially reduced.

Some manufacturers are now building arc lamps which are practically non-destructible, inasmuch as the magnet windings are insulated with non-combustible material, which is of particular advantage on constant-potential arc lamps which use a regulating resistance inside of the case where the temperature is comparatively high. The insulating material in other parts of all modern arc lamps is also non-combustible, which materially increases the lasting qualities and improves the service of the lamps.

"The high economy" direct-current enclosed arc lamp, which operates with a ninety-seven-volt arc on a 110-volt circuit, has been improved to a considerable extent, and the inductive regulating coil which had to be placed several feet above the lamp in order to eliminate the fluctuations of the arc when this lamp was first brought out, has now been successfully placed directly above the operating mechanism in the lamp. This change, and the increase of current for the lamp from four amperes to five amperes, has made this lamp self-contained. The illumination is very satisfactory, notwithstanding the long arc, and the illuminating efficiency over the standard eighty-volt constant-potential enclosed arc lamp is claimed to be from thirty to forty per cent.

For street lighting, the constant-current series alternating enclosed arc lighting system has been in steady demand, and installations of lamps, varying in current consumption from four to seven and one-half amperes, with seventy-two volts at the arc, have been made.

The four-ampere enclosed alternating-current arc lamp is probably too small a unit for general application, although the city of Cincinnati, Ohio, selected this size of lamp and installed 4,500 of them about two years ago, and last year the city government of Cincinnati ordered an additional lot of 1,200 four-ampere series alternating-current arc lamps installed for street lighting.

There is a remarkable difference in the illuminating power of a four and a five-ampere alternating-current arc lamp, and there is considerably less difference in illuminating power between a five-ampere and a 6.6-ampere alternating-current arc lamp, and a central station manager who controls a large number of plants has appreciated this fact, equipping all of his stations with 5 to 5.5-ampere series alternating-current arc lamps for street lighting, with excellent results.

Electrical Theories.

By Dr. John Trowbridge.

IT IS interesting to compare our present views in regard to the nature of electricity with the views held in the time of Franklin. Without going into much detail we can say that the fluid theories are generalizations of an apparent excess and deficit of electricity with resulting changes of pressure which have a close analogy to phenomena in the motion of fluids. Since the time of the founders of the fluid theories of electricity the mathematicians have built up a remarkable branch of mathematical physics called hydrodynamics, and the equations of motion which they have developed are at the foundation of the mathematical theory of electricity; indeed, it is the conviction of the most learned scholars in electricity, that without a knowledge of hydrodynamics the student can not have clear views of electrical phenomena. The equations in hydrodynamics are very general and do not relate to any supposable particle in the fluids. They are in no sense equations of the dynamics of a particle.

It may be said that the mathematical physicist who formulates general equations of the motion of a fluid is in the condition of an observer in a balloon who studies a stream winding far below him on the surface of the earth; exerting pressure here and there, manifesting whirls and vortices in the endeavor to overcome material obstacles. The mathematical physicist in this day of theories of ions and electrons has approached nearer the earth and thinks of the stream as he might of a stream of human beings, each animated particle having numberless degrees of activity. This latter physicist stands for the mathematical physicist of to-day who deals in theories of electrons. Inside the general view given by hydrodynamical analogies there is coming into view a science of detail; a science of the dynamics of the electrical particle.

This closer view of the mechanism of electricity is entirely due to the study of discharges of electricity in rarefied gases, a subject which was unknown in the time of Franklin. This study taken in connection with the related subject of the passage of electricity through fluids or electrolytes has revealed the existence of small particles of matter which are charged with either positive or negative electricity and which are moving with great velocity. They are, therefore, carriers of electricity. One of the most notable contributions to this new idea of electricity can be found in two papers of Professor Townshend, of Oxford (*Phil. Mag.*, November, 1903, to December, 1904), on the sparking potential. To the student who has been greatly puzzled by the phenomenon of the electric spark this paper is most enlightening, for it gives a very rational theory of the mechanism involved.

Professor Townshend was led to his treatment of the subject by a consideration of the action of violet light on the electrical conductivity of a gas. By the action of the light a certain number of negative ions are set free which generate others in their passage through the gas. The computation of the number of negative ions reaching the positive plate or terminal when the distance traversed is small agrees with the theory of ionization; but for larger values of potential and greater distances, calculation shows that some other form of ionization comes into play. Professor Townshend is then led to the theory that all the ionization is produced by collision of positive and negative ions with neutral molecules in a uniform field of forces; a number of negative ions start from the negative plate or terminal, they generate others in the gas and a definite number reach the positive plate; the positive ions move in the opposite direction and also ionize the gas by collisions. Professor Townshend deduces on this theory an equation giving the number of ions produced, which agrees very closely with the results obtained by experiment. It is interesting to notice how a particular and detailed view of the dynamics of a particle here supplants the theory of a positive and a negative fluid moving in opposite directions.

While both the two-fluid theory and the one-fluid theory explain a large num-

Digitized by Google

ber of facts, it is noticeable that the main conception of the one-fluid theory is used in speaking of the flow of electrical currents in conductors. It is always a movement of something from A to B and not of a simultaneous movement of a similar something from B to A. The success of the ionization theories in opening new views of electrical action in the case of discharges in gases has led to an endeavor to explain electrical conduction in solid conductors by the movements of electrons or the negative corpuscles. This attempt is a far-reaching one, for it is leading those who write upon the dynamics of an electron to conceive of the mass of an electron as something of a purely electromagnetic nature. Electricity accumulates upon the volume element of the electron just as matter is supposed to reside in the volume element of what appeals to us as ordinary matter. It may be that all our conceptions of matter may become electrical conceptions; and that we shall come to an idea of knots in the ether.

The most notable utterances upon this electrical theory of matter during the year are contained in the addresses of the Right Hon. A. J. Balfour, Premier of England, and of Professor Horace Lamb, before the British association. These utterances, however, are chiefly philosophical.

Patent Progress During the Year.

By E. G. Siggers.

ACTIVITY has marked every branch, class and line of the electrical art during the past year, and this marked enterprise is probably most strongly evidenced by the great amount of work that has devolved on the three divisions of the Patent Office, given up entirely to the consideration of this important factor in the world's progress. The weekly official gazette published by the Patent Office fairly bristles with the names of inventors who have found fame and fortune by turning their ingenious minds to the consideration of means for making the great unknown force become more and more the well behaved and useful servant of mankind. The great electrical companies appear with almost weekly regularity as the owners and purchasers of patents, and then scattered through the year are those innumerable sporadic inventors, each of whom has hit upon a novel idea, a scheme, a thought, that ends in an invention, perhaps useful, perchance worthless, finally culminating in a patent. However, in all cases something additional is added to the art and presented to the consideration of the world, possibly to be rejected but always liable to be considered worthy of commendation and material favor.

The three electrical divisions in the Patent Office have over one thousand cases on their books which are awaiting their action, and there are undoubtedly at least as many more which have been acted upon and are awaiting responses from the various applicants. The divisions are behind in their work from two to four months, and thus some idea may be gained of the immense amount of labor devolving upon the examiners to properly examine and act upon the inventions presented for their consideration.

An investigation shows no generic or "epoch-making" inventions produced in the electrical world during the past year. Improvement has been the order of the day, and as one examiner has characterized it, the progress consists "mostly in threshing over old straw." Great activity has been shown in alternating-current motors, motor-control and the like, and considerable interest has been manifested in high-speed dynamos and rotary motors or steam turbines for running them. Third-rail systems, traction lines, and the various mechanisms pertaining thereto have received their quota of additional patents, the majority, perhaps, being controlled by the large manufacturing corporations.

In the art of wireless telegraphy, the feature that now appears to be commanding special attention is the production of means by which the distance of transmission can be extended. Thus, in the De Forest system, a successful and what may be termed official test has been made between St. Louis and Chicago, and it is reported that Captain Hogg, at Annapolis, Md., has successfully communicated with the Marconi station at Cape Cod, Mass. These results are considered highly gratifying, in view of the fact that the transmission of messages overland is computed as five to one when compared to the transmission of such messages over water. In other words, the restriction upon the former, due to the absorption of the current by the earth and other causes, is five times greater than under the latter conditions.

In the line of telephony and telegraphy, in general, the same activity as in the other branches has been displayed. Patents on improvements have been obtained in the classes of automatic, central and selective systems, to say nothing of the multitudinous details relating more particularly to the mechanical structures and elements, and forming an important feature of the art.

The case of electric lighting has come in for its share of patronage. The so-called Nernst and Hewitt lamps still attract the attention of inventors, the company controlling the latter having apparently branched into an analogous art, namely, that of current rectifiers, on which a number of patents were recently issued. As in the other classes, the present vigor in the art of electric lighting arises entirely from the improvements being made in the arrangement of parts, combinations, and the various mechanical details of construction.

Finally, there must be taken into consideration the progress of the patent world at large, and with which the electric art is so closely interwoven. There have been thousands of patents secured, where the novelty resides in structures, not relating, *per se,* to electricity, and yet wholly dependent for operativeness and success upon the same. The past year has been one of progress in all lines. The three-quarters of a million mark in patents was reached in January, 1904, and at the present writing, it appears that the year's issue has amounted to over 30,000. The past year was a banner one, so far as patents were concerned, and if the commercial conditions and present prospects remain as favorable during the present as they were during the past year, undoubtedly it, in its turn, will also be eclipsed.

SHORT-CIRCUIT ON THE LONDON SURFACE ELECTRIC RAILWAY SYSTEM—A small boy with an iron hoop, which he inserted into the slot of the London County Council's electric railway system, caused a short-circuit. The London *Electrician* says that the boy was not killed, as there was no member of the engineering staff near enough to do the deed!

Digitized by Google

Review of the Year in Great Britain and the Continent of Europe.

By C. L. Durand.

AS REGARDS electric light and power stations we find that a considerable number have been completed during the year, especially in Great Britain. The Northern Metropolitan Electric Power Supply Company has erected two stations of considerable size in London for operating a large tramway system. One of these, the Brimsdown power station, generates high-tension current at 11,000 volts. When complete it will have eight Babcock & Wilcox boilers, supplying steam to three 1,000-kilowatt Parsons steam turbine groups. Brown-Boveri alternators of 1,000 kilowatts each are used with these groups. High-tension current is sent to three substations in the city. In connection with this is the Willesden power plant, which also delivers current at 11,000 volts. It has four Babcock & Wilcox boilers and three direct-coupled units, one of 600 kilowatts and two of 300, with Ferranti engines and Westinghouse alternators. A 400-kilowatt Brush group is soon to be added. The Heston & Islesworth power plant has a dust-destroyer in connection with it. The plant is equipped with the water-tube boilers, two of which are heated by the dust-destroying furnaces. The dynamo room has two 200-horse-power engines coupled to 150-kilowatt dynamos. A third group of 400 kilowatts will shortly be erected. The Stoke electric lighting plant is another to use a refuse destroyer. It employs the three-wire system with 240 and 480 volts. The outfit comprises two Lancashire boilers and two Willans engines coupled to Dick-Kerr dynamos. The plant uses 300 horse-power at present.

On the Continent we note the two large stations at Budapest for lighting and power. The Schuckert company has installed one of these plants. It generates two-phase current at 2,000 volts and supplies it to three substations, where rotary converters lower it to 260 or 350 volts for the local circuits. A combined steam and hydraulic plant at Zurich may also be mentioned. The hydraulic outfit consists of ten turbines driving a common shaft. To this are connected four alternators. In connection with the former are several engine and dynamo sets, with three-phase, 2,200-volt Oerlikon alternators. A number of the Paris electric light and power plants are increasing their capacity. Among these may be mentioned the new Metropolitan station which is installing a second boiler room and a number of large generating sets with upright engines. The increase is needed to keep pace with the extension of the Metropolitan underground road. The tri-phase is a new plant in the suburbs which sends current to the city over a high-tension line. The Issy plant is installing four 600-kilowatt Westinghouse alternators to replace the machines of an older type and smaller capacity. These machines will run at 3,000 volts. A new substation of considerable size has been installed to supply the lighting current for the stations and tracks of the city belt railroad. It receives high-tension current from the Moulineaux central station.

A number of new hydraulic plants have been erected during the year, and some of the older stations have been increased by the addition of turbine units. In France, water power is used principally in the moutain region around Grenoble and also on the Mediterranean coast near Nice. In the former district may be noted two large plants which furnish current for the surrounding region. One of these is situated at Avigonnet and uses power from the Drac river, with a seventy-foot head of water. The station uses Piccard & Pictet (Swiss) turbines with Schuckert three-phase dynamos. These machines deliver 15,000 volts which is raised to 30,000 by a set of transformers placed in the station. Direct current is supplied to the La Mure electric road by a separate set, with a Thury dynamo. Not far from the preceding is a station located on the Bourne river which furnishes current for several towns in the region. The plant will contain six turbine units when completed. Schneider dynamos of 2,000 kilowatts are used here, and they furnish 4,000 volts, alternating current. This is raised to 36,000 volts by static transformers in the building. The Thomson-Houston company has lately installed a plant of some size not far from Nice; it is located at Plau du Var, where a ninety-foot head of water is secured from a mountain stream. Three Escher-Wyss (Swiss) turbine sets are used, with three-phase alternators of the company's make. These machines give 10,000 volts and operate at 400 revolutions per minute.

The Scotch water power syndicate which has lately been formed expects to develop hydraulic power in the mountain region of Scotland. Among the first plants it will erect is that of Loch Slog, and it expects to obtain a large amount of power from the lake. A dam will be erected at one end of the lake, which will raise its level by sixty feet. In this way they will secure at least 6,000 horse-power. An open canal and a penstock will bring the water to the station, giving a total head of 700 feet. High-tension lines at 4,000 volts will run through a flourishing industrial region which will no doubt use considerable power. Among the new hydraulic plants of Spain may be mentioned a large station which has recently been erected on the Ebro river by the Societa Hidrollectrica Iberica. It furnishes current for a fifty-mile high-tension line which runs to Bilbao, where the current is used for light and power. The power plant uses a seventy-foot head of water to run four 1,000-horse-power turbine and dynamo sets. Escher-Wyss turbines and Siemens & Halske dynamos are used. The latter are three-phase alternators delivering current at 3,000 volts. This is raised to 30,000 volts by step-up transformers. At Bilbao the line is received in a substation which lowers the voltage to 3,000. A second hydraulic plant is now in erection on the Ebro not far from the former. It will use a 130-foot fall and is designed for a capacity of 7,000 horse-power. Among other hydraulic plants recently erected in Spain may be mentioned the San Quirico station and another plant at Camdemola. At Vich, a 3,750-horse-power station is about completed. The falls of the Serge river are to be used for a high-tension plant which will distribute power throughout the region.

It is probable that the question of hydraulic power will soon be taken up in Russia, especially in the region near St. Petersburg. As to the total amount of power which the streams in Russia can furnish, this is estimated at no less than 10,000,000 kilowatts. There are twenty-four streams available, among which the Dnieper alone figures for 180,000 kilowatts. It is proposed to use the falls of the Vonoska region, near St. Petersburg, to furnish current for an extensive tramway system in the city.

We may also mention the new hydraulic

Digitized by Google

plant on the Rhine which a Swiss company is now constructing. It will obtain a 22,000-horse-power fall by means of a canal which is cut across a bend in the river. A large power consumption is assured in the surrounding district.

Electric traction on the main railroad lines is specially worthy of note, and in reviewing the past year we see that the three-phase system has made considerable progress. The Valtelline system of electric railroad is now operating very successfully. The Rete Adriatica Company has now taken definite control of the lines which the Ganz Electric Company had in charge during the first two years' run. The latter company recently delivered three new three-phase 1,600-horse-power locomotives for the road. They work on 3,000 volts and fifteen cycles. One feature is the use of a combined high-voltage and low-voltage motor on the same axle. The Valtelline railroad is soon to make a trial of the Finzi single-phase locomotive. The latter works at 3,000 volts, and takes current by a trolley. In Wales, three-phase locomotives are now running upon twenty-five miles of railroad between Port Madoc and Carnarvon. At present there are ten electric locomotives of 200 horse-power in use. Current is obtained from a 2,000-horse-power hydraulic plant, using a 1,050-foot fall. Current is generated at 1,000 volts, and twelve transformer posts along the railroad lower it to 600 volts for the motors. In Sweden it is proposed to use alternating-current locomotives on the government railroads. Preliminary experiments will be made on a stretch of track specially built for the purpose. Electric locomotives are to be supplied by the Siemens-Schuckert, the Westinghouse and the Allgemeine companies. The Stubaital railroad of Austria is the first on the Continent to use the single-phase system. Trains are made up of a motor-car and two trailers. The motor-car carries four single-phase motors of fifty horse-power each. The Union company, of Berlin, supplied the outfit. Current is obtained from a 5,000-horse-power hydraulic plant on the Sill river. The Oerlikon company will likely fit out an electric station on the St. Gothard railroad, from Ertsfeld to Bellinzona, on the three-phase system, using 15,000 volts and fifteen cycles, with transformers placed on the locomotives.

Regarding direct-current systems, we note the new locomotives which the British Thomson-Houston company recently furnished for the electrical section of the Newcastle railway. They are used for hauling freight trains, and resemble the locomotives which are used on the Orleans railroad in Paris. The Milan-Gallarate-Porto Cerisio railway system, which uses electric locomotives of the Thomson-Houston build, reports an increase of traffic and it is proposed to extend the line in the near future and run it as far as Lugano. We must not neglect to mention the London Metropolitan, which is making very satisfactory progress, also the different extensions of the Paris Metropolitan. A new branch of the latter was finished during the year. It uses a special fireproof locomotive equipped by the Westinghouse company.

In Russia, the St. Petersburg-Oranienbaum railroad, which is twenty-two miles long, is to run electric trains to take up part of the traffic. Russian engineers consider that electric traction could be used to good advantage on the Trans-Siberian railroad. The number of trains now running, forty to fifty per day, is not sufficient, but this can not be increased without using higher speeds, and for this the track would have to be built stronger. Electric trains would afford a good solution of the problem, at least over a part of the road. Denmark is to enter the field with a seventy-mile electric railroad which will run over a part of the island of Zealand.

Tramways have naturally had their share in the progress of the year. Among the new lines may be noted the large system which has been recently opened in the north of London, controlled by the Metropolitan Electric Tramways Company. Current is supplied from the Brimsdown and the Willesden stations above mentioned. The Wakefield & District tramway system is another one which opened lately. It contains a total of twenty-four miles of single track and connects with the Leeds tramway lines. The Maidstone corporation opened a traction line during the year. It uses 500-volt Dick-Kerr motors of thirty horse-power, mounted on Brill trucks. The Gruyère system in Switzerland is a three-phase line. It contains a number of branches, figuring about thirty miles in all. It uses 8,000-volt three-phase current which is supplied from a large hydraulic plant at Montbrun.

Among the new arc and incandescent lamps which have appeared during the year, we may note the Foster hot-wire arc, which is an English invention; it controls the movement of the carbons by the expansion and contraction of a pair of metal strips which are traversed by the current. One advantage is that it works equally well on direct or alternating current. One of the commercial types weighs but twelve pounds. The "Lilliput" arc, which Siemens & Halske brought out recently, has been followed by another small arc, the "Siva," constructed by Ehrig & Gratz. A new arc carbon invented in England is said to give good results. An inner core of carbon is surrounded by a layer of metallic salts and this in turn by an outer layer of compressed oxides. The latter serves as a sheath, while the carbon forms the arc and the light is increased by the vapors of the metallic salts. Carbons with different salts placed in a core in the centre, known as "intensive," are in use in various parts of Europe, and give a very pleasing light which is more diffused than the ordinary arc. As to incandescent lamps, the Allgemeine company, of Berlin, reports an increasing consumption of Nernst lamps. Some of the tests recently made on the Nernst lamp by the Hamburg inspectorate show a very good performance. The candle-power falls somewhat rapidly in the first twenty-five hours, but during the next 500 hours it holds up well. The efficiency remains between 2 and 2.5 watts per candle during several hundred hours. As regards photometry, we may mention the new method of Nisco. He uses a selenium cell with a galvanometer, but allows the light to fall on the cell intermittently. This he finds to give more constant results.

Electrochemistry and electrometallurgy have made considerable advances during the year both as to commercially working plants and new inventions and processes. Among the recent plants we may mention the new carbide works at Zwickau, Germany, which uses a hydraulic station to supply the current. Another successful plant is the Pappenburg electrometallurgical works, which is now producing copper and nickel by a modification of the Hoepfner process, using a solution of chloride. It turns out one ton of refined metal per day. The Gin electric furnace manufactures special low-carbon steels, containing nickel, manganese, vanadium or other metals, at a cost of sixteen dollars per ton of refined product. A prominent question is that of recovering tin from scrap. The Chem-Fabrik Elektron is using a new process at the Ploridsdorf works near Vienna, and the process is also employed at the Brenier metallurgical works in Germany. Caustic soda is used as the electrolyte. The Goldschmidt process with alkaline bath is now in use at Essen, Germany. A sulphuric acid

Digitized by Google

bath is employed in the Smith and Gutensohn process, and the tin is deposited on a copper cathode. Claus employs a hot solution of sulphostannate of soda for the bath, while Hemingway dissolves the tin in ferric sulphate in acid solution, and then deposits it on a copper plate.

Accumulators have been used on several of the new traction systems which have been opened during the year. A type of accumulator car is in successful operation on one of the Dresden suburban lines which forms part of the Saxony railways. The car holds ninety-eight passengers and has four axles, each equipped with a four-pole motor. There are 184 cells which are placed under the seats. The battery gives 430 ampere-hours at a 140-ampere discharge, and delivers 370 volts. Siemens & Halske have recently built an accumulator locomotive which contains 200 Hagen cells at 184-ampere-hour capacity at a two-hour discharge rate. The batteries are charged once a day at 110 volts and on the discharge they give 360 to 410 volts. A Swedish company is using Jungner cells on three large passenger automobiles which run between Nowkoping and Kneippbaden. They resemble the Edison cells, but are considerably larger. The active matter is a combination of iron and nickel hydrates placed in pockets in a sheet-steel plate. A perforated metal cover is then put on. The electrolyte is a twenty-per-cent caustic potash solution.

A satisfactory advance has been made in wireless telegraphy during the year. Italy is equipping a number of stations along the coast and in the interior of the country. The Monte Mario station at Rome and one in Sardinia will be used exclusively by the government, while public messages can be sent from the five other stations. The Bari station is one of the largest of these, and it has a range of nearly 400 miles. The Coltano station which is now building is to be a specially large one, and is intended to connect with South America. The Italian stations will signal to the different steamship lines, and most of the boats have apparatus on board. An extensive coast system is to be established in France. The Porquerolles station has now been opened to the public, and it will be followed by others on the Atlantic and Mediterranean coasts. The battleship St. Louis is said to hold the record for long-distance signaling, as it now covers 273 miles. A large station is to be erected at Constanza in Roumania which will communicate with ships in the Mediterranean. As regards Great Britain, we may mention the experiments which the army is carrying on in Wales near Carnarvon with the Lodge-Muirhead field apparatus. Signals are now sent between two stations placed twenty miles apart. In Germany a number of stations have been erected on the Slaby-Arco-Braun system.

An important point to be noted in the way of telephone developments is that the Pupin system is to be tried on some of the large interurban lines in Italy. The telephone system of St. Petersburg is now operating very satisfactorily and is now proposed to erect public telephone cabins in different parts of the city. At Vienna some experiments are being made with a new fireproof and sound-proof cabin which is claimed to be superior to anything now in use in this line. It is built of artificial stone tiles inserted in an iron framework. The new central telephone building which is about completed at Budapest has a capacity of 40,000 subscribers at the maximum, but will start with a much less number. The common battery system is used here. Wireless telephone experiments are being carried out in different parts of Europe. Professor Mosler, of Brunswick, Germany, uses a singing arc for this purpose and can signal from shore to boat at half a mile distance. Another system is used by Garcia in Spain. He places a microphone in series with an oscillator and thus modifies the character of the waves which the latter produces. The receiver is a Tommasi coherer combined with a telephone. As regards telegraphy, we may mention the agreement which the Danish government recently made with the Northern Telegraph Company as to the new Iceland cable. The cable will be landed on the east coast of the island and from this point a land line will run to Reykjavik, the principal locality. The other end of the cable will join on to the existing Danish cable at the Shetland Islands. A new invention which is worthy of note is the Orling-Armstrong electro-capillary recorder, which is intended to replace the siphon recorder. It is a modification of the Lippmann voltameter and contains a mercury column which rises and falls by the current. The image is projected on a screen so as to give a series of signals.

THE DESIGNING OF FIXTURES FOR MODERN LIGHTING.

BY A. H. PATTERSON.

In no line of useful wares entering into the furnishing and decorating of a house or building of any kind has greater or more rapid strides been made than in the designing and making of fixtures for gas and electric illumination.

It is not many years since the introduction of quality, appropriateness of design and finish, rather than bulk or massiveness, became a feature of fixtures for illumination, and there has been a steady advance and development, so that to-day the gas and electric fixtures are as correct features in appropriateness and harmony of design as are the other interior fittings and furnishings.

There is no exaggeration in the claim or statement that the fixture manufacturers of the United States to-day excel those of all other countries—in design, in finish and in features both decorative and useful.

Not only the fixtures must possess these truly artistic features and excellence of design and finish; but even the glassware accessories that are used with them, such as the globes, shades and imitation candles, must also possess the high qualities of harmonious design as do the fixtures on which they are to be used.

But a few years ago the highest example of a globe for a gas fixture, no matter what design it was an example of or how costly, was that known among dealers as a "Cut Crown," this being the highest type of a gas globe at that time. What a changed condition (and for the better) exists at the present time. Now the glassware used with lighting fixtures must possess character and appropriateness both as to the shape of the globe itself as well as the decoration placed upon it, and be in harmony with the fixtures—just as the fixtures must partake of the architectural and decorative features of the interior where they are to be placed and used.

American manufacturers engaged in these two lines can well feel a pride in their achievement, and the high class of goods produced by them; and also be congratulated for their continued effort in the application of real art (a much abused word) to their productions; thus keeping in close touch with and catering to the rapidly growing taste for and development of all that is "true art," as applied to the articles they manufacture —true allies of other lines devoted to the furnishing and decoration of interiors—each of which, in its line, makes possible "The House Beautiful."

Digitized by Google

Some Continental Central Stations Operating with Gas Engines.

By Franz Koester.

THE CENTRAL STATION AT ROMANSHORN.

AT THE time when the plans were being prepared for the installation of a pumping station at Romanshorn, Switzerland, attention was drawn to the advantages accruing from a combination of a central electric generating station with the hydraulic plant, the central station furnishing the current for lighting the railroad yard and the harbor of Romanshorn.

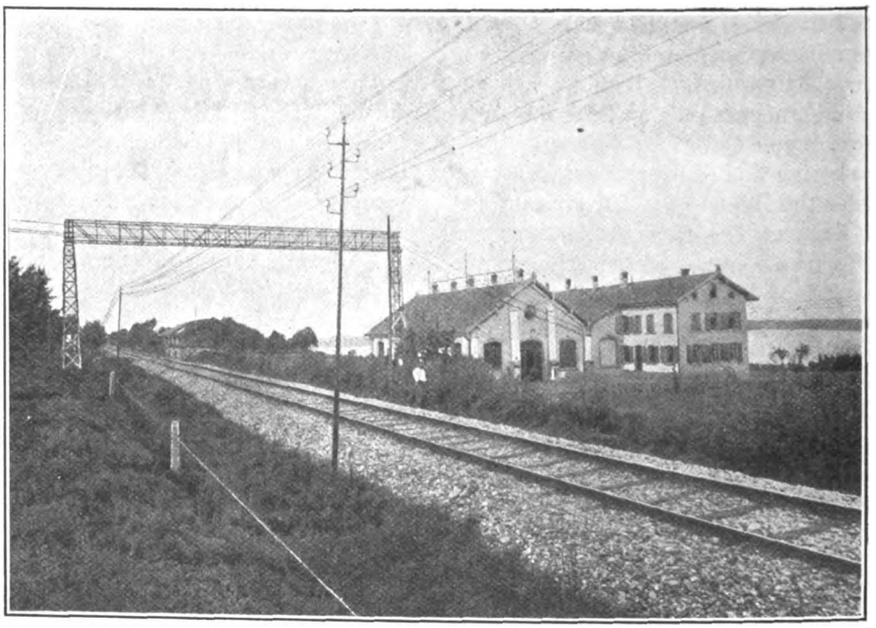
After careful study of the question, the company decided to combine the two enterprises and took the name of Wasser und Elektrizitatswerk, Romanshorn.

The enterprise had been encouraged at the start by the fact that the Railroad Company of the Northwest had contracted in advance to install twenty-eight arc lamps, representing a total of 28,000 candle-power, and 150 incandescent lamps, with a total of 2,400 candle-power. Further than this, the town of Romanshorn contracted in advance for 1,280 candle-power for street lighting. Later the town of Amrisweil contracted to take $2,400 worth of light per year, and the number of new contracts increased so rapidly that an important extension of the original plant was rendered necessary. On this account there were added to the plant equipment a single-phase alternator of sixty horse-power which served to supply current for incandescent lamps, and also two continuous-current generators of fifteen horse-power each for supplying current to the arc lamp circuits.

At the same time that the company decided to enlarge the power-house it also decided to furnish current during the day for operating motors, as many demands for this class of service had been made, and instead of using single-phase alternating current, which had been previously employed, it decided to introduce with the new installation a three-phase system which makes possible a more advantageous distribution.

In order to avoid making a complete change in the secondary wiring system and in the transformers which were already in place, it has kept the transformers as well as the secondary wiring and has divided, as equally as possible, the transformers for the single-phase current upon three conductors of the primary three-phase line; the new transformers being for the three-phase system. As soon as the new building was completed work was commenced on the installation of new gas engines, and later on the installation of the dynamos. The first group of machines was in regular operation inside of four months, and the second group and the transformer station inside of five months. The plans provide for a later installation of a third group similar to the first two.

The work on the line to Amrisweil was completed and the line in operation for regular service within two and one-half months after the beginning of the work. The first gas engines were manufactured by Crossley Brothers, Limited, the two new engines by the factory of Dentz. The entire electric installation was obtained from the works of the Oerlikon Construction Company, of Switzerland.



EXTERIOR VIEW OF THE "ROMANSHORN, SWITZERLAND," GAS-ENGINE-DRIVEN CENTRAL STATION.

The power-house is built on the banks of lake Constance, about the centre of the town, and so close to the railroad line as to be most convenient for the delivery of the fuel supply. The ground floor is divided into three distinct parts: the engine room containing 399 square metres, in which are located the pumps, gas engines, generators and switchboards; the second part containing 160 square metres, in which is installed the gas-producing apparatus; and the third part, consisting of a workshop, containing 120 square metres.

The engine room is spanned by two hand-operated traveling cranes of 2,000-kilogramme capacity each. At the side of the building there is a coal-shed connected to the gas-producing room by a narrow-gauge track. The gas-generating apparatus consists of three Hirzel producers, and a fourth, recently procured from the factory of Dentz, the total capacity being 250 horse-power.

The process of gas production is as follows: from two vertical boilers superheated steam of six-atmosphere pressure is raised and led to the generators which are provided with steam-jet blowers, and in passing through these blowers the steam carries with it the air necessary for the formation of the gas. This mixture of steam and air passes over the mass of burning coals in the generators, where it is converted into gas. The gas is composed of about forty per cent of combustible parts (CO, and H). After leaving the generators the gas is purified by introducing it at the bottom of a scrubber filled with coke and which is provided with a water-spray. From the scrubber the gas is passed through filters filled with sawdust and it is then led to a common storage tank having a capacity of fifteen cubic metres. From this storage tank are led the feed-pipes for the engines.

At the northern extremity of the engine room are two Crossley gas engines of sixty

Digitized by Google

and forty horse-power, respectively. They drive a transmission shaft by means of pulleys and belts. From this shaft are driven a plunger-pump, located in the cellar, and also a generator. At the side of the plunger-pump there is a high-pressure centrifugal pump coupled to a three-phase-motor, which will be mentioned later.

The southern side of the power-house is occupied by two gas engines furnished from the factory of Dentz. They are twin horizontal machines with the fly-wheel in the centre and are belted to the generators. At 180 revolutions per minute these engines have a normal capacity of 120 horse-power, and a maximum of 140 horse-power. Each engine is provided with an admission and an exhaust valve, a gas valve under control of the governor and an electric ignitor. The engines are started by means of compressed air, and for this purpose there is placed in one corner of the building an air compressor operated by a vertical gas engine of two horse-power.

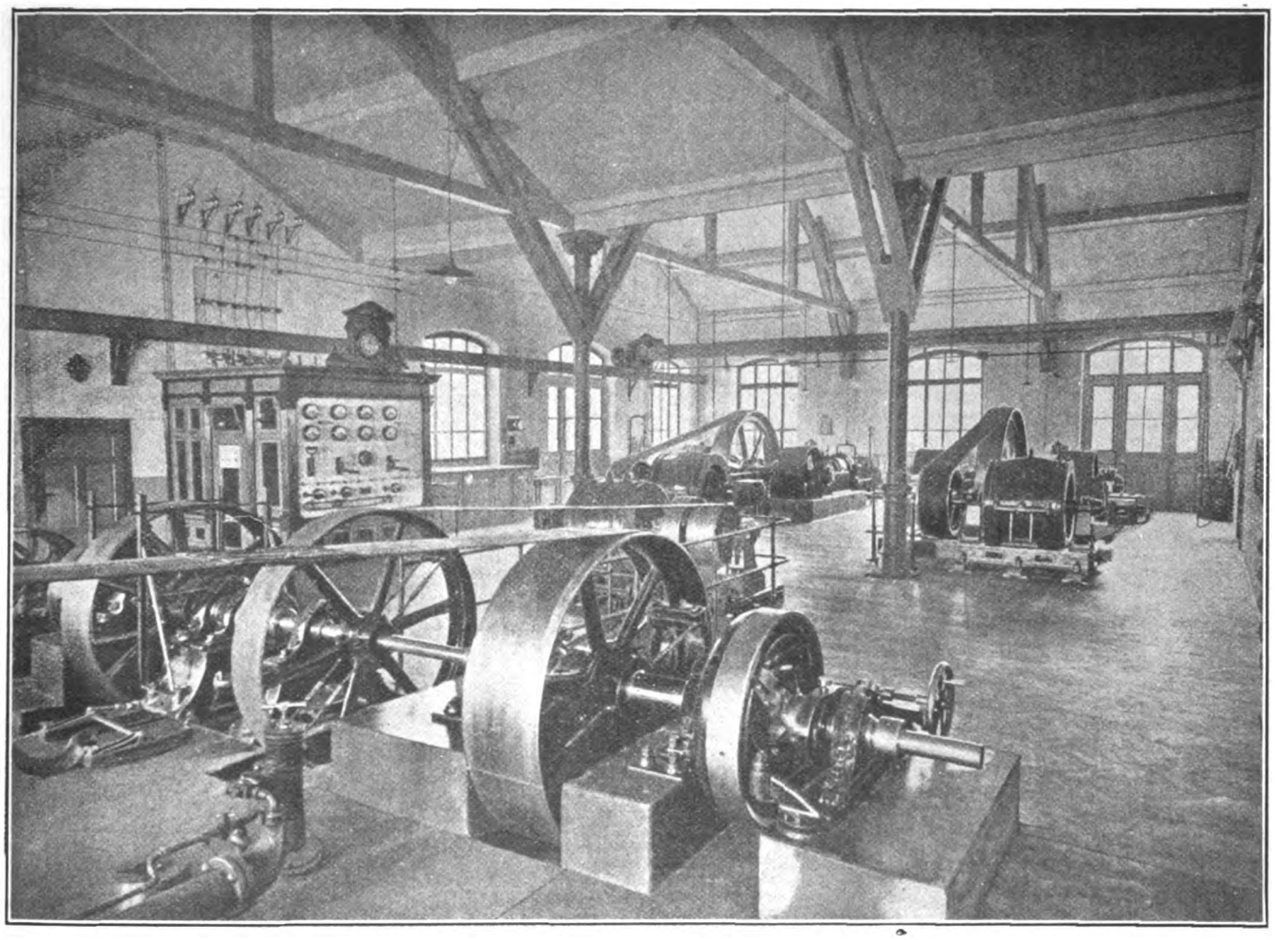
This compressor is used to fill a tank which has a capacity of about 400 litres, the pressure varying from eight to ten atmospheres. This requires about thirty minutes' work on the part of the small engine. The generators operated from the intermediate shaft are of the Oerlikon type, and they run normally at 600 revolutions per minute and produce three-phase currents at 2,250 volts and fifty cycles.

Each of the two halves of the armature is connected in series and contains fifteen coils placed in thirty slots. Each coil is composed of forty-eight turns of copper wire 2.8 by 3.4 millimetres. The exciter is of the same type as that of the large generators and is mounted upon the shaft of the machine. The two alternators operated by the Dentz engines are of the Oerlikon type, and at a speed of 5,000 revolutions per minute furnish three-phase currents at 2,250 volts and fifty cycles per second. Each half of the armature carries eighteen coils, each coil consisting of twenty-five turns of copper wire 4.2 by 4.8 millimetres, the two halves being connected in series.

The switchboard consists of five marble panels carried on an iron framework and is provided with all the apparatus necessary for the four generators and the distribution system. The centre panel is reserved for the distribution system, three other panels carry the apparatus and measuring instruments for the generators; for instance, one ammeter, one voltmeter, one switch and a hand-wheel for the field rheostat.

Behind the switchboard are located the circuit-breakers, the rheostats, measuring transformers and the fuses for the machines. In front of this apparatus are located the main circuit-breakers for the three lines and an ammeter for each line. From the bus-bars are led three high-tension lines, one feeding a transformer in the power-house, the other going to Romanshorn, and the third to Amrisweil. Where the line crosses the railroad, bridges have been constructed in order to avoid any accidents which may result from the breaking of a cable. The line to Romanshorn consists of three conductors five and one-half millimetres in diameter, that to Amrisweil three conductors eight and one-half millimetres in diameter. The wires are fastened to porcelain insulators and carried on wooden poles. In the Romanshorn line 270 poles are used, and 340 in the line to Amrisweil; the length of these being respectively 4,700 metres and 7,200 metres.

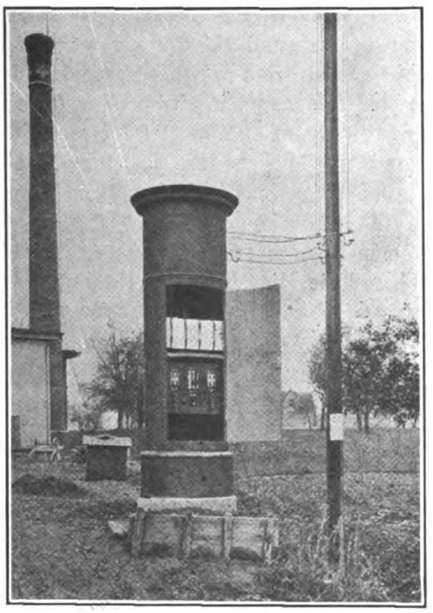
The conductors which feed the transformers for the line are equipped with circuit-breakers carried on wooden poles.



INTERIOR OF POWER-HOUSE, GAS-ENGINE-DRIVEN CENTRAL STATION, AT "ROMANSHORN," SWITZERLAND.

Digitized by Google

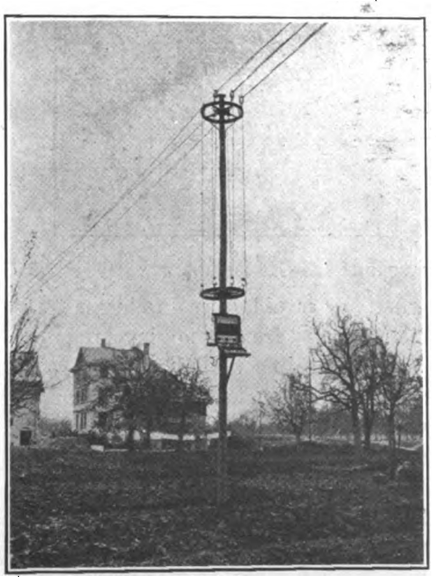
this arrangement allowing a transformer to be cut out if necessary. The transformers are placed in special buildings,



TRANSFORMER HOUSE ON THE "ROMANSHORN," SWITZERLAND, LINE.

there being six at Romanshorn and four at Amrisweil.

The transformer in the power-house furnishes current at 190 volts to the motor which operates the pump. The transformer station in the engine house consists of three transformers, of which one (2,250 to 190 volts) supplies the motor of a motor-generator group and the two others (2,250 to 110 volts) furnish the current for the incandescent lamps.



HIGH-TENSION FUSES AND CIRCUIT-BREAKERS ON THE "ROMANSHORN," SWITZERLAND, LINE.

At Romanshorn the secondary current is distributed partly as single-phase and partly as three-phase, while at Amrisweil three-phase currents alone are employed. In the former instance the secondary line is 6,500 metres long, and in the latter 5,100 metres. The motor-generator group consists of a three-phase motor of twenty-eight horse-power which operates two fifteen-horse-power, continuous-current generators, the motor being coupled to the generators by elastic insulating couplings. These machines were originally located in the power-house, but as the continuous current was used entirely for the arc lamps which are located at the railroad station and at the harbor, it was finally decided that in order to diminish the loss in the line and to obtain a steady light to transfer the motor-generator group to the locomotive round-house.

A small switchboard located near the machines carries the necessary measuring instruments and apparatus. Besides the motor cited above, there is also a three-phase motor of twenty-eight horse-power installed in the power-house itself. This motor operates a plunger-pump which raises the water to a height of seventy-four metres. The pump runs at a speed of 980 revolutions per minute. In addition there are also connected upon the line ten other motors with a total of thirty horse-power which are used for various industries.

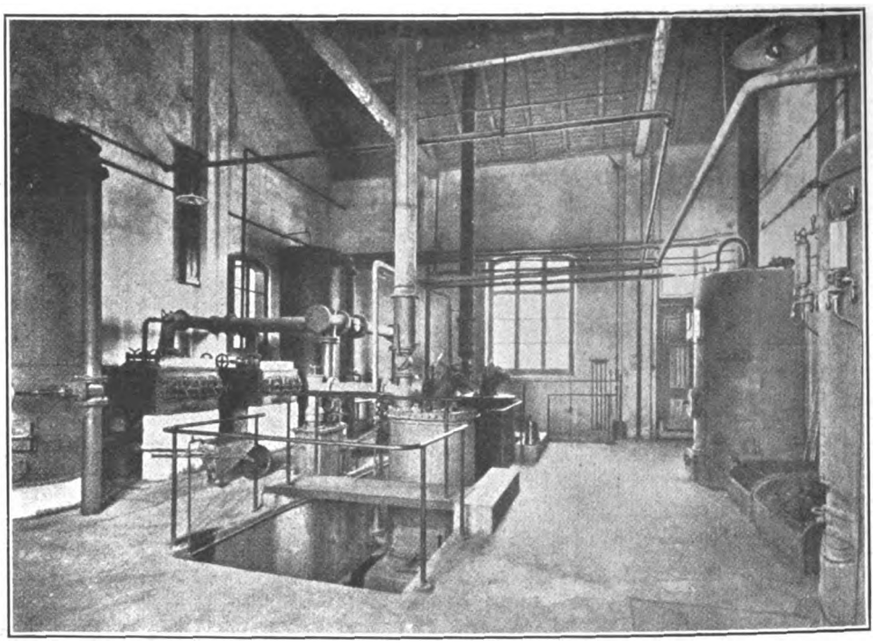
The lighting system comprises thirty arc lamps and 3,669 incandescent lamps, representing a total of 44,978 candles.

LIGHT AND POWER DISTRIBUTION AT USTER, SWITZERLAND.

The town of Uster is situated near lake Greifen in the canton of Zurich. In order that the industries of the town should continue it was necessary to create a source of power for the mills. The town recognized this necessity and decided upon the construction of an electric plant.

A special commission for studying the question was appointed and they decided to build a power plant which would furnish current for lighting and power purposes. The furnishing of the complete electrical equipment and the work of installation were placed in the hands of the Oerlikon Construction Company.

The building erected contains a room for the Dowson gas generators (117 square metres), the engine room (234 square metres), the storage battery room (seventy-three square metres), a coal storage room (thirty-six and one-half square metres), and a room for the gas-holders (thirty-six and one-half square metres).

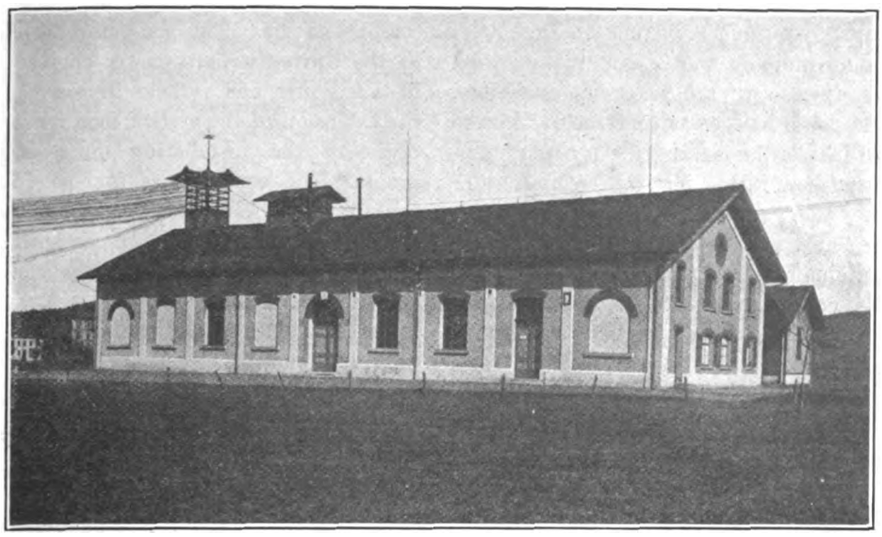


GAS GENERATOR ROOM OF THE "USTER," SWITZERLAND, POWER PLANT.

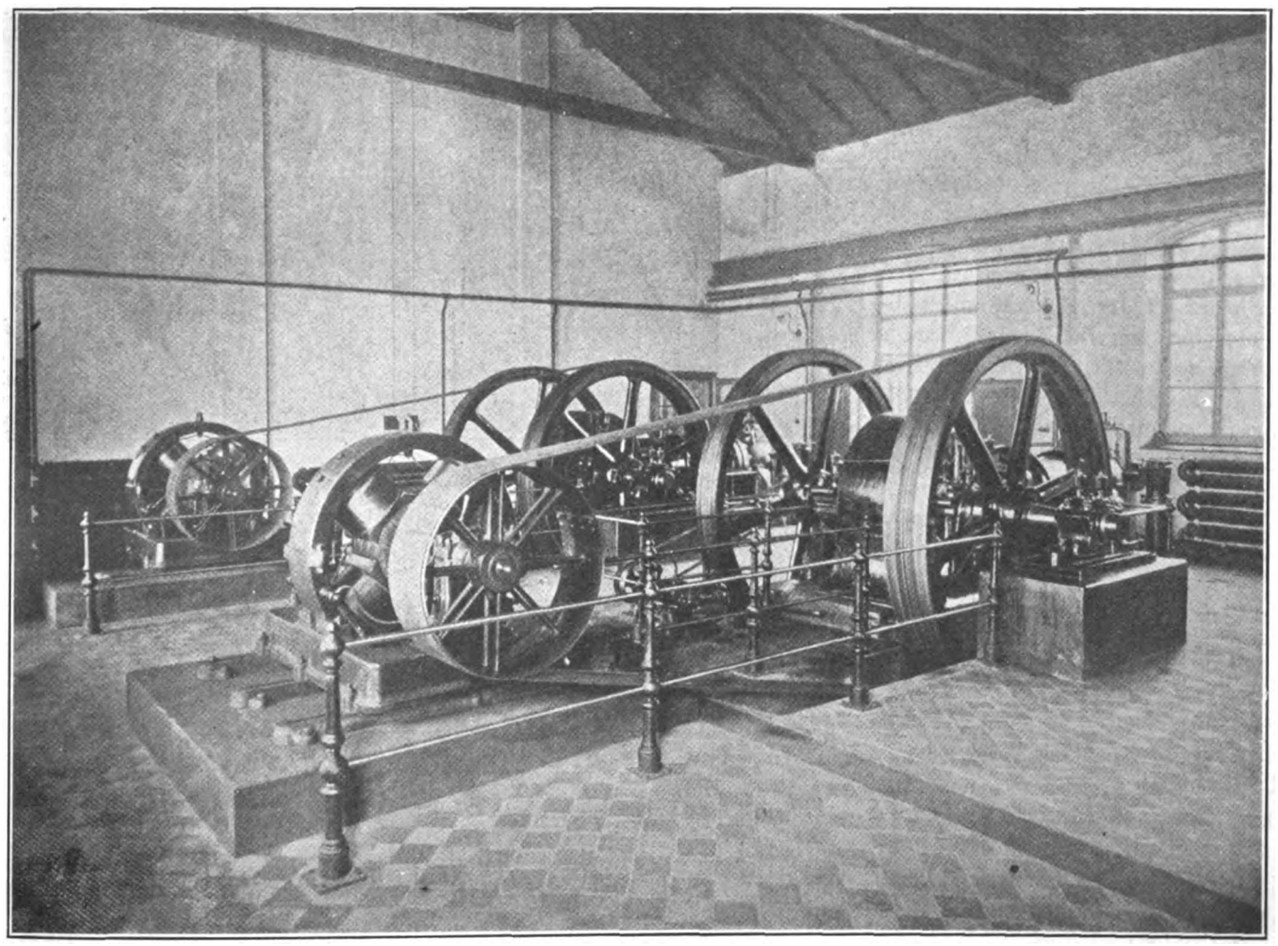
Below the coal storage is a reservoir for the cooling water for the cylinders. The gas generators, as well as the two gas engines, were furnished by the Dentz company. Each of the two generators can produce sufficient gas for one 125-horse-power engine, and in addition there have been installed a steam boiler and the necessary apparatus for purifying the gas. Provision has been made for a third generator and the necessary purifiers. The storage tank has a capacity of thirty cubic metres. The two gas engines have each a normal output of eighty horse-power, but can furnish 100 horse-power. They are both connected to the dynamos. The gas is ignited by means of an electric spark, the current being furnished by the storage batteries. The engines are started

Digitized by Google

by means of compressed air. Each engine is furnished with two flywheels, one of which acts as a pulley. The generators are shunt-wound and built by the Oerlikon company. They operate at a speed of 175 volts, and a special arrangement permits of connecting the two collectors of the same machine either in series or in parallel, thus allowing the two halves of a storage battery to be charged either in



THE "USTER," SWITZERLAND, GAS-ENGINE-DRIVEN CENTRAL STATION.



INTERIOR VIEW OF ENGINE ROOM, "USTER," SWITZERLAND, GAS POWER CENTRAL STATION.

560 revolutions per minute and furnish a direct current of 200 amperes per commutator, of which there are two. The voltage at the brushes of one of the commutators can be varied between 125 and series or each half separately. The storage battery is composed of two sets of seventy elements and has a capacity of 800 ampere-hours.

The diameter of the armature is 520 millimetres and the length 360 millimetres. The armature has 116 slots 6.5 by 2.4 millimetres. Each slot carries two conductors 4.7 by 5.2 millimetres. Each commutator is composed of 116 laminations of copper separated by strips of mica 0.6 of a millimetre thick. The field bobbins on the four spools are connected in series and consist of 968 turns, wound in sixteen layers, the wire being 2.2 by 2.6 millimetres.

From the generators the current is led to the switchboard which carries the measuring instruments and the necessary safety apparatus. It also carries two automatic regulators, one for each half of the battery. Interrupters and switches, by means of which the generators may be thrown either on the line or on the battery, or the generators and battery arranged to operate in parallel upon the line, are provided. This arrangement, which is both ingenious and practical, permits of obtaining during the periods of heavy load a current almost double that which would be obtained from the generators alone. The distribution system is common for light and power, and is built with three conductors. The voltage between the extreme conductors

Digitized by Google

which are used for the motors is 250. The lamps are operated at 125 volts. Both incandescent and arc lamps are used, there being 2,565 incandescent and eight arc lamps. The aggregate number of motors on the system is twenty-one, representing a total of 140 horse-power.

During the morning the generators are run until the battery is charged, this requiring more or less time according to the season. In the afternoon the power plant is in operation from four to six hours, the time varying according to the season. During the night the battery alone furnishes the necessary current. Three men are required to run the plant, two of them being always on duty. For lighting current three tariff schedules have been adopted.

TARIFF I.

For a lamp of	5	c.-p.,	0.24	cent	per hr.
" "	10	"	0.40	"	"
" "	16	"	0.64	"	"
" "	25	"	1.00	"	"
" "	32	"	1.28	"	"

TARIFF II.

For a lamp of	5	c.-p.,	1.6	dollars	per yr.
" "	10	"	3.2	"	"
" "	16	"	5.0	"	"
" "	25	"	8.0	"	"
" "	32	"	10.0	"	"

TARIFF III.

In cases where a meter is used current is charged for at the rate of sixty-four centimes, or 12.8 cents per kilowatt-hour.

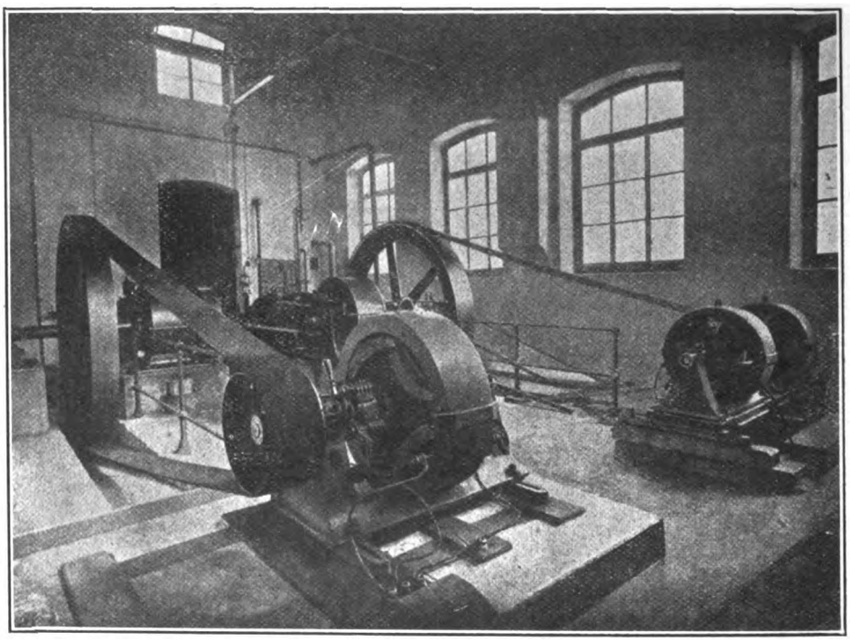
For a factory where current is used eleven hours per day, Sundays and holidays excepted, the fundamental tax is three cents per effective horse-power per hour. Upon this price are given the following reductions:

Horse-Power.	Kilowatts.	Reduction. Per Cent.
1	0.9	1
2	1.8	2
3	2.7	3
4	3.6	4
6	5.4	6
8	7.2	8
10	9.0	10
12	10.8	12
14	12.6	14
16	14.4	16
18	16.2	18
20	18.0	20

For a greater consumption the price is fixed in advance.

DISTRIBUTION OF ELECTRICITY FOR LIGHT AND POWER AT STÄFA, SWITZERLAND.

The town of Stäfa contains about 4,000 inhabitants and is located on the right bank of the lake of Zurich. With the exception of some large factories which have their own electric plants, the town, up to the time of the installation of the plant here described, was lighted by petroleum lamps. The insufficiency of these latter gave rise to a desire for a more practical and less dangerous lighting system. The number of small industries in the town being sufficiently great to warrant a power plant, the plan of joining the lighting system with that of a power distribution system was considered and adopted. It was decided to employ continuous current and the Oerlikon company was given the contract for furnishing the necessary machines. The power-house was constructed close to the lake, after making the necessary provision for furnishing the cooling water for the engines. The power-house is of masonry construction and contains three rooms, one for the gas generators (55.6 square metres), the engine room (eighty-four square metres), and the storage battery room (27.6 square metres). The latter is divided into two compartments, one above the other, and each contains one-half of the elements. The lower room is accessible from the engine room, while entrance to the upper room is obtained through the gas-generator room.



ENGINE ROOM OF THE "STÄFA," SWITZERLAND, GAS ENGINE POWER PLANT.

The size of the gas-producing apparatus is sufficient to furnish gas for engines of a total of ninety-five horse-power. In the engine room are two gas motors of sixty and thirty-five horse-power, respectively, built by the Société Suisse de Lokomotives at Winterthour. Each engine is provided with a flywheel which is used as a pulley. The flywheel of the smaller engine is 2,600 millimetres in diameter and makes 180 revolutions per minute. That of the larger engine is 3,000 millimetres in diameter and makes 160 revolutions per minute. The cylinder diameters are 300 and 370 millimetres, respectively. The effect of the governor is such that with variations of load on the engine the proportions of the mixture of the gas and air are changed.

Both engines are started by means of compressed air. The generator operated by the thirty-five-horse-power engine was installed first and is held in reserve, as the extension of the system soon rendered necessary the installation of a larger group. The generator is four-pole, and has two commutators. It requires thirty-five horse-power and runs at 1,150 revolutions per minute. At the end of the shaft is a pulley 430 millimetres in diameter. The voltage at the brushes on each commutator can be varied between 120 and 175 volts, and the two commutators may be connected either in series or in parallel in order that the two halves of the battery may be charged together or separately. The construction of these generators with these commutators is no more complicated than that of generators with but one, and the operation is also quite as simple.

The diameter of the armature cord is 390 millimetres and the length is 270 millimetres. The armature contains 138 slots 21 by 4.8 millimetres, each slot holding two conductors composed of two wires in parallel, the wires being 3.4 by 4 millimetres.

The exciting current is obtained from one of the commutators. Each commutator is composed of sixty-nine bars of copper, insulated from each other by strips of mica 0.6 millimetre thick; the diameter of the pole bore is 404 millimetres, the

Digitized by Google

field consisting of four bobbins connected in series, each of which consists of 609 turns of copper wire 2.2 by 2.6 millimetres. The sixty-horse-power gas engine drives two four-pole generators which absorb thirty horse-power each and which are on the same shaft. They run at a speed of 1,100 revolutions per minute. Each generator furnishes a maximum current of 160 amperes, the tension varying from 120 to 175 volts. The generators are mounted upon the same bed-plate and carry on the shaft between them a common pulley 430 millimetres in diameter and 350 millimetres face.

The diameter of the armature is 316 millimetres and the length of the iron is 250 millimetres. The armature has eight slots of 6 by 20 millimetres each, enclosing two conductors composed of two wires 4 by 4.6 millimetres in parallel. The commutator is built up of eighty-one copper bars insulated by strips of mica 0.6 millimetre thick. The diameter of the pole bore is 324 millimetres. Each pole carries a coil composed of 725 turns, the four coils being connected in series.

From the generators the current is led to the switchboard which carries the necessary measuring instruments for each machine. There are also two automatic regulators, one for each half of the battery, and switches which allow the generators to be thrown on the battery or directly on the line. The three-wire system of distribution is used, the same lines answering for both light and power. The pressure between the two outside conductors is 240 volts, this pressure being used for motors and for the lamps for public lighting. Other lamps for private lighting are connected between one outside and the central conductor and which gives a pressure of 120 volts.

Five main circuits are led out from the central station, of which three are composed of four wires seven millimetres in diameter, one circuit with two wires eight millimetres in diameter, and one seven millimetres in diameter, and a sixth circuit consisting of three wires six millimetres in diameter. An additional circuit of three wires four millimetres in diameter is led from the power-house and is used to balance the current in the system. One line from this station serves all the lamps for public lighting. The lines are carried either upon poles or are fastened to houses. Each pole is furnished with a lightning-rod. At all railroad crossings the lines are run underground. The battery is composed of two parts of seventy elements and has a capacity of 540 ampere-hours. There are used 1,350 incandescent lamps, representing a total of 17,000 candle-power, and seven motors, representing twenty-five horse-power, are connected to the line.

During the morning the generators operate to charge the battery, this requiring more or less time according to the season. The generators are also operated from four to six hours in the afternoon, while during the night the battery is able to furnish the necessary current. The annual charges for ten-candle-power lamps are given in the following table:

	Hours Lamps are in Use.	Charge.
Sparsely settled localities.	1 to 250	$1.00
Residences	250 to 500	2.00
Stores	500 to 800	3.20
Restaurants	800 to 1000	4.00

Where a large number of lamps are used in residences meters are employed and the current paid for at the following rates:

	Charge per Kw.
For a consumption of less than $20 00 worth of current	17 cents.
For a consumption of more than $20.00 worth of current	14 cents.
For restaurants	13 cents.

For motors operating eleven hours a day, Sundays and holidays excepted, the rates are as follows:

Size, Horse-Power.	Price per Horse-Power-Hour.
½ to 2	3.0 cents.
2 to 4	2.8 "
4 to 6	2.6 "
6 to 12	2.4 "

Early Cable Work.

In an interview with Mr. Henry A. Reed, one of the pioneers in the manufacture of cable insulation, an interesting fact developed as to the use of the first cable. Said he:

"This cable was of No. 9 iron wire, insulated to the thickness of half an inch and was made in 1847 by Stephen Armstrong in Brooklyn, N. Y. It was laid across the North river at about Fort Lee. It only worked a few days when it was dragged out of place by a ship's anchor.

"The first iron-armored cable was made by S. C. Bishop in 1852, and was used across the North river, above Cold Spring. This cable was of No. 14 copper wire with an insulation the size of No. 0, protected by jute and armored with iron wire about No. 8.

"It's a matter of common history that the year before, the first iron-armored cable was laid across the Straits of Dover."

In an interesting collection pertaining to the early history of cable work Mr. Reed has a piece of gutta-percha cable encased in lead, used by the Prussian government in 1847. This was the first gutta-percha cable used underground of which record exists. This was brought from Berlin by Tall P. Schaffer in 1856, and was used by S. C. Bishop in opposing the granting of the Simpson patent. It was also used by Mr. Henry A. Reed, the present manager of the Bishop company, in defeating the Colgate suit for infringement against the Bishop estate in 1878-1880.

Steam Turbines for Driving Dynamos.

In referring to the employment of steam turbines for driving dynamos, in his presidential address, delivered before the Manchester section of the Institution of Electrical Engineers, of Great Britain, Mr. C. D. Taite said in part as follows: "The manufacture of direct-current dynamos suitable for the high speeds at which turbines have to be run has not yet become general practice, although there are a fair number of successful turbo-driven direct-current generators in operation, but, generally speaking, they are of comparatively small size. It is now clear, however, that turbo-alternators can be satisfactorily designed and built for almost any power, and we shall shortly have running the power station of the underground railways in London, equipped with ten 5,500-kilowatt turbo-alternators, these machines being capable of carrying a load of fifty per cent above that at which they are rated. The advantages of turbines have been enumerated so frequently that there is no need to tabulate them here. I would only call attention to two of them, *viz.*, the great capacity they have for overloads, and, secondly, the saving in capital expenditure which their adoption renders possible. A fifty per cent overload can be maintained permanently on a turbine with little loss of efficiency, the principal loss being generally in the reduced vacuum. It is, therefore, important when ordering turbo-driven plants to specify for ample margin in the generator, in order to take advantage of the overload capacity of the turbine, a feature likely to be of the utmost utility in central station work. With regard to the reduced capital expenditure required with turbo-driven plants, it is obvious that the plant itself costs much less than a slow-speed set of similar output, and owing to the reduced weight, the even turning moment, and the absence of all downward thrust, the foundation can be made much lighter. Again, a turbine plant—even of the vertical type—can be housed in a comparatively low building, and the floor space occupied is a minimum. On the other hand, in order to get the best results from a turbine, an ample water supply for condensing purposes is essential, and this to some extent restricts the choice of a suitable site. As regards coal consumption, the advocates of turbines and of reciprocating engines both claim the best results for the type which they favor, but I think that one will not be far wrong in stating that with regard to this feature there is little to choose between the two types, when both are working under suitable conditions."

Digitized by Google

ELECTROLYTIC PREPARATION OF TIN PASTE.[1]

BY F. GELSTHARP.

Tin paste is used for the production of metallic or silvered paper, having the appearance of tin or lead-foil, and it is also used for ornamental purposes. As I believe members are interested in any process in which electrochemistry advantageously takes the place of the older chemical methods, I beg to bring before the Faraday Society the following description of a process for manufacturing tin paste which was specially designed for a firm of paper-makers. The oldest method of making tin paste was that carried out by the natives of India. They melted block tin at a high temperature, and poured it into a wooden box, which was then shaken vigorously, the tin was thus converted into very fine shot and dust. The finer particles which they used for the paste were separated from the coarser granules by gravitation by means of water. It was afterward dried and mixed with a weak solution of glue, and in this state it was ready for use. This they used as a paint, the article to be ornamented was coated with it, and after being dried it was burnished.

The chemical process for making tin paste, as generally carried out in England, is as follows: the commercial ingot is reduced to what is known as feather tin by melting it, and then allowing it to fall some distance. The tin in this form is dissolved in strong hydrochloric acid, with the aid of heat, in copper vessels, and a concentrated solution of stannous chloride thus obtained. The liquid is diluted, and the tin precipitated in the form of paste by introducing metallic zinc. The process is troublesome on account of the fumes, and, moreover, does not give the whole of the precipitated tin in the form of paste, but partly as bright metallic feathers and crystals, which have to be worked over again; whereas in working the electrolytic process about to be described there are no fumes, and the paste is perfect in every respect. Further, the process is not so costly and can be worked continuously, the deposited paste being removed at intervals without stopping the current.

The electrolytic process is similar to the electrorefining of metals. Anodes of tin are dissolved in an electrolyte of dilute hydrochloric acid, and the tin is deposited in the form of a sponge or paste on cathodes of the same metal. The spongy deposit is lighter than the electrolyte, on account of the hydrogen it contains, and consequently floats on the surface of the solution after being detached from the face of the cathodes, so that it can be conveniently removed without breaking the current.

An apparatus capable of producing twenty hundredweight of tin paste per week consists of a generating plant giving 1,500 amperes at eight to ten volts. There are five vats, which are worked in series and are made of slate or pitch-pine wood 106 by 106 by 91.5 centimetres deep (three feet six inches by three feet six inches by three feet deep), each containing four anodes and five cathodes coupled in parallel. The anode plates are about 2.5 centimetres (one inch) thick, roughly cast from commercial ingots of tin; the surface exposed to the electrolyte being 91.5 by 76 centimetres (three feet by two feet six inches). The cathode plates are of block tin or tinned iron, the active surface being 91.5 by 76 centimetres (three feet by two feet six inches). The anodes are supported at the two top corners, and in each vat are all connected to one conductor. The cathodes are supported by and soldered to copper conductors, which are all connected to a main conductor. These main conductors are circular copper bars 3.2 centimetres (one and one-quarter inches in diameter). The electrolyte is a dilute solution of hydrochloric acid in five degrees Tw., which must be free from arsenic. The current density is 270 amperes per square metre, or twenty-five amperes per square foot of cathode surface.

As the anodes are dissolved away they are removed before they crumble and fall to pieces, and what remains of them is melted up with fresh ingots and cast to form new anodes. The electrolyte is kept in circulation by means of a small turbine or plunger pump of lead or block tin, driven by a small motor; the liquid is drawn from the bottom of the vats and discharged into the top; this is found necessary, as otherwise the electrolyte at the bottom of the vats would soon become very rich in tin, and instead of tin paste at the lower parts of the cathodes there would be crystal or leaf tin deposited.

When the deposited tin sponge has grown to about an inch in thickness it is detached from the cathodes by means of a T-shaped scraper, which is pushed down the face of the cathode plates; the floating, spongy tin is removed from the surface of the vat by means of a perforated scoop to prevent short-circuiting of the current through the floating tin; the cathode plates are varnished or painted with a non-conducting material from 5 to 7.5 centimetres (two or three inches) below the surface line. The tin paste is allowed to drain, and is then thoroughly washed with water and dried to make it ready for use.

This may not seem to be an efficient way of utilizing the electric current, because the current-efficiency is only about fifty per cent; but any attempt that I have made to produce tin in the form of paste or sponge at a higher efficiency has been futile; it appears to be necessary to have hydrogen deposited along with the tin, for when no hydrogen is deposited the tin comes down in a crystalline or bright leaf-like form.

[1] Paper read before the Faraday Society, London, England, December 19, 1904.

Utilizing the Magnetic Pull of Dynamos for Adjustment Purposes.

Quoting from a German contemporary, the London *Electrician* describes an instructive case where the air-gap of a 2,400-kilowatt, three-phase alternator was adjusted by utilizing the magnetic attraction between stator and rotor. The generator is driven by a horizontal steam engine, and from the very beginning it appears that the air-gap on the steam-engine side measured only four and one-half millimetres, while the gap on the opposite side was five and one-half millimetres. During the course of two years' operation the one-sided pull produced by these conditions caused the bearing to wear away on one side, and the rotating part shifted three-quarters of a millimetre toward the engine. The diameter of the shaft is 19.65 inches. Short-circuits now occurred more and more frequently, and when it was found that the stator frame had shifted bodily, and that the rotating part touched the stationary part, the generating set was shut down at once; but it was necessary to get it in operation again as soon as possible. The station is served by a traveling crane, but this machine has been designed for twenty-five tons only, and as the stationary portion of the generator weighs fifty-one and one-half tons, it was necessary to find other means for shifting the magnet frame. There was some hesitation about using jacks for pushing the frame over, as it was feared this would cause distortion. It was then decided to make use of the magnetic pull, which could be set between the rotor and the stator so as to equalize the air-gap. To do this a current was sent through one-half of the rotor. This current caused a one-sided pull upward at an angle of forty-five degrees to the horizontal. When the current through the rotor reached eighty amperes, the frame began to move, and by cautiously varying this current a fine adjustment was obtained, the time required for resetting the frame in its original position being but one and one-half hours.

Digitized by Google

A Review of the Storage Battery Situation for the Year 1904.

By Lamar Lyndon.

THERE have been few, if any, important changes or improvements in the storage battery art during the past year. The alkaline batteries so widely heralded, and on behalf of which so much was promised, have, so far, entered but little into the commercial field. The lead battery manufacturers continue to do business at the same old stand and the shareholders in the various battery companies seem to be reasonably well satisfied with the financial results for the year.

One of the events of the year is the final completion of the organization, technical details and factory of a new battery manufacturing company which has for four years been engaged in the long and expensive preliminary work required to prepare for actual business. With a high-grade battery, a well equipped factory, a complete line of auxiliary devices and large capital, it promises to become an important factor in the battery trade. According to verified reports the business announcement of this new corporation will shortly appear and it will actively enter the field within the next thirty days.

There has been a marked change in the methods of regulating automatic boosters. Booster-controlling batteries which regulate fluctuating loads, have heretofore been arranged to vary their voltages automatically with load changes, by passing the load current, or a part thereof, through series windings on the field-poles of the booster itself or of a separate exciting dynamo which energizes the booster field. This requires windings of large cross-section and necessitates the use of large frames with field-poles of excessive length for comparatively small outputs. Furthermore, such boosters do not compensate for changes in condition of the battery with respect to age, temperature, electrolyte density and state of charge, all of which may act to change the required booster voltage for a given load.

The recent boosters have on their fields ordinary shunt-windings with resistances interposed in the field-circuit, which resistances are automatically varied by a solenoid, the core of which is spring opposed, and the winding of which is energized by the load current. The solenoid core, therefore, varies its pull with variation in load, and thereby varies the resistances in the booster field-circuit and in this manner the booster voltage is made to correspond to the load requirements. This method is a distinct improvement, in that smaller machines without special windings may be used, which work at a higher efficiency and the regulation is better, the operation of the system being such that the condition of the battery is compensated for.

It is safe to say that the year 1904 marks the passing of the booster excited directly from the load current.

Despite predictions made a year or two ago that the Planté negative plate would be discarded for the pasted negative, the former is still in extensive use and there are no present indications that it will pass out of commercial existence.

In motor-car batteries the state of the art remains practically unchanged, and there have been within the past year no modifications worth noting, excepting, perhaps, the extension of the use of the wood separator which is now general practice. Manufacturers have learned that business is not improved by promises of unperformable mileages, and the ratings of motor-car batteries have been appreciably reduced.

A better understanding of the necessities of the user on the part of the maker and of the requirements as to care and handling of the battery on the part of the user, have brought about a more satisfactory commercial condition, and complaints are not so numerous nor vigorous as in former years.

While the year has been marked by the installation of but few large power batteries, a number of small and moderate size have been placed in stations throughout the country. Gradually it has been realized that a properly designed battery equipment is a dividend-payer, and regardless of financial considerations, the guarantee of uninterrupted service which such an installation affords makes it in many cases an imperatively demanded auxiliary. The numerous smaller central stations in which the accumulator has hitherto been looked on as an unprofitable and vexatious addition to the existing plant are viewing the question rather differently, with the result that considerable business has been done during the past year in equipments for this class of service.

In train-lighting batteries there has been a marked increase in the number of equipments installed during the past year, and the prospects for a still greater increase during the coming year seem to be favorable.

Altogether the year has been quiet and uneventful from the viewpoint of the battery manufacturer. The business has, however, been considerable, amounting to from eight to ten millions of dollars, according to various estimates and reports.

The Regulation of State Protection for Central Stations.

By Ernest H. Davis, President National Electric Light Association.

THE past year has witnessed a remarkable development in the electric light field, due to decreased cost of generation and distribution, and a wider and increasing use of electricity, especially for power purposes and decorative and sign lighting. The growth of business in the past is certain to be far surpassed in the near future.

Though becoming more and more recognized as a stable industry, the central station still feels the need of a protection against the many, and generally unjust, assaults of the public, the professional politician, and the faddist. And may it not be wise to work toward having the industry so widely regulated by laws that the rights of the public and of the investor will both be properly protected.

Digitized by Google

Telephony in 1904.

By a Telephone Engineer.

IT IS unfortunate for the purposes of this issue that the annual reports of the telephone companies giving statistics for the year do not appear coincident with the beginning of the new year, but it is within common knowledge that the introduction of instruments has continued to increase and that the telephone is becoming more and more infused into all the dealings of life until this scientific wonder of a few years ago is as commonplace as a door bell.

The operation of the telephone like that of the voice produces a remembrance and not a record, but if there could be any transcription of all of the ten million messages which are conveyed over the system each day what a history of great transactions, of important personal affairs, of matters inherent in the business of individuals, corporations, of firms, and even affairs of nations, have owed their successful transaction to this method of instantaneously cooperating with the voice and obtaining an answer.

As the telephone brings people together through the senses of voice and of hearing without other material relations, so it is that as the mind of one thus comes into direct relation with that of the other without the digressing influence of personality, it is adding to the development of purely ethical principles in the conduct of the affairs in which it serves as the messenger.

The telephone is broadening the scope of business, it is increasing the volume of commercial affairs by the rapidity with which bargains of sale are made and contracts consummated. It is adding to the speed of business transactions and diminishing the cost of interest by its reduction of time between contract and delivery and numerous detailed expenses.

An instance of the amplification of business possibilities through the service of the telephone was forcibly presented during the past year when the active member of a firm of cotton manufacturers stated that he was brought up in the house of a firm that had eleven partners, and this one man stated that he transacted a greater volume of business in the same line of business than his eleven former employers, and in addition to this he managed the affairs of two large textile mills, one about thirty and the other about sixty miles away, from his office.

This man ascribed the whole of his increased commercial capacity to the means afforded by the telephone, not merely in the quickness by which he could communicate his wishes to others, or the facility with which those beyond his presence whether it be in a neighboring building or miles away could address him, but he ascribed it to the fact that each of those communications could be answered at once, and as is the usual case in commercial transactions, there could be the discussion of affairs before the consummation of the purchase or sale.

It goes without saying that a man of such capacity was wise enough to refrain from doing those things which he could hire others to do for him, and that in the various offices of his establishment in the city there were telephones at the desks of all with whom he had occasion to communicate, and there were similar extensive equipments at the mills connected by private lines and also private branch exchanges at the offices and the mills, in order that he should not waste time in the detail of calling up persons over the telephone when a private operator would perform the service much better than he could himself.

In social life it is bringing congenial people together, not merely by the facility which it affords to invitation and appointments, but also by the personal conference carried on in spite of obstructions of storm and impediments of distance.

It is important for all the people who are blessed by the telephone service, and that blessing is becoming almost as universal as the sunshine, that all telephone companies should be sustained upon a sound financial basis, as that is the only means by which quality of service and the extension of plant can be maintained, and it is with great satisfaction, not merely as a business proposition but as a matter of self-preservation, that we have noted that the tendency during the past year has been toward furnishing conditions of adequate rates, for any commercial failure of a telephone company is an impairment of the facilities to every other user of the instruments which are so affected.

The improvement in the telephone service is a matter of general remark, and while it is undoubtedly true that the efforts of telephone companies in training operators to prompt and systematic methods have resulted in quicker and more accurate service, yet it appears that the greater part of the improvement must come from the users of the telephone who are becoming more efficient in their usage of the instrument, avoiding unnecessary words in calling the central, speaking directly into the transmitter clearly, but not vociferously, so that there are no delays required for repeating misunderstood calls, and above all the increasing promptness in answering a summons of the telephone bell.

The amenities of the telephone are well established.

It is "bad form" to use by proxy the advantage of this entrance to the office of a busy man, and when he answers at the telephone ask him to "wait a minute" until the principal for whom the call was made has been summoned to the instrument to begin the conversation.

Some persons do not "wait a minute," but hang up the receiver.

Effusiveness over the telephone is even more out of place than in the presence of those whom one meets.

If the course of the Frenchman who answered the telephone call from a lady by an apology for addressing a lady in his shirt-sleeves was followed as a precedent, it is probable that many telephone conversations during the summer months would be unduly prolonged.

Did you ever think how quick telephone service is in comparison with other transactions?

If one takes watch in hand and notes the three to five seconds for the response of "number," and then a second or two more will cover the time for the mysterious clicks, snaps and gurgles, which denote that the other telephone has been called, and then one must await a greater length for the party to come to the telephone and make response.

Compare this time with that consumed at even the best organized stores by glancing at the watch on opening the door, and again when there is an opportunity to inform the salesperson what goods are wanted. The seconds in the first instance may grow to as many minutes in the second, but there is a great difference in the flight of time to one at a telephone with mind wrapped on the subject of the forthcoming usage of the instrument, and perhaps with the eyes fixed upon the wall at less than normal optic focus, while on the other hand, a customer entering a

Digitized by Google

store may not know just what is wanted and the senses are tempted with the display of goods to the stimulation of the pocketbook nerve, and time is pleasantly wafted along by the manifestation.

The elevator service in office buildings, which has been developed from the "vertical railway" invented by Otis Tufts a generation ago, has made the skyscrapers possible, and the rental value of property at the quiet of the upper strata at dizzy altitudes above the street greater than that of offices at a traveling distance from the entrance.

Take watch in hand again and count the seconds required until one starts in upward course in an elevator trip.

Still the telephone seconds will be far less than that of elevator service under the best modern conditions with a battery of three to a dozen elevators.

Of the new uses of the telephone during the past year, the most of them have been in the line of mechanical improvements which are the logical result of the work of many people concentrated upon the affairs of the innumerable telephone offices throughout the country, and mention need be made of but one and that is the extensive use of the telephone by Japan in the present war.

The applications of the telephone to the evolution of military service began with that of the United States army in Cuba, which applied the telephone to existing lines and also constructed many military lines during the operations in Cuba.

The Japanese army has amplified those methods into a most perfect system by which military telephone wires follow advance to the outposts and the skirmish lines, where information is at once transmitted to the headquarters of the commanding officer in the field, and thence as occasion may require, communication is in like manner extended to the chief of the army.

In the Philippines the telephone continues to be developed as an adjunct to both the military and official powers in those islands and the reports of the signal service show that its further extension has been urgently solicited by all officers who have had occasion to make or transmit reports on the subject.

Among the developments of telephone service in this country, apart from the logic of numbers of increasing telephones, there is nothing more marked than the widespread application of the private branch exchange, by which the operator connected with a single establishment provides the telephone calls to other cities or even among those of the same concern.

It is said that the number of private branch exchange operators in New York city far exceeds those in the operating rooms of the telephone company, and the same condition of affairs is being rapidly developed in all of the leading cities.

Satisfactory progress has been made in the adaptation of the Pupin loading system to long-distance lines. In Italy a comprehensive series of trials is said to be under way, and in the United States a great amount of quiet work is being undertaken to perfect details in order to make practical use of this important discovery. But little has been heard of wireless telephony, excepting a minor prominence which was given to several systems exhibited at St. Louis during the World's Fair. In the absence of reports to the contrary it may be assumed that the long-distance cables laid between several points in the British Isles and the continent of Europe, and opened to the public about a year ago, are working satisfactorily.

NEW YORK CITY TELEPHONE SERVICE.

SUPERIOR TO ALL EUROPEAN SYSTEMS ACCORDING TO A LONDON TELEPHONE ENGINEER.

The issue of the *St. James' Gazette* of September 6 has a very interesting article by a London telephone engineer comparing the telephone service of New York, London, Paris and Madrid. The author, Mr. Herbert Low Webb, who is a telephone expert in London, has been associated with the operating telephone companies in each of the four cities above mentioned, and, therefore, knows whereof he speaks. This comparison, coming as it does from one who has been connected with each of the companies, can not help but carry weight.

Mr. Webb writes regarding the telephone service in the four cities as follows:

"In February I was in New York; in the intervening time I have been in London, Paris and Madrid, and in each place the most important subject from my point of view has been the telephone service. In the four cities one finds the telephone service operated by private enterprise entirely, by government management entirely, by private enterprise subject to government control, and by a combination or competition—it is difficult to know just how to describe the peculiar telephone arrangements of London—of private enterprise and government management. There enter into the problem too many outside conditions, too many variations of personal equation, for it to be possible to draw any very exact deductions from the very different results attained with the telephone in the four cities above named, but the difference is sufficiently startling and the comparison sufficiently interesting to warrant a discussion of some of the causes of the extreme variation which obtains.

"In old New York city—that is, the boroughs of Manhattan and the Bronx, which constitute what most people know as New York—there were in February last over 120,000 telephones in service. Counting Brooklyn, which is legally a part of New York, although physically as much a distinct city as it was before the incorporation of Greater New York, there were almost 200,000 telephones in use in the whole of New York. Hardly any visitor to the metropolis of America fails to be impressed by the very general use of the telephone service and by its high efficiency.

"In London there are at the present time, between the two systems, approximately 80,000 telephones; that is, London, with three times the population of old New York, has about two-thirds as many telephones, or in proportion to population London has one telephone where New York has five. Yet London has a greater need for a widely developed telephone service than New York, on account of its great area, which would render a highly developed and efficient telephone service a most invaluable facility. London has also fully as great a proportion of well-to-do people as New York, fully as active business interests, and certainly as high a standard of comfort and convenience. The field is here; what is needed is the active and energetic tiller and the removal of the trammels which now exist.

"Paris has at the present time between 30,000 and 40,000 telephones, and every user of those telephones is in a state of rampant indignation at the inefficiency of the service. The system has been operated by the French telegraph department since 1889, when the government forcibly took possession of the property of the then existing telephone company. The system has been allowed to fall behind the times in technical equipment, and has not been developed in proportion to the demands of the public. A very much larger number of subscribers could be obtained in Paris without any difficulty, but a deadlock has long existed because of the unwillingness of the government to spend money on the technical reorganization of the system and on a broad scheme of development to meet the requirements of the public.

"In Madrid, a wealthy city of nearly

Digitized by Google

600,000 inhabitants, there are now about 2,300 telephones in service. The technical equipment of the system is extremely antiquated, and the service, small as the system is and therefore very easy to conduct, evidently leaves much to be desired. While I was in Madrid I read in a report of the debate in congress of the previous day a vigorous complaint addressed to the government of the inefficiency of the telephone service. The simple fact that the telephone subscribers in Madrid call for each other by name, instead of the number, shows how little the requisites of a telephone service are understood there. Barcelona, which, though a smaller city than Madrid, is of greater commercial activity, has about 3,000 telephones, and this is the largest telephone system in Spain.

"New York shows how to do it; London, Paris and Madrid show how not to do it. The wonderful telephone development in New York has been attained by unrestricted private enterprise. The main features of the telephone business in New York are that there are no government restrictions on the business as a whole, and no municipal opposition to the building of wires. The company operating the New York telephone service has three cardinal points in its policy—the supply of the most efficient service attainable, the charging of rates based exclusively on the individual use of the service, and an active business propaganda for the education of the public in the value of the service. The telephone service in New York is advertised as effectively as any service or commodity of general use to the public. As a result the New York system has increased for several years past at the rate of over 20,000 telephones a year; it has become by far the largest telephone system in the world, and it supplies a service of the very highest efficiency."

Statistics recently given out by the local company operating in the boroughs of Manhattan and the Bronx give 152,714 as the number of telephones under contract and in service in the above boroughs on January 1, 1905. These figures serve to show what a thoroughly efficient and businesslike administration of telephone affairs can accomplish. The American public has been taught to appreciate the immense practical value of telephone service, and although the number of telephones already in service is extremely large, yet there seems to be no decrease in the continued demand for this valuable service.

One feature of the New York telephone service, not mentioned by Mr. Webb, which is greatly appreciated by the New York public, is the fact of its reliability. Not for a moment of the twenty-four hours of any day is the service out of order, except in so far as it is disturbed by an occasional local line trouble, which may be and is promptly corrected. It is this adequate, prompt and courteous service rendered at reasonable rates which has caused the New York telephone system to expand, until it is the admiration of the entire telephone world.

The Faraday Society.

The tenth ordinary meeting of the Faraday Society was held on Monday, December 19, 1904, at the Institution of Electrical Engineers, London, England, Mr. J. Swinburne, vice-president, occupying the chair.

The chairman announced that the council had made the following nominations of officers and members of council to serve during the coming year. The election will take place at the annual general meeting, to be held in February.

President—Lord Kelvin, O. M.

Vice-presidents—Professor A. Crum Brown, F. R. S., Sir W. Huggins, P. R. S., Sir Oliver Lodge, F. R. S., Dr. Ludwig Mond, F. R. S., Lord Rayleigh, O. M., Alex. Siemens, president I. E. E., James Swinburne.

Council—G. T. Beilby, Bertram Blount, W. R. Cooper, Sherard Cowper-Coles, Professor A. K. Huntington, Dr. R. A. Lehfeldt, W. Murray Morrison, Dr. W. S. Squire, Dr. O. J. Steinhart, Professor E. Wilson.

Treasurer—Dr. F. Mollwo Perkin.

M. Adolphe Minet communicated part ii of his paper on "The Electric Furnace: Its Origin, Transformations, and Applications," which was kindly read in abstract by Mr. R. S. Hutton.

In the first and introductory part of his paper, which was read before the society on June 9 last, M. Minet showed that the historical development of the electric furnace falls into the three following periods:

1. Laboratory furnaces, 1808 to 1886.
2. Industrial furnaces, 1886 to 1890.
3. Development of industrial applications from 1890 to the present day.

The present instalment, after some preliminary general remarks on the electromotive force, current densities, and yields, with arc furnaces and resistance furnaces respectively, proceeds to deal in detail with the evolution of the furnace during the first period. The subject is subdivided as follows:

(a) Original furnaces, namely, Davy's arc, Pepys's resistance furnace for the cementation of iron, and Davy's and Napier's cathode furnace.

(b) Electrolysis at high temperatures; the production of aluminum and its alloys and the alkali and alkaline earth metals.

(c) Miscellaneous furnaces, of which the most important are the early Despretz and Pichon furnaces, Berthelot's electric "egg" for the synthesis of acetylene, Siemens's and Huntington's well-known steel and other furnaces, the Louis Clerc furnace, interesting as the progenitor of the famous Moissan type, and Borcher's resistance furnace.

The paper, which is illustrated with diagrams of the principal furnaces alluded to in the text, closes with a bibliography covering the period dealt with. A final instalment will discuss the furnaces of the second and third periods.

Mr. W. B. Clarke referred to the importance and difficulty of making temperature determinations of electric furnace processes, and expressed the hope that M. Minet would deal with that question in part iii of his paper.

Mr. L. Gasta handed round some "siloxicon"—one of the newest products of the electric furnace—and described its properties.

Mr. E. Kilburn Scott (communicated) described some of his experiences in the early days of the manufacture of calcium carbide.

The chairman described a novel type of furnace that he had once hit upon by accident, and which he thought might turn out to be useful. He was sending a current through fused barium chloride, and the temperature having been allowed to get too high the cast-iron crucible melted and formed a fused mass that was kept together by an outer skin of solidified chloride. This suggested the use of a neutral substance like barium chloride for heating to a very high temperature alloys or metals which it was desired not to contaminate with impurities.

Dr. F. Mollwo Perkin read a paper by himself and Mr. W. C. Prebble on the "Electrolytic Analysis of Cobalt and Nickel."

Cobalt—The aim of the experiments was to obtain bright deposits of the metal that should be quantitatively accurate. Various reducing agents were first of all employed, but only with sodium hypophosphite were brilliant deposits obtained, and then phosphorus was found to be present. Salts of the various organic acids were next tried, but only ammonium oxalate and tartrate gave satisfactory results, the latter having the better appearance. Traces of carbon, however, were deposited with the metal. Ammoniacal solutions of ammonium borate were also tried. The most satisfactory results were obtained with a solution containing an alkali phosphate and a little phosphoric acid, the latter to prevent the precipitation of the double sodium cobalt phosphate. To remove a brown anodic deposit which forms, the addition of a

Digitized by Google

little hydroxylamine is recommended. By this method the whole of the metal can be thrown out in from three to three and one-half hours.

Nickel—Similar solutions were tried for nickel deposition. In this case splendid results were obtained with the borate solution, while the phosphate solution, which gave such good figures in the case of cobalt, was not at all satisfactory.

The authors have not yet succeeded in devising an accurate electrolytic method for the separation of nickel and cobalt, and they find that the methods given in books are unreliable.

Dr. O. J. Steinhart discussed the problem of the separation of the metals. The present method is based on the fact that cobalt is more easily oxidized by chlorine than is nickel. He also referred to the possible industrial bearing of the work of the authors in connection with nickel extraction.

Dr. L. Dobbin, in a written communication, drew attention to the work of Marshall on the same subject. In the case of cobalt he merely added a little nitrate to the ordinary double sulphate solution.

Dr. Perkin said that the presence of nitrate rendered deposition very slow.

Mr. F. Gelstharp presented two short papers entitled "The Electrolytic Preparation of Tin Paste" and "Note on the Electrolytic Recovery of Tin" respectively, which were read by the secretary. An abstract of the first named paper appears elsewhere in this issue.

Mr. W. C. Prebble thought an endless band would be a less crude method of removing the paste than that given by the author. Regarding the presence of arsenic, which was hurtful here, it was curious that in the case of zinc this actually causes a spongy deposit to form.

Dr. O. J. Steinhart gave a few particulars of an electrolytic detinning process that was now successfully treating in London seven or eight thousand tons of scrap per annum. A great difficulty found in practice was to dry the tin sponge without its firing.

Dr. T. C. Cain did not think it probable that sodium was deposited with the tin.

Mr. H. Sayer asked what percentage of the tin was recovered. An objection to an alkali process was that it would not remove the tin from the alloy at the surface-junction of the two metals.

Mr. A. C. Bawtree sent in a written communication describing an electrolytic method for making tin powder that he had worked out some years ago. His solution contained 0.5 per cent $SnCl_2$ and 0.33 per cent $SnCl_4$, and was worked cold with an electromotive force of 2.32 volts. This solution successfully overcame the difficulty of crystalline deposits.

Mr. H. S. Coleman also communicated some of his own experiences in tin deposition. He had worked under conditions similar to those described by Mr. Gelstharp. He found, however, that if the bath were worked between fifty and sixty degrees centigrade no difficulty was experienced in starting the current, and the scrap was stripped clean in twenty minutes.

The Bradford, England, Breakdown.

Further particulars are now given in our English exchanges of the breakdown which occurred at the Bradford (England) municipal station the early part of last December. On the thirteenth of that month a serious short-circuit occurred in the underground mains, throwing the station out of service for practically the entire day. Many of the mains were burned completely in two, and while repairs were going on faults developed at other points of the system.

The mains in use there consisted wholly of single core, until within the past few months. There are no fuses upon these. Various faults have been discovered and remedied during the week following the breakdown, and there has been much difficulty in carrying out this work. The system has been changed a number of times, it being originally a two-wire, 115-volt supply. It was then changed to a two-wire, 230-volt, and then again to a three-wire, 460-volt system. Building maps and records of the underground system have not been kept, and great difficulty is being met in tracing out the various cables and locating their faulty points.

The cause of the trouble is said to have been due to electrolysis, which cut away the lead sheathing. The contributory cause has been the manner in which the joints have been made. The joint boxes were of an old type with rubber glands, and in many cases imperfect contact or none at all was made between the lead sheath and the joint boxes. No special means for preserving the metallic continuity of the sheath was adopted, and corrosion took place at these points, ultimately breaking the cables down and either causing a leak to earth adjacent to the spot, or raising the potential of the sheath and the potential of the core of the cable. This brought about arcing at adjacent points before finding a way to earth. In this manner a fault, once started, led to others. At the time these cables were laid the importance of maintaining a continuous metallic sheath was not recognized. The electrolysis which took place, while being undoubtedly partially due to the local tramway system, may have been assisted by the distributing system itself, since it is impossible to prevent leaks from occurring at different points.

That such a condition of affairs existed in some degree was known to the engineer, and work was going on at the time the breakdown occurred to remove trouble, though the serious condition was not appreciated. One important line which has been examined showed that no provision had been made for preserving the electrical continuity of the sheath, and it is now recommended that all the joints on this line be remade. It is estimated that the carrying out of repairs to the distributing system at Bradford will cost nearly $15,000.

London Tramways.

There are in London, writes United States Consul-General Evans, at London, England, about one hundred and fifteen and one-half miles of tramways, of which eighty-eight miles have been purchased by the London county council under the provisions of the tramway act, 1870, the remainder, about twenty-seven and one-half miles, are still in the hands of various tramway companies, nine in number.

The tramways owned by the council comprise on the north side of the Thames river the undertakings of the North Metropolitan and the London street tramways companies, a total length of forty-eight miles, and on the south side of the Thames the undertakings of the London, the Southeastern Metropolitan and the South London tramways companies, a total length of about forty miles. The tramways owned by the council on the north side of the Thames (forty-eight miles) are leased to the North Metropolitan Tramways Company for a period of fourteen years, expiring in 1910; those on the south side of the Thames (forty miles) are operated by the council itself.

The tramways act of 1870 provides that the local authority concerned may purchase compulsorily, after a period of twenty-one years, from the date of the authorization by Parliament, any tramways constructed and operated by private companies.

Digitized by Google

A New Tunnel Construction Company in New York City.

The formation and financing of the Hudson Companies, of New York, was announced on January 9. The company has been formed with $21,000,000 capital to take over and eventually operate the tunnels which are now being constructed under the North river, from Hoboken, N. J., to Christopher street, New York city, and the one which is to be built from Exchange Place, Jersey City, to Church and Cortlandt streets, New York city. The new company has purchased the stocks of the construction companies which were formed to build the tunnels, and also that of the New York & New Jersey Railroad Company and the Hudson & Manhattan Railway Company.

It is also announced that the new company has made a contract with the Pennsylvania Railroad Company, by the terms of which the Jersey City terminal of the tunnel from Cortlandt street, New York, under the North river will be beneath the Pennsylvania Railroad station in Jersey City, with a connection to the platform of the station by elevators, and by which the Pennsylvania Railroad will have a ticket office in the Manhattan terminal of the tunnel. The contract with the Pennsylvania Railroad runs for 500 years, and it is stated that similar arrangements have been made with the Erie Railroad, under whose yards the tunnel will run, and also with the Central Railroad of New Jersey at its terminal.

The complete tunnel system of the Hudson Companies will comprise twin tunnels from the terminals of the Central Railroad of New Jersey through Jersey City, with connections at the Pennsylvania and Erie stations, and along the water-front to Hoboken; twin tunnels across the North river from a point between the Erie and Lackawanna stations, connecting with the proposed Jersey City water-front tunnel to Morton street, Manhattan, thence under Christopher street, where one branch will run up Sixth avenue to Thirty-fourth street, and another branch under Ninth street to the connection with the rapid transit tunnel at Fourth avenue, a tunnel from the Pennsylvania station in Jersey City, under the North river and under Cortlandt street, to Church street, thence under Church street to Fulton street and under the river again to the Pennsylvania terminal in Jersey City. It is estimated that the entire work will be completed in two and one-half years.

The Nationai Electric Light Association.

Mr. Henry L. Doherty, as chairman of the committee on membership of the National Electric Light Association, is working hard to increase the membership of the association along the special lines inaugurated at the recent convention. Attractive booklets are being distributed, calling attention to the various classes of membership, and the privileges and benefits to be secured through such membership. Application blanks are also being distributed, making it a comparatively easy matter to secure proper information upon this important subject.

The question box, under the direction of Mr. Homer E. Niesz, as editor, is being enlarged from day to day. A handy form of question blank is being distributed, placing the questions under various headings and asking for suggestions for the betterment of this department.

"Electricity *vs.* Gas" is the title of a pamphlet just issued by the National Electric Light Association for the use of its members who are threatened with Welsbach competition for street lighting. This paper was originally written by Mr. W. F. White for the 1900 meeting of the Ohio Electric Light Association. Mr. White has practically rewritten the paper and has brought it down to date by adding data recently collected from cities and towns all over the country. The pamphlet is illustrated with reproductions from photography showing graphically the difference in street illumination by the two methods. It should prove of great value to the members of the association.

New York Electrical Society's 247th Meeting.

The 247th meeting of the New York Electrical Society will be held in the lecture room of the American Institute, 19 West Forty-fourth street, Wednesday, January 18, at 8 P. M.

Professor W. S. Franklin, of Lehigh University, will lecture on "Electric Waves and the Reaction of Transmission Lines." The elementary physical theory of electric wave motion will be outlined, and the mechanical analogies carefully developed.

The physics of wave distortion and of wave alternation will be popularly discussed and the methods for reducing wave distortion and wave alternation will be clearly and exhaustively explained.

The lecture will be illustrated by lantern slides and by several models, one of which gives a full representation of the distribution of electromotive force and of current along a 200-mile, single-phase, alternating-current, power-transmission line.

The Wire Situation in the Dominion of Canada.

More than 6,000 miles of land telegraphs and sea cables are in operation in the Dominion of Canada. The beginning of the year showed a total of 6,584 miles of completed lines, with 299 offices. The government system consists practically of three blocks. One block connects Quebec with stations at the Atlantic end of the St. Lawrence, with stations eighty miles beyond the Canadian boundary, in Newfoundland, and with stations in Labrador, at Chateau bay, opposite Belle Isle in the Straits of Belle Isle. A cable proceeds southwardly by way of the island of Anticosti and the Magdalen Islands to Cape Breton, with branches in Nova Scotia and New Brunswick. Another block serves the boundary of the great territories of Assiniboia and Saskatchewan. The third block extends from the southern section of the British Columbia north beyond Dawson City in the Yukon, with a branch from the main line to Port Simpson on the Pacific coast below the Alaskan strip of the United States, with a spur to Aberdeen on the coast below Port Simpson.

The wireless telegraph system has been used by the government in connection with its land lines at various points in the Gulf of St. Lawrence and on the Atlantic coast. At Chateau bay, the terminus of the north shore line in Labrador, there is a Marconi station, by means of which communication is maintained with Belle Isle.

The United Engineering Building

At the meeting of the conference committee on the United Engineering Building, held January 7, Mr. Alfred R. Wolff was unanimously appointed consulting engineer for the heating and ventilation of both the United Engineering Building and the Engineers' Club to be erected at Thirty-ninth and Fortieth streets, under the Carnegie gift to engineering of $1,500,000. Mr. C. O. Mailloux was selected as the consulting electrical engineer for the United Engineering Building, and the firm of Bates & Neilson were selected as consulting electrical engineers for the Engineers' Club. All these gentlemen are well known in connection with the execution of large work of the class named in New York and vicinity, in addition to which they are prominently identified with the organizations that will occupy the buildings in question. Mr. Wolff and Messrs. Bates and Neilson are also members of the Engineers' Club of some years standing, and Mr. Putnam A. Bates was for a long time district engineer for all the Crocker-Wheeler installations in the New York territory.

Digitized by Google

Electric Supply in the Gate City.

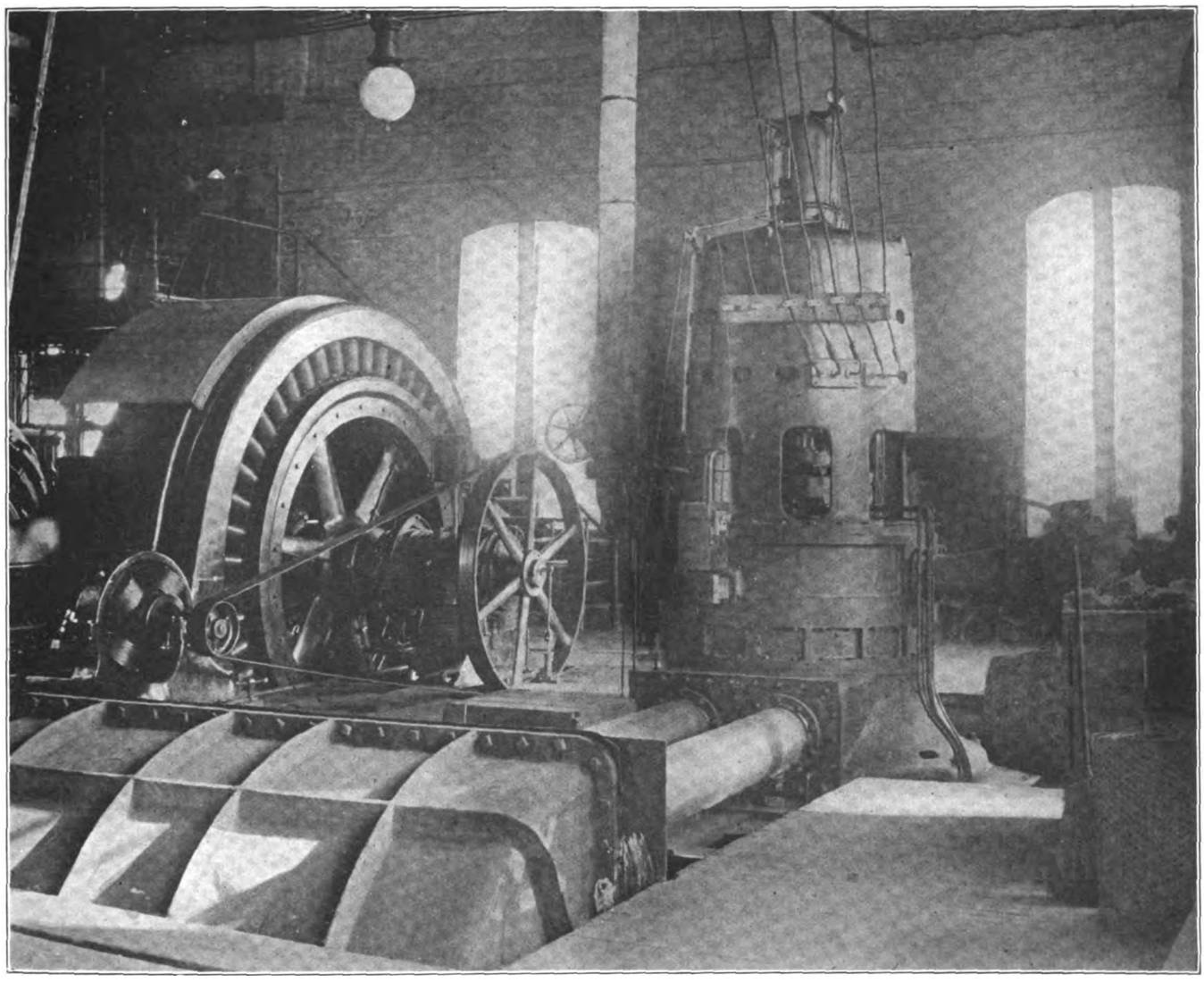
By Alton D. Adams.

OMAHA, the gateway of the Middle West, contains a tenth of the population, and is the market for one-half of all electric supply in Nebraska. In 1900, the federal census gave the state 1,066,300, and Omaha 102,555 persons. As lines from the Omaha plant extend to South Omaha and across the Missouri river to Council Bluffs, Iowa, which are independent cities with populations of 26,001 and 25,802, respectively, the total number of persons within its service area was 154,358, in the census year.

The entire state of Nebraska, in 1902, contained fifty-four central light and power stations, exclusive of those operated by electric railway companies, and these stations had connected 2,608 arc lamps and 151,162 incandescent lamps, and delivered 12,315,775 kilowatt-hours during the twelve months ending with June 30 of that year. In September, 1904, the Omaha system was operating 1,525 arc lamps and 100,000 incandescent lamps, besides electric motors of 435 horse-power total capacity, and during the twelve months ending August 31 of that year the output amounted to 5,701,098 kilowatt-hours. During this same year the Omaha station consumed 17,304 tons of coal, costing $2.50 per ton, unloaded, and the output was thus 323 kilowatt-hours for each ton of coal burned. In the year ending August 31, 1904, thirty-seven alternating-current series arc lamps, eighty-nine alternating-current multiple arc lamps, and 13,130 incandescent lamps of sixteen nominal candle-power were added to the connected load of the system, and the output in kilowatt-hours was greater by 193,357 during the first six months of 1904 than that in the corresponding period of 1903.

The large and growing load of the Omaha system has been built up with moderate prices and good service, largely on the meter basis. On September 1, 1904, the number of meters in use was 2,909, and the regular rates per kilowatt-hour were fifteen cents for lighting and ten cents for power service. From these rates varying discounts are given according to the amounts of energy consumed per month. For series arc street lamps in Omaha and South Omaha the annual rate is $94.50 per 6.6-ampere enclosed arc, all night and every night, and $69.50 yearly per lamp of equal capacity on the moonlight schedule.

In Omaha and South Omaha the number of 6.6-ampere alternating-current enclosed series arcs is 660, the number of



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—A PORTION OF THE ENGINE ROOM, SHOWING 500-KILOWATT CURTIS TURBINE.

Digitized by Google

multiple enclosed alternating-current arcs 600, and the number of sixteen-candle-power incandescent lamps 90,000. Across the river, in Council Bluffs, the 6.6-ampere enclosed series arcs on streets number 165, the commercial enclosed arcs in multiple 100, and the sixteen-candle-power incandescent lamps 10,000. Besides the motor load above mentioned, an equipment of one fifteen-horse-power, three twenty-five-horse-power and one fifty-horse-power, three-phase induction motors has recently been connected to the electric lines for the purpose of operating a grain elevator. Among other loads of heating apparatus is one in a clothing factory where a maximum current of 150 amperes at 106 volts is required for electric smoothing irons. Direct current at the generating station in Omaha is developed at 500 volts for distribution to stationary motors in that city, and at 2,300 volts, sixty cycles, three-phase, for the general supply of both lamps and motors.

In Omaha, the 2,300-volt current is distributed to transformers, both overhead and underground, that feed secondary mains and lamps at 106 volts, and induction motors at 220 volts, three-phase. The 2,300-volt current at the generating station is transformed to 6.6 amperes at a maximum of about 8,000 volts for series arc circuits and also to 5,500 volts for the lines that run to South Omaha and Council Bluffs.

A large part of the distribution circuits in the central portion of Omaha is made up of underground cable laid in 380,000 duct-feet of clay conduit. These conduits with the size, number of conductors, and length of each are as follows:

Length in Feet.	Size of Each Conductor.	Number of Conductors per Cable.
108,607	No. 6 B. & S.	one
32,368	No. 2/0 "	"
370	133,000 C. M.	"
4,507	500,000 "	"
19,575	No. 2/0 B. & S.	two
15,131	250,000 "	"
5,922	No. 2 B. & S.	three
6,204	No. 2/0 "	"
4,507	No. 4/0 "	"

The underground transformers, located in manholes about the central part of Omaha and connected to the low-pressure mains are as follows:

UNDERGROUND TRANSFORMERS.

Capacity Each in Kw.	Number of Each Size.
5	2
7.5	8
20	20
30	5
50	9

These forty-four transformers have a combined capacity of 1,070 kilowatts.

The greater number and capacity of service transformers are overhead, and their sizes are as follows:

Number of Each Size.	Kilowatt Capacity.
78	0.6
82	1
116	1.5
24	2
81	2.5
15	3
40	4
31	5
2	6
41	7.5
8	10
6	15
28	20
1	25
2	50

In South Omaha and Council Bluffs the electric supply is drawn entirely from the 2,300-volt, three-phase lines. The Citizens' Gas and Electric Company distributes the electric energy in Council Bluffs, but control of this corporation passed to the Omaha Electric Light and Power Company in the spring of 1903.

Wherever an induction motor of more than five-horse-power capacity is operated it is connected to a power circuit, and not to one that supplies lamps, and this is true in both Omaha and Council Bluffs. The 5,500-volt, three-phase current in the latter city is received at a one-story substation of twenty-four by thirty-seven feet ground area, and is there transformed to constant current of 6.6 amperes for series arc lamps, 2,300-volt, three-phase current for the general distribution of light and power, and 115 and 230-volt current for use on the three-wire system in the business section of the city. In the substation are two transformers, each rated at 6.6 amperes and 6,000 volts, for arc street lamps, two seventy-five-kilowatt transformers for the 230-volt, three-wire system, two fifty-kilowatt transformers for the 2,300-volt, lighting circuits, and three twenty-five-kilowatt transformers for the 2,300-volt, three-phase motor lines. All of these transformers take primary current at 5,300 volts from the generating station in Omaha. In Council Bluffs, as in South Omaha, the standard pressure on the secondary distributing mains is 115 volts, instead of 106 volts as in Omaha.

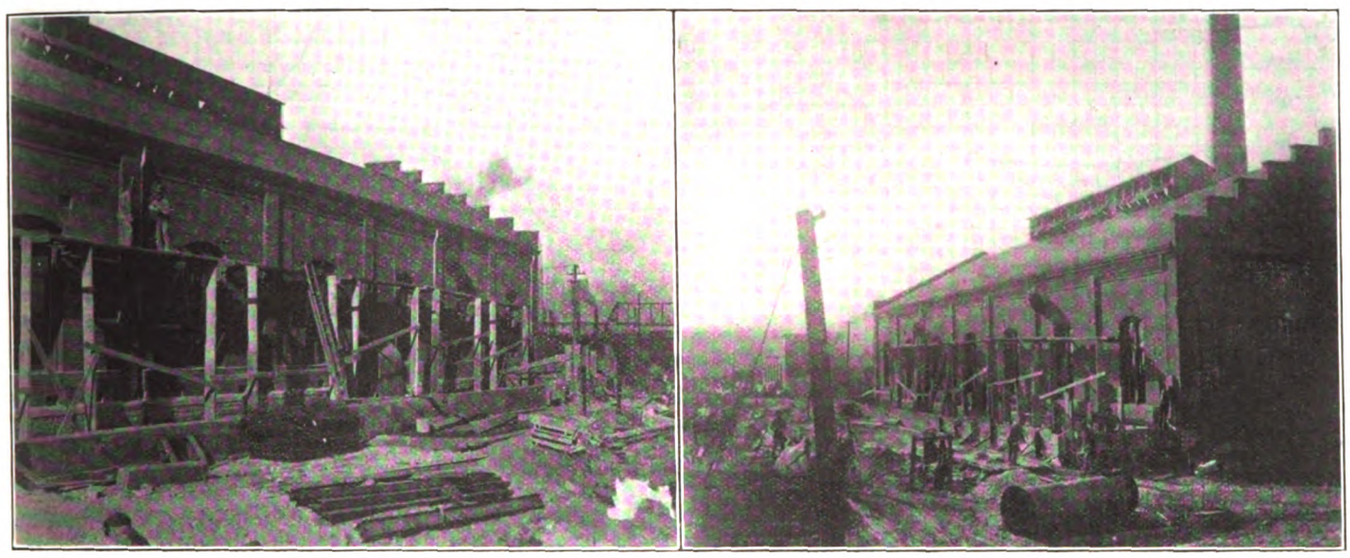
The generating plant is housed in a one-story brick building on the bank of the Missouri river, in Omaha, and has railway connection. Tile supported on steel trusses forms the roof of the station, and the floor is concrete on a masonry foundation. Steam for the plant is developed by nine water-tube boilers with a total rated capacity of 3,800 horse-power. Each of four of these boilers is of the Cahall type with a rating of 450 horse-power, and the other five are of the Heine make and rated at 400 horse-power each. All of these boilers are hand-fired save as to the distribution of the coal, which is effected by chain grates. Two stacks are provided for these boilers, one being of brick, 185 feet high and eight feet in internal diameter, and the other of steel, 150 feet high and eighty-six inches in diameter. Steam is developed by these boilers at 160 pounds gauge pressure, but the pressure of one battery, at least, will be raised to 200 pounds for the operation of a steam turbine, a little later. Power for the Omaha system is generated entirely by steam at this station and the reciprocating engines are all of the McIntosh & Seymour make, in the following sizes: one 1,500-horse-power, cross-compound, horizontal engine; one 750-horse-power, tandem-compound, horizontal engine; two 500-horse-power, tandem-compound, horizontal engines. All of these engines operate condensing, and with 160 pounds steam pressure. Steam at the same pressure goes to a Curtis turbine that drives a vertical direct-connected electric generator, made by the General Electric Company. This turbine unit is rated at 500 kilowatts, 2,300 volts, three-phase, but is intended for only temporary use and is to be replaced by a similar unit of 1,500-kilowatt capacity at a later date. It is interesting to note that though this 500-kilowatt turbine unit is supported on six fifteen-inch I-beams that have a span of twenty-one feet there is no trouble from vibration. All of the horizontal electric generators are also of the General

AT WORK ON THE INTAKE, OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY.

Digitized by Google

Electric make, and they are direct-connected to the several engines as follows: the 1,500-horse-power engine drives a 1,200-kilowatt, 2,300-volt alternator; the 750-horse-power engine is connected to one 500-kilowatt, 2,300-volt alternator, and to a 300-kilowatt, 500-volt, direct-current generator; one of the 500-horse-power engines drives only a 300-kilowatt, 2,300-volt alternator, and the other engine is connected to an alternator of this capacity and also to a 300-kilowatt, 500-volt, direct-current generator. Allowing 750 horse-power for the steam turbine, the combined rating of all the above-named engines amounts to 4,000 horse-power. The electric generators have a combined rating of 2,900 kilowatts. All of the alternators, save that connected to the steam turbine, were formerly of the monocycle type, but they have been, or shortly will be, changed to the three-phase winding. A 500-kilowatt, 500-volt rotary converter has been ordered, and is to be located in the generating station to carry the load of direct-current motors, and thus displace the direct-current generators. For the series circuits of arc street lamps the station contains seven General Electric transformers with a capacity of 6.6 amperes and 8,000 volts each.

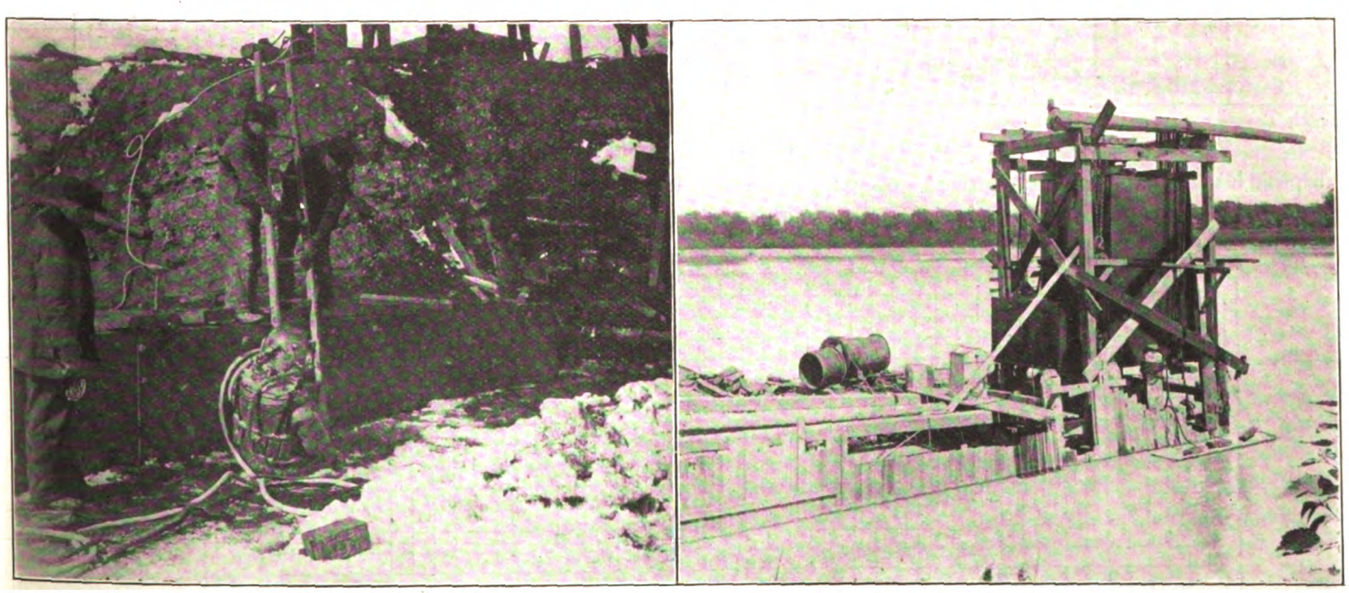
Two transformers of 150 kilowatts each, and four of seventy-five kilowatts each, are used to step the station voltage of 2,300 up to 5,500 for the transmissions to South Omaha and Council Bluffs, and another transformer of 150-kilowatt capacity is to be added for the same purpose. Along one side of the station is the switchboard with the operating gallery some feet above the generator floor. Besides the operating switches and indicating instruments this board carries a set of recording wattmeters for the station output.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—EXTENSION OF STATION FOR NEW SWITCHBOARD.

Water for the engine condensers is taken from the Missouri river, and for this purpose an intake has been built some distance out into the stream. An iron suction pipe connects the intake with the pump and condensers. On the face of the intake is a rack composed of one and one-quarter-inch by one-quarter-inch iron bars, and behind these there are two screens with five-eighths-inch mesh, formed with No. 11 steel wire.

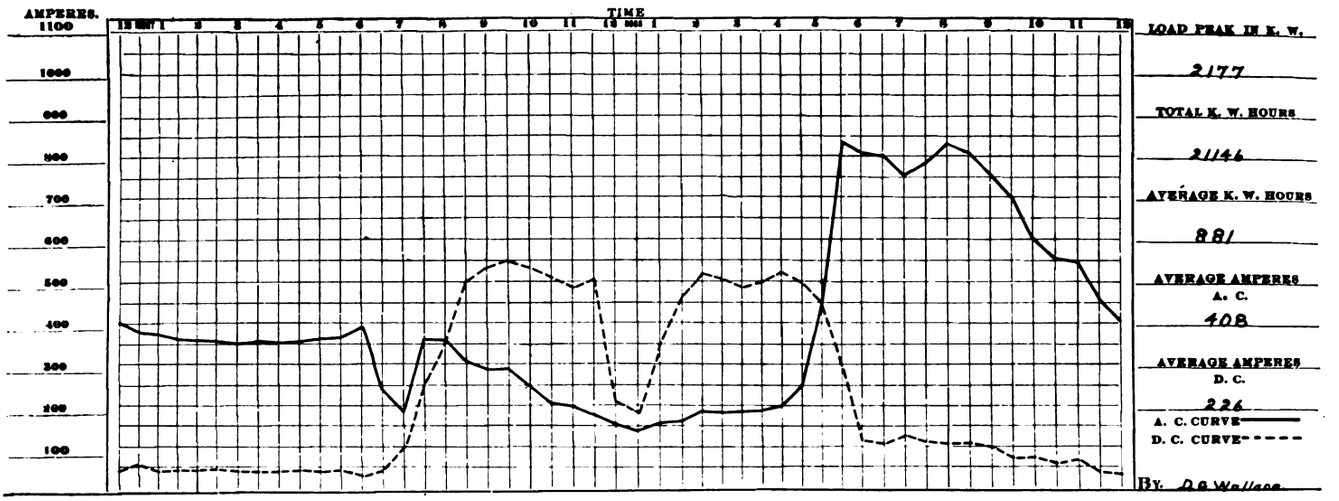
Three curves presented herewith illus-



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—AT WORK ON THE INTAKE.

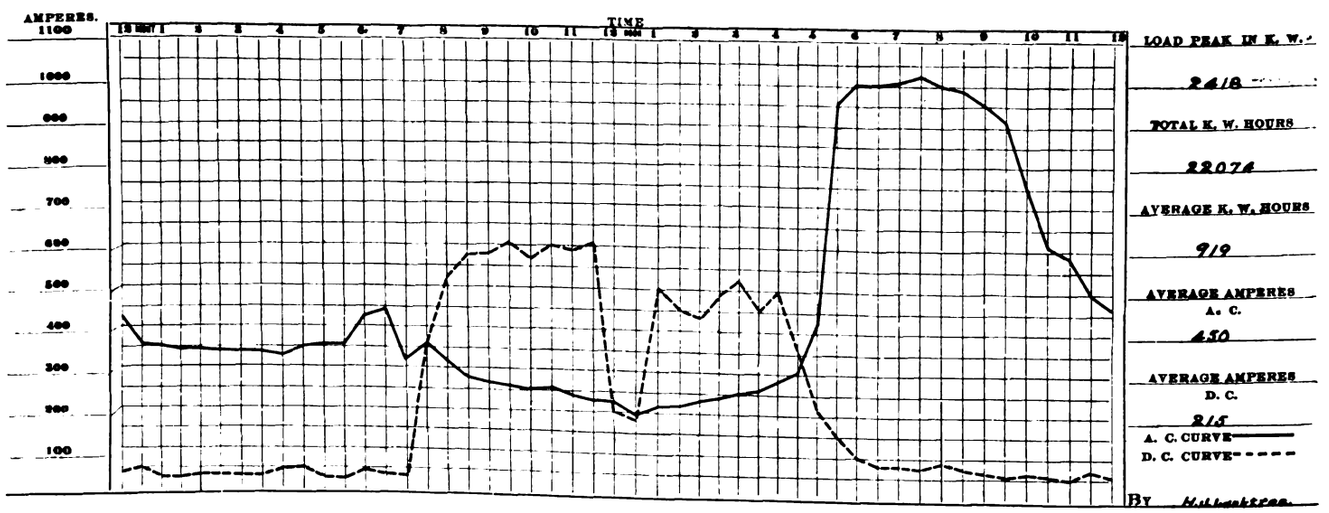
Digitized by Google

trate the character of the load on the Omaha electric system, and also its growth during eleven months. The earliest curve, that of December 22, 1903, has a peak load of 2,177 kilowatts occurring at 5.30 P. M., on the December day. For this day the total output was 21,146 kilowatt-hours, with an average of 881 kilowatt-hours, so that the average load was forty-one per cent of the maximum. Most of the supply to motors was carried out with direct current at 500 volts, and its peak this motor load reached 550 amperes at 500 volts, or about 275 kilowatts, and its average amperes for the twenty-four hours were 226. The average amperes of the three-phase load at 2,300 volts were 408, or nearly double the average of direct-current amperes, so that the alternating current was more than eight times the direct-current output of energy.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN DECEMBER 22, 1903.

OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN JUNE 22, 1904.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN NOVEMBER 26, 1904.

Six months later, on June 22, 1904, the peak load was down to 1,539 kilowatts

Digitized by Google

and was made up mostly of lamps, at 9 P. M. The average load was 559 kilowatts, corresponding to the total output of 13,430 kilowatt-hours for the day. For the direct-current motors the maximum load was 600 amperes, or fifty amperes more than that of the previous December, and the average direct-current load for the twenty-four hours was 255 amperes, or forty-two per cent of the maximum. With the combined load of lamps and motors the average amounted to only thirty-six per cent of the peak. As the average alternating current was 236 amperes at about 2,300 volts, while the average direct-current amperes were 255 at 500 volts, the energy output for the twenty-four hours was about four times as great on the three-phase as on the purely power service, in contrast with a corresponding ratio of eight to one in favor of the three-phase current during the previous December day.

Eleven months after the record of the former of the above-named curves was made, on November 26, 1904, the peak load on the Omaha system reached 2,418 kilowatts, an increase of eleven per cent, in spite of the fact that lighting demands are not as heavy in November as in December. For this November day the total output was 22,074 kilowatt-hours, and the average load 919 kilowatts, a lead of about five per cent over the previous December. On the three-phase generators the average amperes were 450 for the day, and on the 500-volt motor lines the average was 215 amperes, so that the alternating was nearly ten times the direct-current output of energy. This gain of the three-phase in comparison with the direct-current load seems due to the gradual adoption of induction motors.

At the generating station of this interesting system the tendency is toward a single type of main generators, direct-coupled to horizontal reciprocating engines, or vertical steam turbines. For loads beyond the easy reach of 2,300-volt, three-phase lines, the plan is to provide substations that receive current at 5,300 or some higher voltage, and transform it for constant pressure and for series lines. Direct-current distribution is already confined to 500-volt motor service in the business portion of Omaha, and large, new motors in the future will be mainly of the induction type. Underground cables are doing a rapidly increasing share of the work of distribution, and there is a marked tendency to carry the central part of the lighting load on low-pressure underground mains fed by comparatively large transformers in manholes.

So satisfactory are the service and prices of the electric system at Omaha, that a proposition to establish a municipal plant was defeated by a large majority at a recent city election.

The foregoing facts have been obtained through the kindness of Mr. H. A. Holdrege, general manager of the Omaha Electric Light and Power Company.

Automobile Shows in New York.

Two automobile shows will be held in the city of New York during the coming week—that of the Importers' Automobile Salon, which is being held in Herald Square Exhibition Hall, on the top floor of the Macy Building, from January 11 to 24; and the fifth annual automobile show, which is being held at Madison Square Garden from January 14 to 21, under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, Incorporated.

The Importers' Salon is given up to the exhibits of foreign manufacturers. In decorating the hall the plan has been followed of decorating it as a whole. The general color scheme is green. The columns and cornices are draped with American and foreign flags and wound with evergreens crowned with circles of colored electric lights, about 3,000 lights being used altogether for this purpose.

About 250 motor-car and accessory manufacturers have taken space in the exhibition at Madison Square Garden. The demand for space was greater than ever before, and enough applications were received to fill a building three times the size of Madison Square Garden.

A number of dinners and meetings will be held in connection with the show. On Sunday evening, January 15, will be held the E. E. Schwartzkopf breakfast, at the Café des Beaux Arts. On Sunday evening the New York Motor Club will have a dinner at the Hotel Astor. On Monday, January 16, will be held the annual banquet of the American Automobile Association, at the Waldorf-Astoria. The National Association of Automobile Manufacturers will hold a smoker and vaudeville entertainment on Friday evening, January 20, and the Automobile Club of America will hold a dinner at the Waldorf-Astoria on Saturday, January 21. The American Automobile Association will hold its annual meeting at the Hotel Seville, Monday, January 16.

Among the exhibitors are the White Sewing Machine Company, Cleveland, Ohio; Pope Manufacturing Company, New York city; Olds Motor Works, Detroit, Mich.; Baker Motor Vehicle Company, Cleveland, Ohio; the George N. Pierce Company, Buffalo, N. Y.; Thomas B. Jeffrey & Company, Kenosha, Wis.; Electric Vehicle Company, Hartford, Ct.; Northern Manufacturing Company, Detroit, Mich.; E. R. Thomas Motor Company, Buffalo, N. Y.; Daimler Manufacturing Company, Long Island City, N. Y.; Vehicle Equipment Company, New York city; National Motor Vehicle Company, Indianapolis, Ind.; Studebaker Automobile Company, South Bend, Ind.; H. H. Franklin Manufacturing Company, Syracuse, N. Y.; Diamond Rubber Company, New York city; R. E. Dietz Company, New York city; the Goodyear Tire and Rubber Company, Akron, Ohio; C. F. Splitdorf, New York city; the Veeder Manufacturing Company, Hartford, Ct.; American Roller Bearing Company, South Framingham, Mass.; Weston-Mott Company, Utica, N. Y.; National Carbon Company, Cleveland, Ohio; American Coil Company, West Somerville, Mass.; Dow Portable Electric Company, Braintree, Mass.; the Standard Welding Company, Cleveland, Ohio; Dayton Electrical Manufacturing Company, Dayton, Ohio; Automobile Supply Company, New York city; Rushmore Dynamo Works, Plainfield, N. J.; Lunkenheimer Company, New York city; Electric Contract Company, New York city; United Electrical Manufacturing Company, New York city; Charles H. Metz, Waltham, Mass.; Edison Storage Battery Company, Glen Ridge, N. J.; William Roche, New York city; Charles E. Miller, New York city; New York Edison Company, New York city; Warner Instrument Company, Beloit, Wis.; Brown & Sharpe Manufacturing Company, Providence, R. I.; Polyphase Ignition System Company, New York city; Constant Dynamo Company, Boston, Mass.; Meyrowitz Manufacturing Company, New York city; American Electrical Novelty and Manufacturing Company, New York city.

Texas Telephones.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of December 31 the statement appears that the Cuyahoga Telephone Company has established two street telephones on lampposts on Euclid avenue in the city of Cleveland, and that but one other city in the United States, namely, Bridgeport, Ct., shares the distinction with Cleveland of having devices of this character placed at the disposal of the public. I beg to say that several of these street telephones were placed in Dallas by the Southwestern Telegraph and Telephone Company quite a year ago, and they have been in successful operation ever since.

I might also remark, incidentally, that if there is anything in the way of up-to-date telephone equipment that Dallas is without we are not aware of it, which is true, likewise, of most other things that contribute to the making of a live hustling, wide-awake, largest small city in the United States.

FRANK B. KNIGHT.

Dallas, Tex., January 5.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Calcium Metal.

Electrometallurgy has at last succeeded in producing metallic calcium in commercial quantities, and the method is here described by Mr. R. H. Hutton. Until a short time ago this metal had been available in small amounts only and remained a rare laboratory specimen. It is now obtainable at a price per kilogramme less than that charged by most chemical dealers for a small one-gramme sample. This metal was first formed by Davy, who made an amalgam by electrolyzing lime mixed with mercuric oxide, slightly moistened with a mercury cathode. He isolated the metal in small quantities by distilling off the mercury. Matthiesen, making use of Bunsen's suggestion of applying high current-density at the cathode, succeeded in obtaining a few grammes at a time by electrolyzing fused chloride or mixtures of calcium and other chlorides having a lower fusing point. Moissan found that molten sodium forms an excellent solvent for calcium, and by heating calcium iodide with a large excess of sodium, obtained on cooling a cake of sodium calcium alloy resting on the sodium iodide. Treating small quantities of the alloy with absolute alkali, a fine crystalline powder consisting of pure calcium was obtained. By pressure and fusion this powder was agglomerated, and fine specimens of calcium were exhibited at the Paris Exposition in 1900. To Moissan largely is due our present knowledge of the properties of the pure metal. Borchers and Stockem and Ruff and Plato employed a principle similar to that of Matthiesen, but succeeded in obtaining better yields of calcium. The latest developments have been brought about by Suter and Redlich, who, by employing a cathode which only just touched the surface of the fused calcium chloride, obtained a small layer of fused calcium under the cathode. Before the calcium has collected in sufficient amount to flow away, the electrode is very slightly raised. The metal comes into a cooler zone and solidifies. By continuing the process a rather irregular rod of calcium is built up, which itself forms the cathode. The metal is supplied in these rough rods, which in outward appearance resemble cabbage stalks, but show a white metallic surface when cut through. The present price quoted in Germany is $5 a kilogramme retail, or $3 a kilogramme in 100-kilogramme lots. The product is said to contain over ninety-seven per cent of pure calcium, the impurities being chiefly calcium chloride and sodium. There may not be a large demand for the metal.—*Abstracted from Nature (London), December 22.*

Electrical Conductivity of Very Dilute Hydrochloric and Nitric Acid Solutions.

It is very difficult to obtain an exact value for the equivalent conductivity of completely dissociated acids, owing to the large effect of the impurities of the water on the conductivity of even strong acids in very dilute solutions. These effects give rise to a maximum value of the conductivity at a dilution of from 500 to 2,000 litres, but to a marked decrease in its value at greater dilutions. A knowledge of the theoretical limiting value is of importance, since upon it is based the assumed value of the equivalent conductivity of the hydrogen ion and the calculated decrease of dissociation of acids in general. In 1898 Kohlrausch derived values for the conductivity of strong acids at extreme dilution, by adding to the observed value at 0.001 normal a quantity equal to the product of the observed increase between this dilution and 0.0001 normal in the case of neutral salts, by the ratio of the increase between 0.1 and 0.001 normal in the case of the acids, the corresponding increase in the case of neutral salts, the conductivity of the latter having been first subtracted in all cases. In the present article Messrs. H. M. Goodwin and R. Haskell have endeavored to devise a method which would eliminate, to a great extent, the effect of the impurities in the water, by appropriate measurements of the conductivity of dilute acids. The solution was prepared with extreme care, and a special arrangement of cell adopted, in which the measurements were made. The method of correction involved the principle that the total effect of the acid and of the impurities in the water on the conductivity of each other is already produced when a relatively small quantity of acid has been added to the water, after which further additions of acid remain unaffected by the impurities. The results of the measurements give evidence of the correctness of this principle. Two methods were employed. The values for zero concentration or infinite dilution were found by extrapolation from those for 0.00025 normal, under the assumption that the change between these two limits of concentration stands in the same ratio to that between 0.00025 and 0.01 normal as in the case of neutral salts. The values found were less than one per cent lower than those of Kohlrausch, and are believed to be substantially correct.—*Abstracted from the Physical Review (Lancaster, Pa.), December.*

Electromechanical Compounding of Generating Sets.

An electromechanical method of regulating steam-driven generators has been devised by M. J. L. Routin, and is here described by M. De Kermond. The usual method of governing generating units is to maintain the speed of the engine as nearly constant as possible, and then, by means of compounding or other regulating device, to hold the voltage of the generator constant. Routin takes advantage of the condition, that a given load upon a generator calls for a definite valve opening if constant speed is to be maintained, and this load also requires a definite excitation of the generator if the voltage is to be constant. It is therefore possible to combine the engine governor with the generator regulating device, and thus control both machines at the same time. The method of doing this for a direct-current generator consists in exciting this in shunt, the excitation being varied by means of a field rheostat. This field rheostat is controlled by a small motor, which is itself supplied by an auxiliary generator. The auxiliary generator is coupled to the generator shaft so as to be driven at the same speed. It is excited by means of two windings, the one a series winding through which the generator load passes; the other a shunt winding which acts in opposition to the series winding, and the current which passes through this shunt winding is controlled by the small motor just mentioned. The field of this latter motor is in shunt with the system. This little motor, besides regulating the shunt circuit of the auxiliary generator, drives, through a worm wheel, a mechanism which varies the field resistance of the main generator. To this same mechanism is attached a speed governor driven by the engine itself. The action is as follows: the series and shunt windings of the auxiliary generator being in opposition, and there being no load on the generator, the small motor will shift the regulating rheostat of the auxiliary generator until there is no current

Digitized by Google

passing through the latter's shunt coil. There then being no excitation, there will be no current passing through the armature of the motor, and it will cease to turn. But while this machine has been turning it has been introducing resistance into the main generator's field, bringing the voltage to normal. When any load is thrown on the system, current passes through the series winding of the auxiliary generator, excites its field, and thus sends a current through the governing motor, causing this to turn. This decreases the resistance in the main generator field, and, at the same time, causes the current to pass through the shunt winding of the auxiliary generator. When this winding just balances the series winding, the small motor will cease to turn, and this will occur if the system is in proper adjustment when the voltage of the system has been brought up to normal. While this adjustment has been going on, the tension on the governor spring has been changed through the attachment previously mentioned, and the speed of the engine brought back to normal. In addition to these devices there is an electromagnet whose coil is connected across the generator terminals, and the pull of which acts against the governor springs. This arrangement not only provides for changes in load on the supply system, but also takes care of any change in steam pressure. To apply this method of control to an alternating-current system, it is only necessary to convert the alternating current which is sent through the various windings into a proportional direct current. It will then regulate the system, maintain the voltage constant independent of changes in load, changes in power-factor and changes in steam pressure, keeping both voltage and frequency constant.—*Translated and abstracted from L'Électricien (Paris), December 24.*

Water Power and Steam Power in the British Isles.

The water power of England is small, amounting to not more than 10,000 horse-power, while the total development in all countries is between 1,500,000 and 2,000,000. This want of enterprise Mr. E. Ristori believes is due to two causes: first, the reluctance of the English people to take up the new ideas quickly, and, second, to a prevailing notion that practically no water power exists in the British Isles, and that what there is is unsuitable for commercial development, the more so as coal in England is so cheap that there is no advantage in using water power instead of steam. This last assertion, the author holds, is wrong, and he endeavors to prove his case in this article. Wherever there is a combination of a large water-shed near such geographical formation of the ground as affords a suitable site for a reservoir, and a considerable difference of level within a short distance of the storage, water power may be developed. On the west coast of Scotland, in Wales and in the west of Ireland there are a great many places where these conditions can be found and where water power can be developed just as cheaply as in many places abroad. The climatic conditions in these districts are very favorable to water power, because the rainfall is large and uniform. In these districts there will be needed storage for only 100 days, whereas in other countries it must be provided for 150 or even 200 days. Moreover, winters are mild and there is no danger of low water during the cold season. In comparing a proposed water-power plant with a steam plant it should be borne in mind that the latter requires many auxiliary appliances not necessary for the former, all of which involve a large capital expenditure and require heavy maintenance. A steam plant requires more ground and a larger building to house the machinery than does a hydraulic plant. As regards cost of the installation, the electrical portion of the plant in any generating station is independent of the motive power used, but, if anything, the plant required for a steam-generating station is more expensive than that for a water power, because the former requires a system of large and small units to enable operation to be carried on efficiently at light loads. In the case of the water power, only large units are used, as the loss at light loads is represented by a little waste of water. As regards the other portions of the capital expenditure required in the case of water power, these are represented by the dam, the water carrier (this may be a canal or pipe line), the pipes conveying the water under pressure to the power station, and the set of turbines. Turbines for low falls are comparatively more costly than those for high falls, but the pipe line, being shorter, costs less. In any case, the total of these two items may be taken at from ten dollars to fifteen dollars per horse-power installed in the case of fairly large installations. The cost of the dam and the conduit is independent of the amount of power. Examining several hydraulic installations, it is found that the cost varied from thirty dollars to seventy dollars per horse-power for them. If the load-factor is low, the cost per horse-power installed will be even less. It is difficult to obtain a close figure for the cost of dams and canals, but the author estimates that the total cost of the hydraulic works of any good power scheme, including the turbines, should not exceed $100 per horse-power. It is said that there are some instances where this cost fell as low as fifty dollars per horse-power. The bulk of this expenditure is represented by dams, conduits and pipes, which in practice do not depreciate at all. The only depreciation takes place in the turbines, which represent only from $2.50 to $5 per horse-power. It is therefore allowable to take the depreciation of such a plant at not more than one per cent per annum. Adding the interest, the annual cost represented by these two items will not be less than three dollars nor more than six dollars per horse-power. A corresponding figure for steam is obtained on the assumption that the cost of the steam appliances, exclusive of the generator, will be not less than sixty dollars—probably nearer eighty dollars—per horse-power. Depreciation on this plant will be between $7.50 and $11 per horse-power per year. To obtain the figure for the working cost of steam plants, the records of the British Board of Trade are consulted, and a rate of 0.7 cent per kilowatt-hour is obtained for an economical steam plant (for such only need be considered). Assuming a twenty-five per cent load-factor, it is found that the running cost of such a plant amounts to $11.90 per horse-power-year (not including the labor item), but this is all saved in a water-power plant. Adding this figure to that obtained above for the interest, maintenance and depreciation, it is found that the annual cost per horse-power-year for a steam plant with a twenty-five per cent load-factor is $19.40. For a water-power plant the annual cost will not exceed $8.50 per horse-power-year. The conclusion is therefore reached that, under the conditions assumed, water power would cost at least ten dollars less per horse-power-year than steam.—*Abstracted from Engineering (London), December 23.*

Electrical Business in Chicago in 1904.

The business of Chicago, Ill., in electrical apparatus during 1904 is given as follows: manufactures, 1904, $15,000,000; manufactures, 1903, $16,000,000; decrease, six per cent. Sales, 1904, $13,000,000; sales, 1903, $13,000,000.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Demonstration of Electric Heating and Cooking Apparatus at R. H. Macy & Company.

The accompanying illustration shows a handsome iron booth erected by the firm of R. H. Macy & Company, in the house-

ELECTRIC HEATING AND COOKING APPARATUS.

furnishing department of their large department store at Herald Square, New York city. In this booth there is being demonstrated the electric heating and cooking apparatus made by the Prometheus Electric Company, of New York city, a full line of which is displayed at the various counters, as shown.

An expert demonstrator prepares throughout the day delicious dishes which are dispensed to the public, using at different times food-heaters, chafing-dishes, stoves and oven, and also showing the use of the laundry-irons.

This is probably the first time that a large department store has shown the actual use of electric cooking apparatus directly to the public, and the manner in which the latter have purchased this material proves conclusively that this manner of educating the public to the use of these up-to-date utensils is a correct one.

At the other end of the booth other electrical apparatus are sold and the entire display makes a very attractive and instructive exhibit.

Marshall Sockets.

The Marshall Electric Manufacturing Company, 301 Congress street, Boston, Mass., reports a very active market for its sockets. These sockets are made in very large quantities by patented automatic machinery. The process of manufacture ensures a uniform product and this is largely the reason for the popularity of the material.

The Warner Arc Lamp.

The Warner arc lamp and the Warner multiple series system for direct-current series circuits, manufactured by the Warner Arc Lamp Company, Muncie, Ind., are meeting with substantial success in all parts of the country. This system is not a laboratory experiment, as the designer is now and has been for over fifteen years actively engaged in the electric lighting business. He is in a position to understand the needs and requirements of central-station practice and the lighting public.

The Warner lamp is a shunt-controlled lamp, but no effort has been made to feed the carbons down gradually, not even a dashpot being used to complicate the mechanism. The Warner lamp, because of its positive action in bringing the carbons together with considerable force each time they are fed down, keeps any mushroom formation from taking place at the carbons.

The Warner multiple series system is simply the application of the regular Warner multiple lamp to a 9.6-ampere series circuit, the lamps being wired in multiples of two throughout the entire circuit, with a Warner branch box to each pair of lamps. The function of this branch box is threefold: (1) to properly divide the current, giving each lamp an equal amount; (2) in case a lamp becomes inoperative through the carbons burning out or open circuit, or from any other cause whatever the branch box automatically throws all the current through the remaining lamp and feeds the carbons at the proper time; (3) should both lamps become inoperative from any cause (open circuit or otherwise), the branch box closes the circuit and automatically shunts the current around the two disabled lamps, without affecting the operation of the remaining lamps in the circuit.

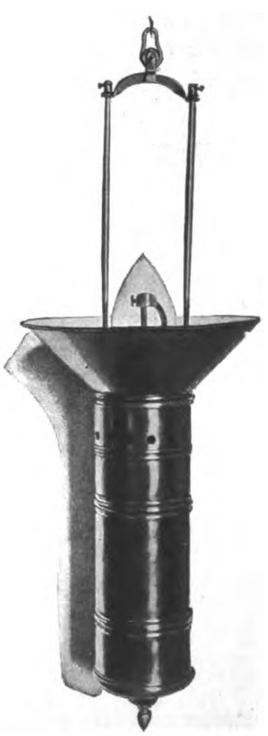
A plain series circuit may be changed over to the new system gradually, hanging in a pair of lamps and a branch box here and there, at any convenient point. In fact, the circuit can be part plain series and the rest multiple system, and the standard 9.6-ampere series enclosed arc lamp may be used for the part of the circuit left plain series.

A Constant-Potential Inverted Arc Lamp.

The C. J. Toerring Company, of Philadelphia, Pa., has recently placed on the market a constant-potential direct-current inverted arc lamp. In designing this lamp the following three conditions were held to be ideal for artificial illumination:

1. The light intensity should be sufficient to render all objects clearly visible without fatigue to the eye, and be so well distributed and diffused that no perceptible shadows could be cast by moving or stationary objects of ordinary size.

2. The visible source of light should not itself be perceptibly brighter than objects illuminated by it.



INVERTED ARC LAMP.

3. The color of the light should approximate that of sunlight in order to give true color values.

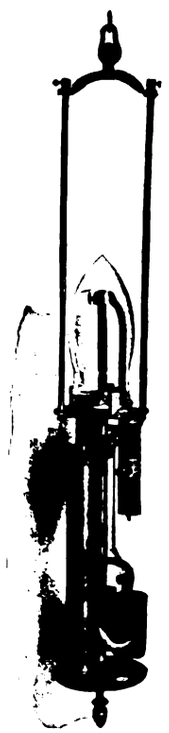
These conditions have been fairly well met by this inverted arc lighting system.

Digitized by Google

The two illustrations show the design of a constant-potential direct-current inverted arc lamp.

With the direct-current arc, eighty-five per cent of the total light comes from the crater of the positive carbon, five per cent from the incandescent vapor of the arc proper, and ten per cent from the negative crater.

In order to approximate the first condition it was considered expedient to throw the intense crater light upward against the ceiling if suitable or against a ceiling



INVERTED ARC LAMP WITH CASE REMOVED.

reflector. To do this economically with a direct-current arc it was necessary to place the positive carbon below the negative, which allows eighty-five per cent of the light to be thrown on the ceiling reflector without loss by reflection. The ceiling reflector then becomes the secondary source of illumination. When the light reaches the ceiling reflector it is spread over a relatively large area, its intensity being correspondingly lessened. From here the light is reflected to the floor with no greater loss than when passed through the usual alabaster globes, and is better diffused.

To satisfy the second condition the arc-enclosing globe is surrounded by a metal reflector which absolutely prevents any light from the arc and arc-enclosing globe to penetrate directly to the eyes of persons on the floor. If it were allowed to do so it would tend to contract the pupil of the eye and thereby render it much less sensitive to the light reflected from the objects in the room.

The third condition is most effectively obtained with the light from the 110-volt enclosed arc lamp. For 220-volt circuits two 110-volt lamps are placed in series, the operating mechanism being changed to suit this condition.

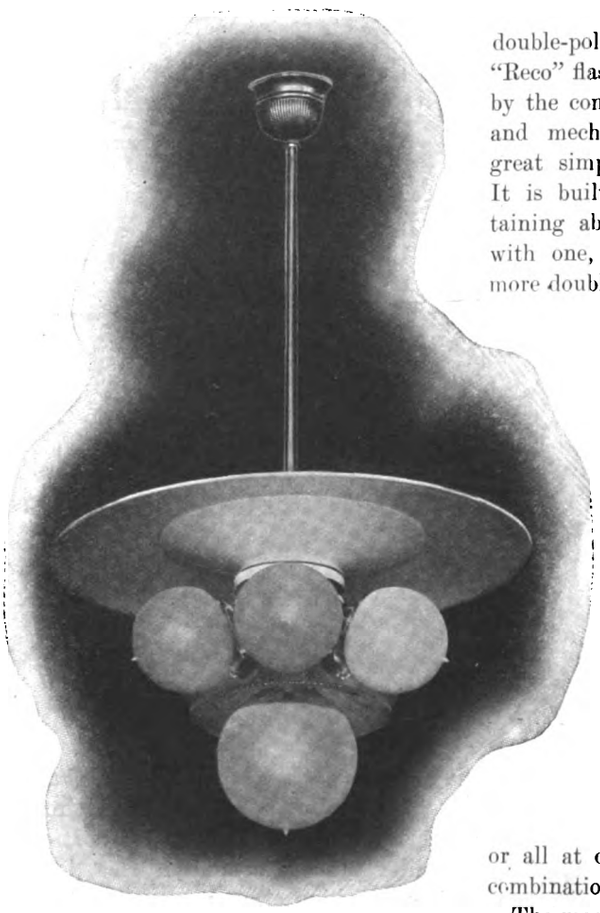
The design and construction of the lamps is of the usual Toerring standard. Before placing the lamps on the market several lamps were put into the hands of competent engineers who operated them for nine months without developing the least fault.

When several lamps were placed in a draughting room the diffusion of the light was found to be so perfect that when a pencil was placed in a vertical position on a drawing-board the shadows cast were almost imperceptible.

The lamps are especially suited to the lighting of textile and silk mills, draughting rooms, large commercial offices and wherever light with a minimum of shadow and no glare is wanted.

A New Form of "Arc-Burst."

The accompanying illustration shows the new form of "arc-burst" placed upon the market by the Benjamin Electric Manufacturing Company, Chicago, Ill.

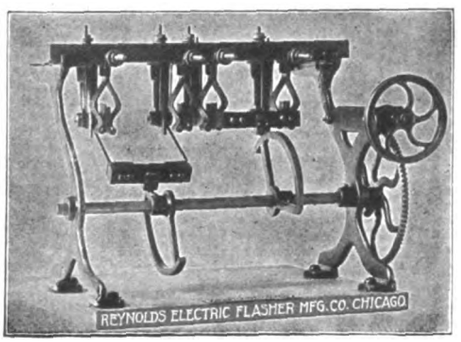


BENJAMIN "ARC-BURST."

This "arc-burst" is constructed from a Benjamin wireless cluster. It is adapted to art galleries, restaurants, stores and public buildings, and consists of a Benjamin cluster with a three-foot stem, a crow's foot, canopy, shades, shade-holders and lamps. The standard finish of the fixture is polished brass. Other finishes may be furnished if desired. The fixture is furnished in three standard sizes: four-light, 130 candle-power, 270 watts; five-light, 155 candle-power, 320 watts; six-light, 180 candle-power, 370 watts.

The "Reco" Electric Sign Flasher.

The Reynolds Electric Flasher Manufacturing Company, 221 Fifth avenue, Chicago, Ill., has placed on the market a new form of electric sign flasher with



THE "RECO" ELECTRIC SIGN FLASHER.

double-pole switches, designated as the "Reco" flasher. This apparatus is claimed by the company to be perfect electrically and mechanically, and is possessed of great simplicity, and operates perfectly. It is built for controlling circuits containing above six amperes, and is made with one, two, three, four, five, six or more double-pole switches. These switches have a capacity of 20, 35, 50, 75 or 100 amperes each. Thus, from 50 to 500 four-candle-power lamps may be flashed on and off with one switch, and as many switches may be added as desired. The switches are controlled by cams, which close them automatically in any desired manner, producing any combination or flashing effect. With this flasher electric signs may be flashed as a whole; double-face signs flashed alternately, each side as a whole; signs containing a number of words or lines, each word or line flashed separately or all at once. In fact, any number of combinations can be secured.

The mechanical and electrical construction is simple, heavy and substantial. The construction avoids a multiplicity of circuits running through the flasher, as the division of circuits can be made at a

Digitized by Google

cutout box located in the circuit between the sign and the flasher.

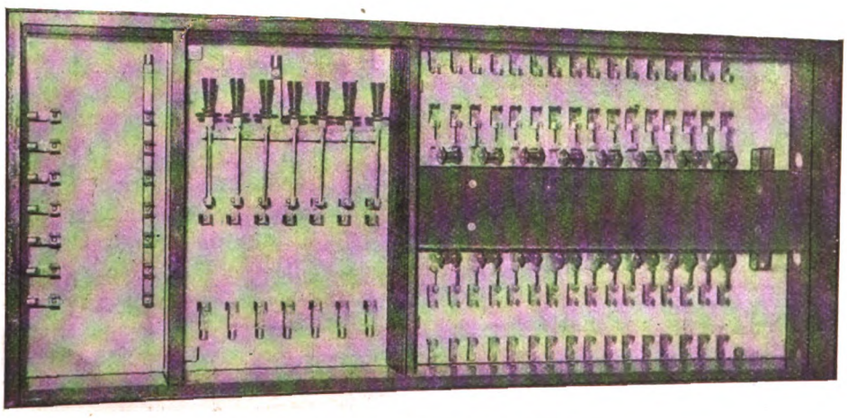
The switch jaws are provided with self-lubricators in the shape of grease-cups or pockets, which hold sufficient grease to keep the sliding contacts perfectly clean and well lubricated for weeks without refilling. These may be observed in the accompanying illustration.

The switch blades drop from the jaws by gravity action as soon as they are released by the cams, thus ensuring an instantaneous break and avoiding undue arcing.

These flashers are simple to connect, and require but one lead from each side of the sign and one return wire, or one positive and one negative from each word or line, and two or three mains from the service, according to the system. In other words, these flashers are simply cut in between the sign and the service, and can be quickly connected to signs already installed.

Subway Station Panels.

The accompanying illustration shows a typical panel-board built by Waterbury & Company, 69 South street, New York city, for the Interborough Rapid Transit Company, for installation in the subway stations of the latter company's underground railway system. These panels are built according to the specifications drawn up by W. Parks, of the Interborough company, and C. W. Cornell, of the Tucker Electrical Construction Company. All of the panels installed in the subway



Subway Station Light and Power Panel.

stations are similar and control the lighting circuit as well as the circuit for driving small motors in the station for ventilating and other purposes.

These panels are compact in construction and both 500-volt and 220-volt lines are controlled from the one panel-box The bus-bars are mounted upon slate, and there are slate barriers between the 500-volt and 220-volt buses.

Waterbury & Company is increasing the output of its large factory at Kent avenue, Brooklyn, N. Y., and is now engaged on considerable high-tension work. The concern is installing a large feeder system for the Coney Island & Brooklyn Railway system, and is also at work upon other large contracts for underground transmission, and telephone and telegraph cables.

An important order which the company has recently secured is that covering all the switches and panels to be installed in the New York Hippodrome, the new amusement palace being erected in New York city by Messrs. Thompson & Dundy.

Large Flashed Sign at the St. Louis Exposition.

The Reynolds Manufacturing Company, Chicago, Ill., built the largest flashed sign known at the present time. It was erected at the main entrance to the World's Fair, St. Louis, Mo. The sign was on the roof of the terminal station of the Olive street car line. It was about sixty feet long, thirty feet high above the roof, and the letters were two and four feet high, respectively. The letters were of the grooved type, and contained eight-candle-power lamps throughout. The sign was double-faced, and was flashed on alternate sides. When one side was lighted the other was dark. There were about twenty flashes per minute. A No. 233 Dull's carbon series-type flasher was used. There are not more than half a dozen of these flashers in use, as there are very few loads of this size to be flashed.

In this type of flasher the current is broken on both metal and carbon six times in series on each branch. There were about 23,000 watts on each side of the flasher at about 230 volts, a two-wire system being used. When the machine was ordered, it was intended for 12,000 watts, but the load was later increased at the request of the owner.

Large Flashed Sign at St. Louis Exposition.

As originally designed, the arc jumped over a three-inch air-gap, and it was necessary to increase this air-gap to five inches between metals of opposite polarity with the heavier load. The sign was run about eight hours a day. It was installed by E. H. Abadie & Company, of St. Louis, which was also the contractor for the sign work.

The Baikal Lake Section of the Siberian Railway.

The total cost of the Baikal lake section of the Siberian railway was about $30,000,000, amounting to approximately $186,300 per mile. Preliminary studies and geological investigations since 1895 have cost over $540,000. The track is laid with T-rails weighing sixty-four pounds per yard. The bridges have steel spans on masonry piers, and the viaducts are of masonry. The line has a capacity of fourteen trains per twenty-four hours in both directions. Construction was commenced in the spring of 1903, and was intended to be completed early in 1905. The military necessity for the line, however, led to the work being pushed early in the last year, and the road was opened to a limited traffic in October, 1904.

Digitized by Google

The Duncan Direct-Current Wattmeter.

The Duncan Electric Manufacturing Company, Lafayette, Ind., manufactures a direct-current wattmeter which embodies a number of new improvements. The principal features involved in the recent developments have been along the lines of increasing the driving torque and, incidentally, the retardation so that the accuracy on very small loads can be depended upon to a degree not attainable heretofore. Another important change recently accomplished is one of design, whereby the bearings may be readily inspected and renewal of spindle points and jewels made with the greatest possible ease, without having to use special tools.

Fig. 1 shows the Duncan direct-current wattmeter, with its cover in position. This cover is removable from the front, thereby permitting the meter to be installed quite close to the ceiling. It fits closely into a felt-lined groove, making the instrument absolutely dust and insect-proof. By way of testing the dust-proof qualities of the meter, the makers installed one of them in a flouring mill eleven months ago, and upon being inspected three weeks ago it was found to be as clean and free from dust within as when first installed.

FIG. 1.—VIEW OF THE DUNCAN INTEGRATING WATTMETER.

Fig. 2 shows the meter with cover removed, and Fig. 3 is a side view. The series field coils are machine wound, and then thoroughly taped to ensure perfect insulation. They are clamped to and held on their supporting rods in the simplest possible manner.

The armature is wound with 10,000 turns of No. 41 magnet wire. The makers state that the torque of the armature is from twenty to twenty-five per cent higher and that it does not consume as much energy as the older types. The retarding magnets are put through an artificial ageing process requiring six months, and by the time they are put into the

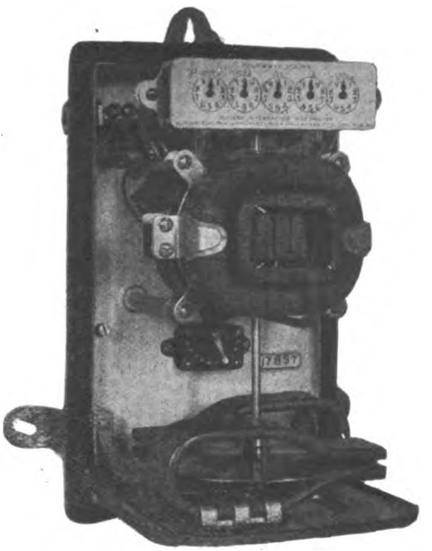


FIG. 2.—DUNCAN INTEGRATING WATTMETER, WITH COVER REMOVED.

meter they are guaranteed to be proof against becoming weak, even in the presence of strong external fields. This quality causes the meter to maintain its accuracy indefinitely and it will not change its characteristic after it has been calibrated at the factory. The retarding disc is made from the purest aluminum obtainable and is accurately weighed and balanced before being assembled.

A recent improvement in the construction of the Duncan meter is the "visual" bearing and "threadless" jewel-post arrangement. The detachable spindle point may be taken out and inserted again without the slightest inconvenience. No special tools are necessary and the difficulties of the older clumsy and more awkward methods of renewing pivots are completely and successfully overcome. The "threadless" jewel post, as the name implies, is bereft of threads and is held firmly in position by a wire spring. Its insertion or removal requires but a moment and no trouble is experienced from the stripping or binding of threads.

To prevent the brushes from getting out of alignment, they are mounted upon a suitable moulded lava support and, being firmly secured thereto, their tension upon the commutator is also maintained constant.

No part in the make-up of a commutator meter is productive of more trouble than the commutator itself. The Duncan Electric Manufacturing Company has made numerous experiments during the past two years in an effort to produce an alloy that would be especially suitable for use with commutators. In this it has apparently succeeded. Their composition will not tarnish and the commutators do not turn black after having been in service for a short time.

To overcome effectually the friction of the bearings and enable the meter to measure accurately very small loads, a compensating coil is employed which is rigidly fixed within the front series field coil and in close proximity to the armature. Its supplemental torque effect upon the armature is varied by cutting in or out of circuit a portion of the turns comprising it. The terminals of the various groups of windings of the coil are connected to corresponding contacts of a "multipoint" switch having a small lever or arm. This arm makes connection with any of the contacts and brings into circuit any number of turns desirable. To compensate for friction, the lever of the "multipoint" switch is moved toward F, thereby cutting in turns of the com-

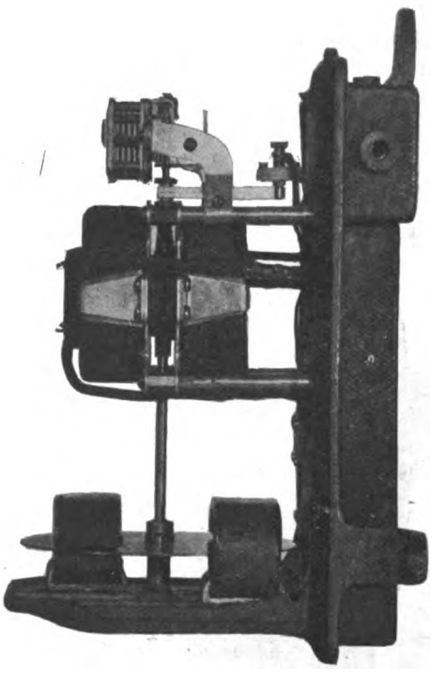


FIG. 3.—SIDE VIEW OF DUNCAN INTEGRATING WATTMETER.

pensating coil, and to compensate for creeping the lever is moved toward S, thus cutting out turns from the coil. These changes require but an instant and are absolutely permanent. There is no pushing in or out of a loose compensating coil which changes its position every time an attempt is made to fasten it,

Digitized by Google

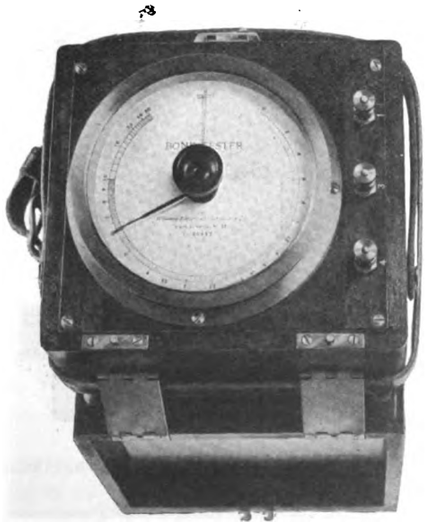
neither is there any change of position to contend with every time the series field coils are subjected to abnormal rushes of current. The range of the compensating coil is exceptionally great and with its switch arm set for any given number of turns or compensation, it may be absolutely depended upon for permanency.

The binding-posts in the Duncan meter are made fireproof and mark a great improvement. No wood or other combustible material is employed in their construction, but instead, a specially prepared insulating fibre that is chemically treated with tungstate of sodium.

The appearance of the meter is particularly pleasing. Its finish is that of a semi-dull, hard-rubber black. The nameplate is silvered. The dials are extremely large and are made of porcelain; they have no constants and read direct in thousands of watt-hours (kilowatt-hours).

Direct-Reading Bond Tester.

The Whitney Electrical Instrument Company, Penacook, N. H., is placing on the market a new direct-reading bond tester, which is shown in Fig. 1. It is light and compact, so that it may be carried about for long periods by the observer without fatigue, and it will show the resistance of the bond under test directly on a scale which reads in terms of the number of feet of length of uncut rail, whose resistance equals that of the bond. It will show instantaneously whether the bond resistance is above or below any predetermined value. A single observer can take all readings.



DIRECT-READING BOND TESTER.

The method of using the bond tester is shown in Fig. 2. The instrument is supported by a strap passing around the neck of the observer. The strap, in conjunction with the cover—which opens downward at right angles to the top of the tester—holds the device securely in a horizontal position. By adjusting the strap length, the dial can be brought to a definite distance from the observer's eye.

METHOD OF USING DIRECT-READING BOND TESTER.

To make a reading, the contact bar is connected up to the instrument by means of flexible cords which are furnished for the purpose. All cords and binding-posts are numbered to facilitate proper connection. The contact bar is placed on the rail, with the two more closely adjacent rail points spanning the joint. The needle coming through the dial—shown in Fig. 1—will deflect from its zero position. The needle is brought back to zero by rotating the hard rubber button in the centre of the glass cover. The resistance of the bond is shown on a scale by the position of the pointer, which is moved by the button.

If it is desired to ascertain whether the resistance of the bond is or is not greater than a predetermined amount, the pointer operated by the hard rubber button is first set to the predetermined value. When the contact bar is placed in position on the rail, the small needle will deflect either to the right or the left of its zero position, depending upon the direction in which the current is passing through the rail.

The range of the bond tester includes all resistances from zero up to the equivalent of a length of thirty feet of rail. The length of the scale is about fifteen inches.

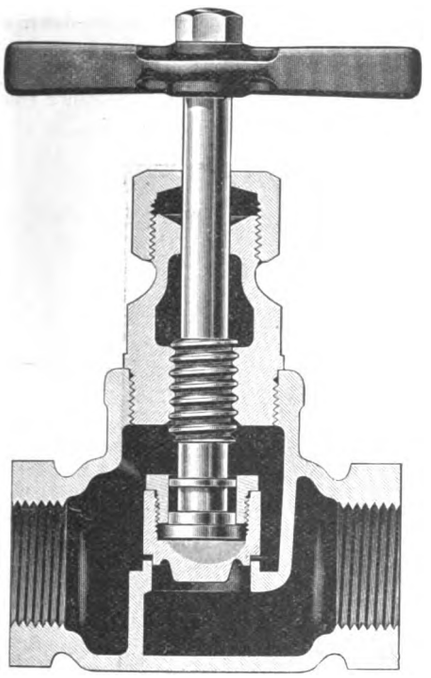
The apparatus measures five and one-quarter by eight and one-quarter by seven and one-half inches over all, and weighs about six pounds. The contact bar is hinged at the centre of its lower member, and where the vertical bar joins the lower member. The whole device will fold into a package one and one-half by three by thirty-six inches.

Machado & Roller, 203 Broadway, New York city, are general agents for this tester.

Digitized by Google

The Hancock Valves.

The Hancock globe, angle, sixty degrees and cross valves are made screwed and flanged in sizes up to three inches. These valves are made of special composition giving great strength and resistance to wear. They are made one standard only, for all pressures. Under actual test, the bodies of these valves will stand a pressure of 4,000 pounds per square inch without breaking and are tight with a water pressure of more than 1,000 pounds per square inch. The company's guarantee is that every



HANCOCK GLOBE VALVE.

type of Hancock valve has been tested with 1,000 pounds water pressure and found tight before leaving its works, and the valves are guaranteed for 500 pounds steam pressure.

In order that the valve seat may be hard and durable, the body is made of a specially hard and tough mixture. The discs are made of a special mixture which does not contain any zinc. The spindles are all made of Tobin bronze. Experience has demonstrated that a Tobin bronze spindle working in a special composition bonnet will not cut under the highest steam pressures.

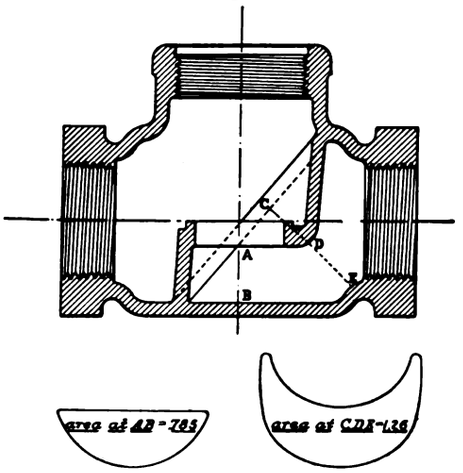
These valves are made after the same general design as the Hancock main steam valves, used on locomotives for a number of years and found to give perfect satisfaction with the high steam pressures carried. From the sketch shown herewith of a one-inch globe valve, it will be seen that the area of the most contracted part of the valve is ample and of full size.

These valves have been designed so that the metal is distributed to give uniform strength throughout, and the areas have not been reduced or contracted for the purpose of reducing the weight.

Attention is called to the way the valve is guided on the stem. An inspection of the section of this valve will show two collars or guides upon the stem which guide the disc nut, compelling the disc to always seat squarely and preventing the disc from cocking.

The valve seat is flat. This form of seat has many advantages. The valve disc has a projection on it which serves two purposes. In the first place it acts as a guide when the seat is ground. In the second place, this lip or projection on the disc prevents the cutting of the seat by the wire drawing of the steam when the valve is cracked or slightly open. Again, when the valve is slightly raised from its seat as shown in the illustration with the lip entering slightly, it allows the escaping steam to clean the seat, so that when the valve is seated all dirt and foreign matter have been washed or blown completely off the seat. This is a most important feature, as experience has fully demonstrated that when the Hancock valve begins to leak it requires very little regrinding to make it tight. This is accomplished so easily that a tight valve can be maintained for a great length of time.

The bonnets of these valves are made with a long thread engaging the body of the valve, and the shoulder on the bonnet is made narrow. By means of this narrow seat on the shoulder, it is possible to keep the bonnet tight, and when it is



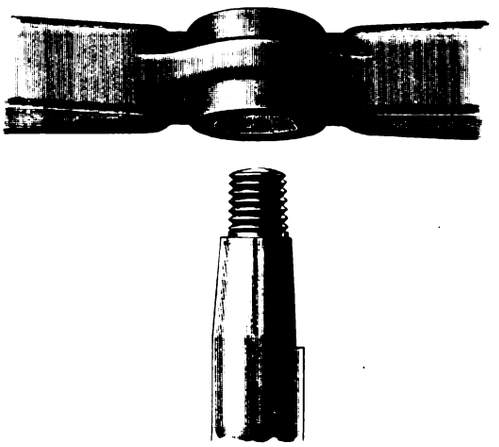
SECTIONAL VIEW OF HANCOCK GLOBE VALVE, SHOWING AREA OF RESTRICTED PASSAGES.

desired to unscrew the bonnet, it can be easily done.

When it is necessary to regrind the valve to its seat, the bonnet is removed, the disc nut unscrewed from the disc. A piece of wood can be inserted in the disc, enabling it to be ground perfectly as the projection on the disc guides it. It not being necessary to have any special regrinding tools for this purpose.

The tee handle shown on the Hancock valve has proved to be very efficient in opening and closing. It has become very popular among the users of these valves, and the demand is so universal that all valves sent out are equipped with the tee handle.

The illustration shows the peculiar method of attaching the tee handle. The hole in the handle is made tapering with one side flat and the spindle of the valve is also made tapering with one side flat-



TEE HANDLE, HANCOCK GLOBE VALVE.

tened to receive the handle, the tee handle being held on the spindle by means of a nut. The flattened side holds the handle rigidly in its place, and the taper enables the handle to be drawn tightly to the spindle, avoiding any annoyance from handles or wheels working loose.

The Hancock valves are made by the Hancock Inspirator Company, whose general office and salesroom is at 85-87-89 Liberty street, New York, with a western branch office and salesroom at 22-24-26 South Canal street, Chicago, Ill. The company's factory is at Boston, Mass.

Flywheel Accidents and Their Prevention.

Statistics show that the number of serious accidents resulting from racing engines is steadily increasing, and it is reasonable to suppose that for every such accident reported in the public prints there are many minor, yet costly, ones that are never heard of outside the plants in which they occur.

These accidents happen in spite of thorough inspections and such other precautions as an efficient engineer may employ, and generally the least of them does sufficient damage to necessitate a

Digitized by Google

brief shutdown for repairs, with a consequent loss of time and profits.

Occasionally the engineer, perhaps at the risk of his life, is able to reach the throttle in time to avert a serious disaster; but very often he fails to do so and the engine gains speed until it bursts the flywheel, wrecks itself, demolishes its surroundings and maims or kills whoever happens to be in the path of the flying iron.

These are the cases which are chronicled in the daily press and which are causing more and more of those who, from a mistaken sense of security, have heretofore given the matter little or no attention, to seek some method by which "racing" may effectually be prevented.

The Monarch engine-stop and speed limit system is made to meet just such emergencies, and a booklet of testimonials entitled "As Others See Us," recently issued by the manufacturer of this device, the Consolidated Engine-Stop Company, 100 Broadway, New York city, testifies to the fact that the Monarch system has been the means of preventing many engine accidents. This system is connected directly to the main flywheel shaft, and when the engine exceeds the speed at which the speed limit is set, no matter from what cause, the speed limit operates the stop automatically and positively by electrical contact, the steam being immediately shut off and a gong rung notifying the engineer. The stop may also be operated from any part of the shop by means of especially devised push switches, conveniently placed and thoroughly protected from meddlesome employés.

The wide use of electric motors for power purposes has shown the desirability of a device which will do for the electric motor what the engine-stop does for the steam engine, and this has also been produced by the above-named company.

The Monarch motor-stop places an electric motor or a motor-driven machine under absolute control from any part of the works through snap switches of an improved dial pattern, a single turn of which operates a separate battery system which throws the main switch at the board. These switches, while carefully protected, are always available for immediate use.

The switchboard is an attractive sheet of marble or slate, carrying a testing apparatus as well as the main switchboard. It may be used as a main switchboard, or placed in the office or other part of the plant for use only in emergencies.

The Monarch motor-stop may be connected with any size of motor, using any kind of current. It will stop a machine under load in from two to five seconds, and may be arranged to protect any desired number of motors.

This new apparatus gives the company a system of power-control and speed-limiting devices which meets every requirement of both electric and steam-driven machinery.

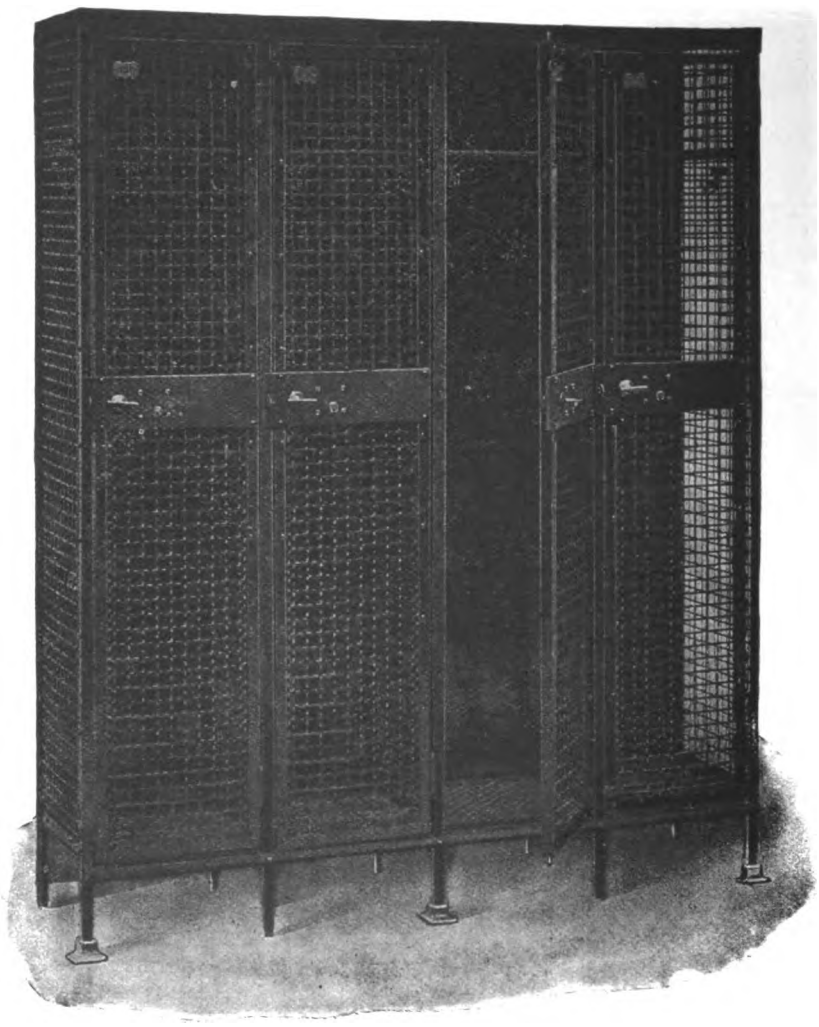
The "Pen-Dar" All-Steel Locker.

The solution of the problem as to the method or system to be adopted for the disposition of wearing apparel of employés, while engaged in performing their daily labor, has become a difficult one for the managers of large manufacturing plants, railroad companies and in fact any place or building where a large number of people are employed. Edward Darby & Sons Company, Incorporated, Philadelphia, Pa., has introduced an all-steel locker which meets all requirements and overcomes all the objections met with in older styles of clothes lockers or receptacles.

The old method of using wooden lockers or compartments for clothes has been admitted by all interested in the subject to be unhealthy and unsanitary. Being entirely of wood, they were like a closed box, allowing of no ventilation, and dust, dirt and so on from umbrellas, boots and clothes soon collected in the corners, on the sides, bottoms and shelves, until they become dangerous and unhealthy. The clothes left in them, especially if they were the least damp, soon became mouldy and foul-smelling. This has been overcome by the introduction of the "Pen-Dar" metal locker.

This locker is constructed entirely of steel. The frame and supports being of angles well riveted and braced. The fronts, sides and bottoms are of open mesh, and allow of a free circulation of air. The backs and tops are of sheet steel. Each locker has a shelf, nickel-plated coat hooks, and is fitted with a three-point combination lock. This device, which is ingenious and entirely new, securely fastens the door at the top, bottom and centre with one motion. Duplicate keys are provided and each set is mastered. They are made in groups of a convenient number and are shipped knock-down or set up and crated.

These lockers have been endorsed by the fire underwriters and insurance companies throughout the country. Being of open mesh, the contents can be inspected at will and any fire arising within the locker can be instantly discovered. If for any reason the necessity for fumigation should arise, an entire locker room can be so treated without removing a single garment from the locker. They are finished in the finest manner, and when set present a neat and attractive appearance. The great number of lockers installed by this company since first placing them on the market is sufficient proof that they fill a long-felt want, and are all that their manufacturer claims for them.



THE "PEN-DAR" ALL-STEEL LOCKER.

Digitized by Google

A New Single-Phase Integrating Wattmeter.

The Westinghouse Electric and Manufacturing Company has developed the type B Westinghouse integrating wattmeter for use upon single-phase circuits of 7,200 and 16,000 alternations. It shows improvements in a number of features that

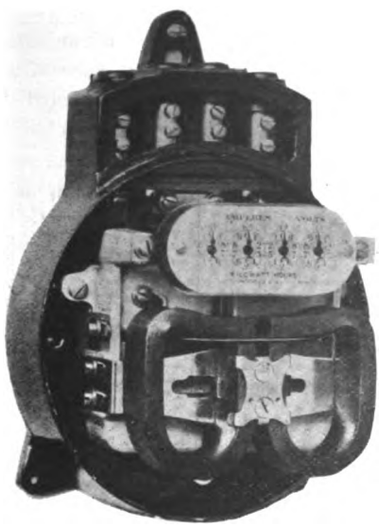


FIG. 1.—WESTINGHOUSE INTEGRATING WATTMETER WITH COVER REMOVED.

give it an increased efficiency and long-lived calibration.

In every essential it follows the Westinghouse standard designs, employing the principle of shunting the greater portion of the field due to the shunt winding, and allowing only a small portion of it to combine with the series field to produce a torque on the disc. By this means good load-voltage and frequency curves are obtained. By a change in the design of the electromagnet the effect upon the disc is made double that produced in the type A, with the same small shunt loss, the same accuracy upon light work and a minimum amount of variation in performance due to changes in voltage and frequency.

Fig. 1 shows the type B integrating wattmeter with cover removed. It is compact in form and can be installed in a small space, the front connections on the top of the meter case adding materially to the convenience in installation. The fact that it is a sealed meter, with the original calibration preserved under the manufacturer's seal, and requires no adjustment when put into service also reduces the cost and the labor of installation. It is only necessary to fasten the meter securely to its supports by three screws, to connect the line wires to the four terminals and to take the initial reading of the meter. It will be noted that the use of four binding-posts, and the connecting of both sides of the circuit to the meter, prevents its stoppage by removing a shunt lead, without interruption to the circuit. The shunt connection is permanently made inside the meter. All of the working parts are attached to a single casting. This gives strength and rigidity, and ensures a perfect alignment and reduces the liability of injury from jarring. The moving element retains the lightness of that of previous types, with a greatly increased torque. The magnets are well aged and mounted upon one bracket, which ensures perfect alignment. The use of two magnets permits the adoption of a wider air-gap, thus eliminating the danger of the disc rubbing. Adjustments for frequency, speed and friction are conveniently located and easily made. At full load the disc makes twenty-five revolutions per minute.

The essential features of the ball bearing in the type A meter are retained in the type B. The lower end of the shaft, upon which the rotating disc is mounted, is fitted with a sapphire jewel slightly cupped. A corresponding jewel is placed in the end of the adjusting screw which forms the lower half of the bearing, and into the hollow space between the jewels a hardened steel ball is introduced. The polished steel surface of the ball is slightly less in radius than the jeweled cups, reducing the friction to an inap-

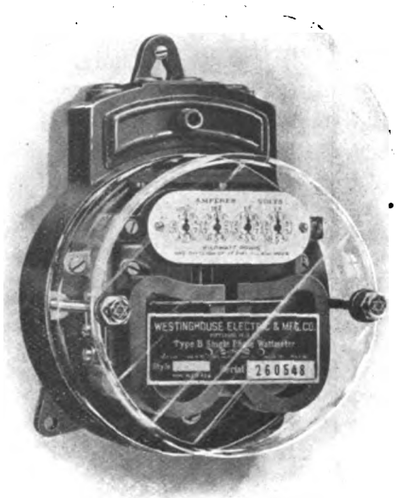


FIG. 2.—WESTINGHOUSE INTEGRATING WATTMETER WITH GLASS COVER.

preciable amount, owing to the smallness of the points of contact.

The upper bearing is new and presents some excellent features. The shaft which supports the disc is drilled out at its upper end slightly larger than the pin which is attached to the upper screw. The diameter is reduced at one point in its depth to form a bearing for the pin. At the bottom of the hole is placed a small piece of felt which is impregnated with oil. Capillary attraction causes the lubricant to creep upward, oiling the bearing. Friction is thus reduced to a minimum, decreasing the wear and eliminating noise.

FIG. 3.—WESTINGHOUSE INTEGRATING WATTMETER WITH METAL CASE.

A four-dial counter is employed; its construction and the connection with the disc shaft being so perfect that no friction effects are perceptible. On meters of less than 3.84-kilowatt capacity the first dial reads in the tenths of kilowatt-hour; in larger capacities the first dial records units.

The meter records directly without the use of a constant. The accuracy is not affected by reasonable variation in voltage and it records correctly from two per cent of full load to fifty per cent overload, and under all conditions of power-factor and wave-form.

Fig. 2 shows the meter furnished with a glass cover. It is also furnished with a metal instead of a glass cover as shown in Fig. 3.

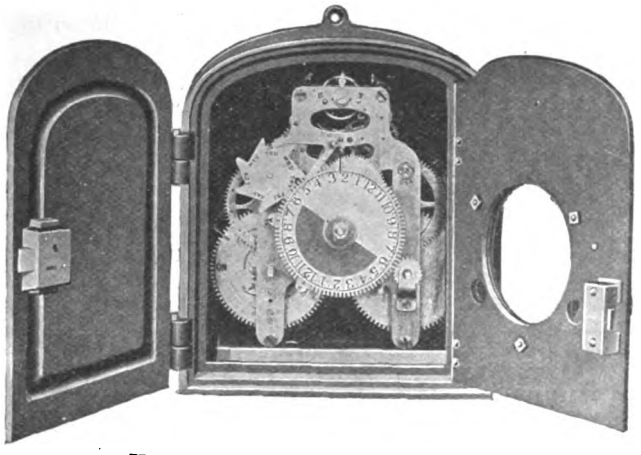
Long-Distance Telegraphy.

During the past year the Indo-European Cable Company has had in operation the Wheatstone system over the full length of its line. This route starts at London and terminates at Teheran, Persia, the distance being about 3,800 miles. Recently these messages, as they have come into London, have been relayed to Liverpool and Manchester instead of being retransmitted by Morse. The messages are received as clearly at these places as they are in London. The two cities exchange their messages direct with Teheran.

Digitized by Google

The Hartford Time Switch.

Two new types of automatic switches have been put on the market by the Hartford Time Switch Company, Hartford, Ct., that should prove of interest to central station managers and contractors, as they greatly widen the field of usefulness for automatic switches.



HARTFORD AUTOMATIC TIME SWITCH.

The first model of the Hartford automatic time switch is known as type "B," which, it is claimed, has fully demonstrated, by long service in actual operation, its reliability to work continuously and successfully under all conditions, in the varying temperatures of summer and winter, and in protected and unprotected positions.

Type "C," one of the new models, has been put out to meet the demand for a switch that would automatically omit throwing the switch on Sunday, without in any way interfering with its regular operation on week-days. This switch is not complicated, and when set up requires no more attention than the type "B" switch.

The type "D" switch was designed particularly for controlling window and sign lighting on thoroughfares which have crowds at certain regular periods daily, such as streets in the vicinity of theatres and those leading to railroad stations, with suburban traffic before and after the theatre. This switch throws the current on for two periods each day. For example, it can be set to light windows and signs from 5 to 8.30 P. M. and again from 10 to 12 P. M., or at such other hours as the user may desire. It gives the maximum of useful display lighting with the minimum of expense. This switch can be furnished combined with the automatic cut-out feature of type "C."

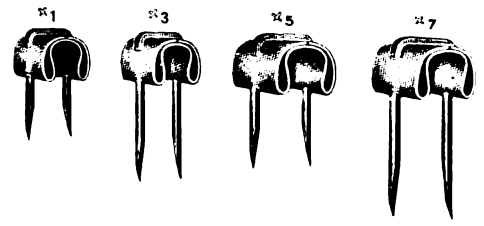
Many switches have been made to fill special requirements, and there are few conditions, where an automatic switch can be used, that the Hartford switch can not be arranged to fill. All switches are equipped with a high-grade Seth Thomas marine clock movement; the switch is of the rotary type having double contacts of ample capacity and thoroughly insulated. The entire mechanism is enclosed in a japanned iron case with double doors and is dust and weatherproof. The subtreasury lock used on the outer door prevents any unauthorized tampering with the mechanism. All switches are furnished wired and ready for immediate installation.

A. Hall Berry, vice-president, F. H. Lovell & Company, 97-101 Warren street, New York city, is sole sales agent for the Hartford Time Switch Company.

The Blake Insulated Staples.

The Blake Signal and Manufacturing Company, Boston, Mass., is placing on the market four sizes of insulated staples, which are shown full size in the accompanying cut. These four sizes cover the demand of the field for insulated staples for low-voltage wiring, such as telephone, telegraph, annunciator, bell and all battery circuits. The special features are that the fibre forms a good insulating and mechanical protection, preventing the metal of the staples from coming into contact with and damaging the insulation of the wiring, causing short-circuits; the fibre is securely attached so that it can not come off in driving; flat-head, substantial shanks and sharp points give excellent driving qualities.

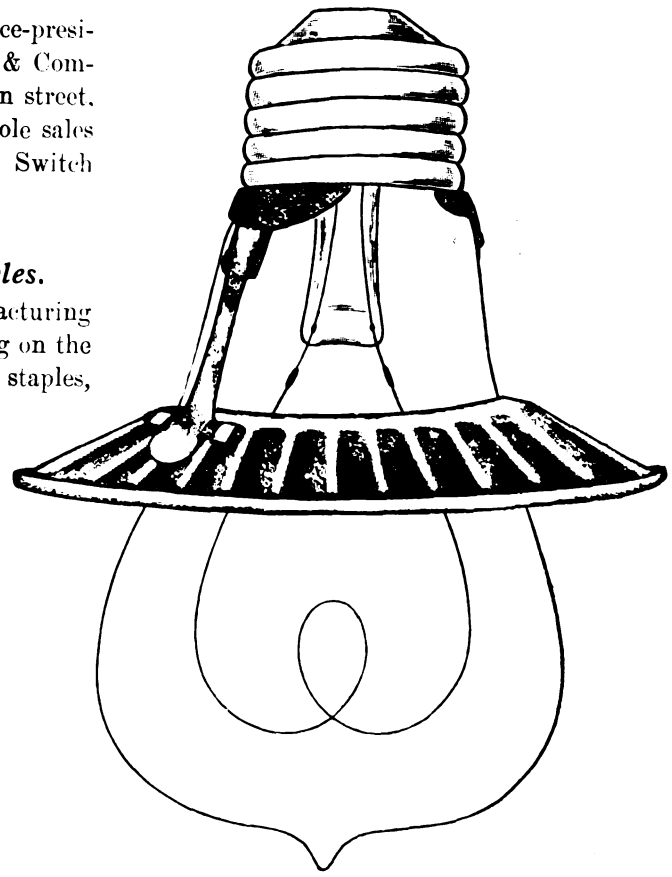
The cost of the staples is less than the screws alone used in cleat work, and the insulating and mechanical protection is stated to be as good. Wiring can be done more quickly with these insulated staples than with either bare staples or cleats. The staples already have a large and increasing sale among the Bell and independent telephone companies, and also for telegraph, fire-alarm, annunciator and other low-voltage wiring.



BLAKE INSULATED STAPLES.

A New "Sarco" Specialty.

The Sarco Company, New York city, has placed upon the market a new form of special two-light reflector for railway, steamship, trolley car and any outside or exposed service. The great success with which the company has marketed the regular "Sarco" two-light reflector has indicated the possibilities for a successful handling of the new form of special apparatus. This type of reflector is designed for service where a substantial reflector is required, which will not be affected by rough usage or exposure to the weather.



"SARCO" TWO-LIGHT REFLECTOR LAMP.

The special two-light reflector comprises all the advantages of the regular two-light reflector, allowing the light to penetrate to the top and bottom of the lamp, and, in addition, has the feature of allowing the removal of the lamp by bending back the German silver springs without removing the lamp from the socket. This makes the reflector especially adapted to railway service, where frequent cleaning is necessary.

The reflector is claimed to be shadowless. It possesses great reflecting surface, and is easily applied.

Digitized by Google

The "Interpole" Variable-Speed Motor.

The Electro-Dynamic Company, Bayonne, N. J., has placed on the market a new motor (shown in Figs. 1 and 2) which is essentially a variable-speed motor, but which can also be used on constant-speed work. It was designed especially to drive machine tools, pumps, blowers, woodworking machinery and all other classes of machines, either driving the same directly or in groups. The motor operates on any two-wire, direct-current circuit from 110 to 500 volts.

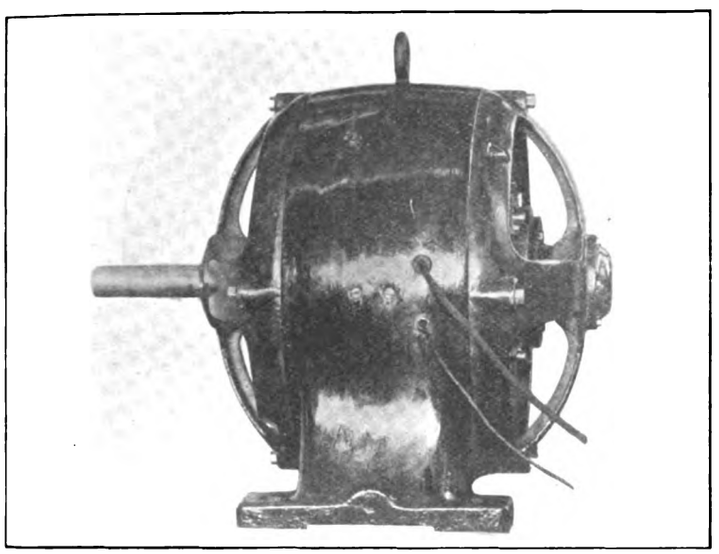


FIG. 1.—ASSEMBLED "INTERPOLE" MOTOR, SHOWING BEARING HOUSING.

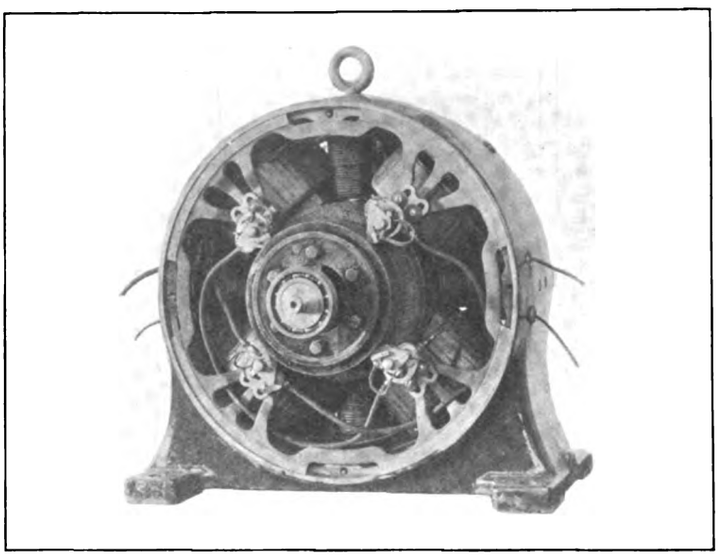


FIG. 2.—ASSEMBLED MOTOR, SHOWING "INTERPOLES" AND BALL BEARINGS.

In any direct-current, shunt-wound motor having a variable speed, the strength of the main field-poles must be decreased if the speed of rotation is to be increased. Sparking at the brushes will then result, and if an attempt is made to fit the motor to run in either direction by shifting the brushes to positions equidistant between the poles, the sparking will be still further increased. In this motor, however, the brushes are placed equidistant between the poles, and it is capable of reversing its direction of rotation without sparking with variable load as well as with variable speed. This is accomplished by means of the auxiliary poles, which may be seen in Fig. 2, between the main poles.

The coils in the auxiliary poles are so proportioned and arranged as to give the proper field for commutation, and as these coils are connected in series with the armature, weakening the field of commutation by increased load is prevented, and the auxiliary poles produce a compensatory field of commutation independently of the main field, which is weakened with an increased number of revolutions of the armature. The function or effect of the auxiliary poles is independent of the direction of rotation of the armature, for if the latter is reversed, the current in the auxiliary field is also reversed. The armature is shown in Fig. 3. The motor applied to a Niles-Bement-Pond horizontal boring mill is shown in Fig. 4, and the wiring diagram of the motor is shown in Fig. 5.

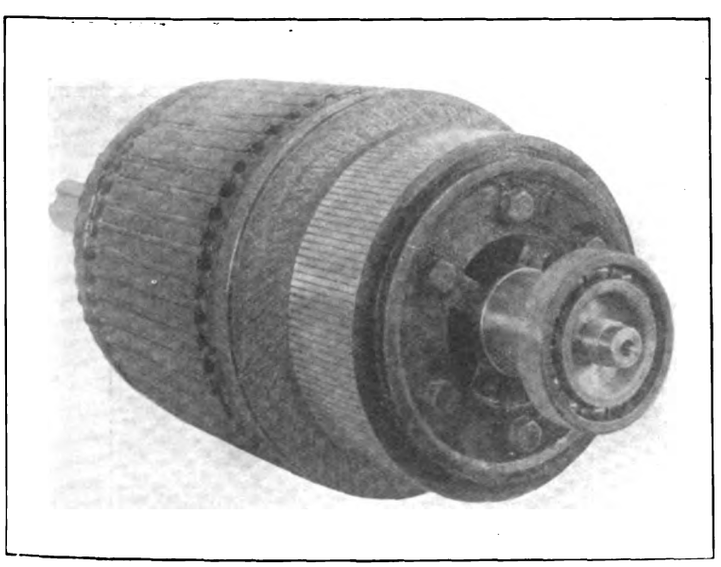


FIG. 3.—ARMATURE, SHOWING BALL BEARINGS.

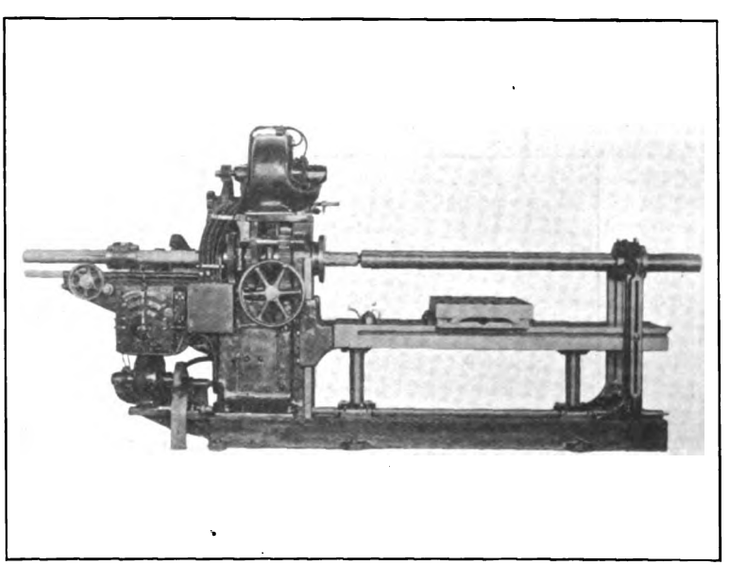


FIG. 4.—"INTERPOLE" MOTOR DRIVING HORIZONTAL BORING MILL.

A striking feature of the motor is the introduction of four auxiliary poles in the field between the main poles of the motor. The main poles are in shunt with the armature, while the auxiliary poles, which are considerably smaller than the others, are in series with each other and with the armature.

Another novel feature of this motor is the use of ball bearings in place of the ordinary journal bearing. This bearing consists of two races, one of which is fastened to the armature shaft, and the other to the bearing housing. Between

Digitized by Google

the balls are placed spring separators which are packed with mineral wool. This mineral wool takes up the lubricant and feeds it gradually to the bearing. The only attention required for the bearing

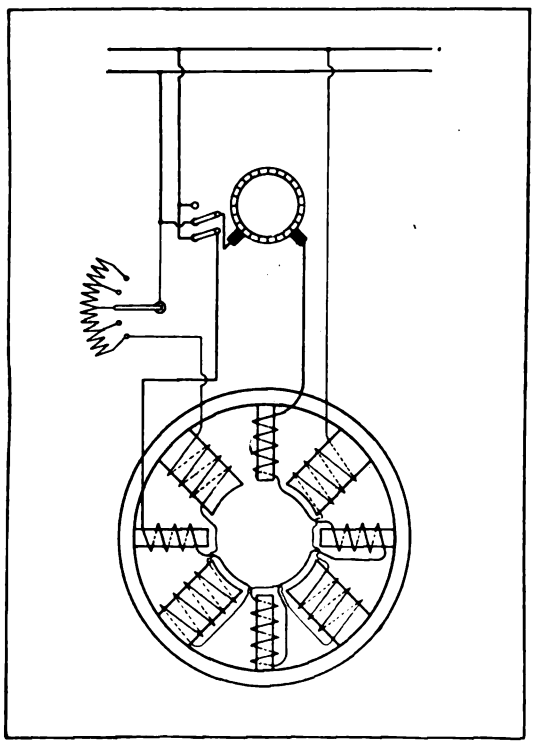


FIG. 5 —WIRING DIAGRAM OF "INTERPOLE" MOTOR.

is to have the lubricant renewed once about every six months. The bearing is shown very plainly in position on the end of the armature shaft in Fig. 2.

The motor has been designed so that it will operate in any position, even with the shaft vertical, without any change being made in the machine. It is readily adaptable for use open, semi-enclosed or enclosed. The average speed variation is five per cent from full load to no load, at any set speed of the controller. This is a particularly important point to be considered when machine tools are equipped with motors for variable-speed duty.

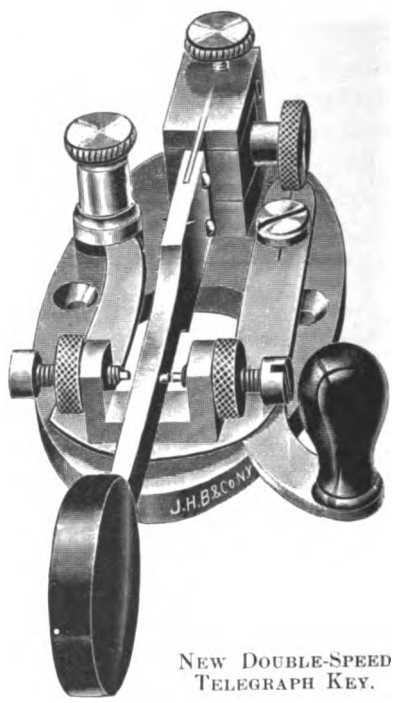
The Electrical Department of the Allis-Chalmers Company.

The Bullock Electric Manufacturing Company has within the year just passed come under the control of the Allis-Chalmers Company, and is now the electrical department of that company.

This department has enjoyed a year of prosperity during 1904, and begins the new year with its shops so crowded with work that additional room is imperatively needed, although a two-story building, 300 feet long and 101 feet wide, was but recently completed and added to the equipment. This building is constructed of steel and buff-colored brick. Another addition to the plant, a building four stories in height and to measure 210 feet in length by fifty-five feet in width, is already under contract, and ground has been broken for the foundation. Bids are now being considered for an addition of 12,500 square feet to the area of the machine shop, known as No. 3. The constant expansion of the fields of electrical application assures to the electrical industry continued and increased prosperity. The indications are that the shops of the Bullock Electric Manufacturing Company will be called upon to take care of a great volume of business during the coming year. Not only has the volume of the electrical business been large during the past year, but there has been a marked increase in the size of the units built. Several generators of from 5,000 to 6,000-kilowatt capacity have been turned out and already installed, and there is now being finished a motor-generator set of 8,000 horse-power. This contains the largest electrical motor ever built. The company's facilities for handling large work are exceptional. It has tools and appliances for turning out promptly units of any size up to 10,000-kilowatt capacity.

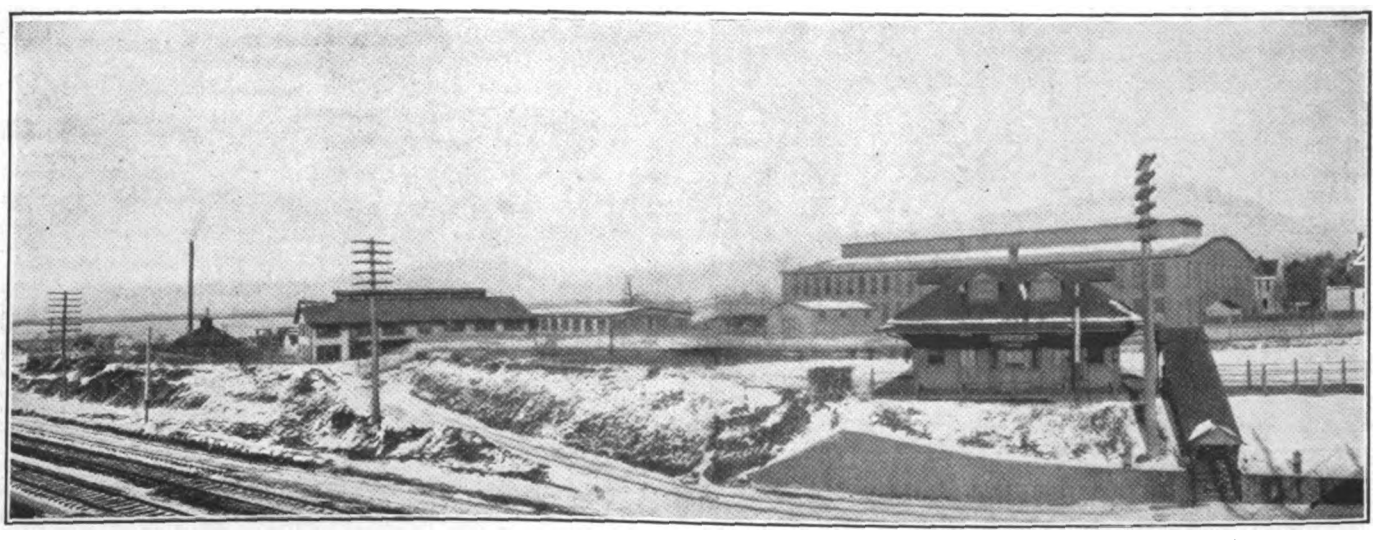
A Double-Speed Telegraph Key.

J. H. Bunnell & Company, 20 Park Place, New York city, are placing on the market a new form of telegraph key, an illustration of which is shown herewith. It is said that this key is condemned by an operator at a first glance, but, on reflection, this judgment is quickly reversed,



NEW DOUBLE-SPEED TELEGRAPH KEY.

and a trial or demonstration creates enthusiasm. The key requires but one-half the motions of the ordinary key, and these are made by a sidewise rocking motion of the hand. This action is easily acquired, and will not bring about telegraphers' cramp; and that those affected with cramp will be helped to recover their speed and style. The key lever moves in a horizontal direction, standing normally between the two points, but in contact with neither. The knob should not be gripped, but allowed free play between the thumb and finger. About one-half the ordinary motions are required in forming signals. For instance, the letter "p" with the ordinary key requires ten movements of the hand—five down and five up; whereas with the double-speed key only six movements of the hand are necessary.



THE ELECTRO-DYNAMIC COMPANY'S PLANT, BAYONNE, N. J.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MARYLAND POWER PLANT PROJECTED—Plans are being formulated by the Patapsco Electric Light and Power Company for the establishment of a power-house on the Patapsco river, below Ellicott City, Md. It is claimed that in view of the excellent water power afforded by the river at the point selected the operations can be made very profitable.

CONSOLIDATION OF BALTIMORE LIGHTING INTERESTS—The United Electric Light and Power Company, of Baltimore, Md., has purchased a majority of the stock of the Consolidated Gas Company, of Baltimore. This is the beginning of the consummation of plans contemplating the consolidation of the United Electric Light and Power Company and the gas company.

CHICAGO UNION TRACTION COMPANY PAYS INTEREST ON MORTGAGES OF UNDERLYING COMPANIES—The Chicago (Ill.) Union Traction Company paid to Judge Grosscup on December 31, 1904, the sum of $200,000, the interest on the mortgages on the properties of the North and West Chicago street railway companies, thus escaping being declared in default on its leases with these roads.

NEW HIGH-SPEED ELECTRIC LINE IN PENNSYLVANIA—The Shenango Street Railway Company is to build and equip a trolley line from Cambridge Springs to New Castle, Pa. Eventually the road will connect Buffalo and Pittsburg. Among those who are interested are J. M. Guffey and Murray Verner, of Pittsburg, and J. W. Parker, of New York. There will be about eighty miles of new track laid. The cost of the new line and equipment is estimated at $1,500,000.

NEW POWER PLANT IN CALIFORNIA—A power plant is proposed on Bishop creek in Eastern California, about ninety miles from Goldfield, Nev. Water rights have been secured on Bishop creek capable of developing 5,000 horse-power, and the power will be transmitted to the mines at Goldfield and Tonopah, Nev. Surveys for the line have been made and construction work will shortly begin. Among those interested are Tasker Oddie, Tonopah; Rodney Curtis and David Moffat, both of Denver.

TRACTION ALLIANCE IN OHIO AND INDIANA—It has been announced that an alliance of a number of large traction companies in Indiana and Western Ohio is planned. Through lines are to connect the cities of Cleveland, Cincinnati and Toledo, in Ohio, Indianapolis and Fort Wayne, in Indiana, and the smaller places between them. The Elkins-Widener Syndicate, of Philadelphia, and the Cincinnati, Dayton & Toledo Traction Company interests are reported to be behind the deal. A newly incorporated company, known as the Cincinnati Northern, with a capital of $500,000, is also interested.

EXTENSIONS OF THE CENTRAL NEW YORK TELEPHONE COMPANY—The directors of the Central New York Telephone and Telegraph Company have appropriated $2,000,000 for extensions and improvements of the present system. Part of this amount will be spent in the city of Syracuse, N. Y., where a new building is being erected. All the wires will be put underground. The greater part of the amount is to be used in extending the service to the cities in the neighborhood of Syracuse, and to all the smaller towns and hamlets in the central part of New York, and in improving it in the towns which the company has already entered.

THREE-CENT FARES IN CLEVELAND, OHIO—The Cleveland Electric Railway Company, Cleveland, Ohio, is to institute an experiment in three-cent fares for a distance of two miles from the centre of the city on all the lines of the company. The cars on which the three-cent fare will be paid will run only the two miles. On the regular cars, which will go the usual distance, a five-cent fare will be charged. No transfer will be given for a three-cent fare. The trial is the outcome of recent local agitation over the settlement of the street car question in Cleveland, and is for the purpose of demonstrating the practicability of three-cent fares.

RIGHT OF WAY SECURED FOR THE HAMILTON, ANCASTER & BRANTFORD RAILWAY—It is announced that the Hamilton, Ancaster & Brantford Electric Railway (Ontario) has secured the right of way over private property from Toronto to a point in Ancaster Township, through which it has running rights on the highways. The road is to be operated with power from the Cataract Power Company, and will run into Toronto on existing tracks. The company has given a contract for the construction of the railway to Elmer T. Haines & Company, of New York. The railway is capitalized at $300,000, and the road—twenty-three miles in length—is to be bonded for $20,000 a mile. The surveys have already been made and work is to be started at once. The road will be running by next fall.

BONDS ISSUED FOR THE TOLEDO, COLUMBUS & CINCINNATI RAILWAY COMPANY—It is announced that $5,000,000 worth of the $10,000,000 construction bonds of the Toledo, Columbus & Cincinnati Railway Company have been floated. The Toledo, Columbus & Cincinnati is an electric railroad 282 miles long, projected between Toledo and Cincinnati, to pass through Lima, Bellefontaine and Columbus. From Columbus to Cincinnati it will be almost an air line. The road was first known as the Toledo, Columbus, Springfield & Cincinnati, but no progress was made in construction, and the company surrendered its charter to the Toledo, Columbus & Cincinnati Railway Company, which was incorporated a year ago under the laws of Ohio. The construction contracts will be let immediately, and it is expected to have the road open between Toledo and Columbus by next fall, and to Cincinnati in about eighteen months.

ELECTRIC TRAMWAYS TO BE BUILT IN SHANGHAI, CHINA—American contractors are asked to bid for the construction and operation of about twenty-four miles of electric tramways in Shanghai, China; alternative proposals are desired for single-trolley and double-trolley lines. Further information will be supplied by the Shanghai council's agents, Fearson, Daniel & Company, 96 Wall street, New York. A proforma contract is open to inspection at their office and prospective bidders can obtain copies of the same. The conditions stated in the proforma contract are open to such modifications as tenderers may consider necessary. A deposit of £5,000, or certified security to that amount, must be made payable at date of signature of contract, and forfeit if the concession is not availed of. Sealed tenders endorsed "Tender for Tramway Concession" must be sent to the secretary, municipal council, Shanghai, and must be received on or before March 31, 1905.

NEW YORK-PHILADELPHIA TROLLEY ROAD PLANNED—Plans have been announced for the construction of a shorter trolley line between Camden, N. J., and New York city. Charter papers for the New York-Philadelphia company have been filed with the county clerk of Camden. The new organization has a capital of $4,000,000, and the stock is held in Pennsylvania, New York and New Jersey. The incorporators are A. N. Chandler and H. D. Long, of Philadelphia, and Norman Gray, counsel for the Corporations Company, of Camden. The new company will operate the electric lines which compose the present system between Camden and Jersey City. The various lines will be consolidated into one corporation, controlled by the New York-Philadelphia company. It is proposed to reconstruct the lines, building cutoffs and reducing the distance between the terminals, and double-tracking the entire distance. The time between Philadelphia and New York is to be cut down to three hours. In addition it is planned to construct several subsidiary lines through the smaller towns in central New Jersey. Right of way for these roads is now being obtained, and the work will be started upon the complete organization of the company.

Digitized by Google

TELEPHONE AND TELEGRAPH.

PHILADELPHIA, PA.—A Bell telephone exchange is to be built at Fourth and Green streets.

PAPILLON, NEB.—The Home Telephone Company has completed a line from Gretna to the state fisheries.

SIOUX CITY, IOWA—The Clark Automatic Telephone Company has installed a telephone system in Sergeant Bluffs.

WEST UNION, IOWA—The Iowa Telephone Company has made extensive improvements to its plant in West Union.

PLEASANTON, KAN.—The farmers living in Rose Hill and Union districts have constructed a line to Pleasanton.

PORTLAND, ORE.—An independent telephone line is being built from Corvallis to the Brown's Bridge neighborhood.

DANBURY, CT.—The Southern New England Telephone Company has constructed a line from North Ridgebury to the Scotland district.

HUNTINGTON, W. VA.—The Southern Bell Telephone and Telegraph Company has purchased the Catlettsburg & Ashland Telephone Company's lines.

NORTH YAKIMA, WASH.—The Ahtanum Telephone Company, capitalized at $750, has been organized to build a telephone line from North Yakima to Ahtanum.

GLOUCESTER, MASS.—The Manchester board of selectmen has granted a franchise to the New England Telephone and Telegraph Company to lay and maintain an underground conduit system.

REYNOLDSVILLE, PA.—The Farmers' Telephone Company will soon extend its line from Reynoldsville to Rathmel, and will, in a short time, connect with the Red Bank Telephone Company.

MISSOULA, MONT.—Active operations have been begun on the new building of the Rocky Mountain Bell Telephone Company, and it is hoped to have the structure ready for occupancy by May 1.

ALPINE, TEX.—All of the private telephone lines in that part of the state are to be consolidated under one management. Some of these lines are more than 100 miles long and run to remote cattle ranches and towns.

FREMONT, NEB.—By the completion of a circuit between the Golden Rod Company's lines in Saunders County and the toll system north of Lincoln, independent telephone service between Fremont and Lincoln is now possible.

CHILLICOTHE, MO.—Announcement has been made of the sale of a half interest in the Chillicothe telephone exchange, owned by Arthur W. McArthur, of Kansas City, to W. H. Ellett, president of the People's Savings Bank, of Chillicothe.

NEW ALBANY, IND.—A number of Clark County farmers will ask for a franchise for a telephone line between Sellersburg and Charlestown and intermediate points, which, when established, will be connected with the Home telephone system in New Albany.

WHITEWOOD, S. D.—C. C. Haas is about to organize a company for the purpose of putting in a telephone line from the Belle Fourche river to Whitewood. He has already constructed two miles of private line. The line will benefit a large number of farmers who live between the river and Whitewood.

JACKSONVILLE, FLA.—The city council of Jacksonville has granted the right to the Bell Telephone Company to absorb the properties of the defunct Jacksonville telephone system. Thirty thousand dollars will be spent by the Bell company in improving the system. The enlarged capacity will be 5,000 telephones.

FREMONT, NEB.—The farmers in Ponoco precinct, Saunders County, who want telephones, have closed arrangements for connection with the lines of the Fremont Telephone Company. They are to put in their own instruments, set the poles and furnish the wires. The installing is to be done by the Fremont company.

GUTHRIE, OKLA.—The Choctaw Telephone Company, of Durant, I. T., has sold all its property, including toll lines to Denison and Paris, Tex., and Hugo, I. T., to the Pioneer Telephone Company, of Guthrie, for $30,000. This sale practically puts the Pioneer company in complete control of both Oklahoma and Indian Territory.

COUNCIL BLUFFS, IOWA—The Nebraska Telephone Company has completed extensions of its lines from Neola to Yorkshire. Portsmouth and Panama on the line of the Chicago, Milwaukee & St. Paul, and these towns are now in connection with the Council Bluffs office of the company. The line will soon be extended to Persia.

TULSA, I. T.—The Pioneer Telephone and Telegraph Company announced recently that it would install a new telephone system in Tulsa with a capacity of 2,200 telephones. This will be an exact duplicate of the system in Muskogee and will cost in the neighborhood of $50,000. Nine new toll lines will be built in Indian Territory by the company during the next six months.

ROANOKE, VA.—The Bell Telephone Company's plants in Roanoke and at Salem, Va., have been purchased by the Virginia & Tennessee company, which operates an exchange in Roanoke, and the two exchanges have been consolidated under the management of the Virginia & Tennessee company. Traffic arrangements have been made to give the new owners connection with the Bell long-distance lines.

MIDDLEBORO, MASS.—The selectmen have granted a petition of the Southern Massachusetts Telephone Company for the privilege of pole rights in the highways leading to Wappanucket, to string wires for the proposed extension of the farmer's telephone line from Middleboro to Lakeville. The Lakeville board has granted a similar franchise. The company proposes to extend these lines into the outskirts in every direction where there is a disposition shown to use them on the part of the residents.

PORTLAND, ME.—The annual meeting of the stockholders of the Eastern Telegraph Company was held in Portland recently, when the following officers for the ensuing year were elected: directors, R. C. Clowry, B. Brooks, of New York; C. F. Ames, of Boston; Frederick Robie, of Gorham; A. Woodle, C. D. Livermore, H. H. White, of Portland. At a meeting of the board of directors the following officers were elected: president, Frederick Robie; treasurer, C. F. Ames; clerk, C. D. Livermore.

WHEELING, W. VA.—The officials of the Belmont Telephone Company have awarded the contract for the installing of the switchboard, central office appliances and telephones for the new Bellaire system to the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The contract provides that the system shall be installed by April first. The building is nearly completed and most of the poles for the new line are up. The exchange will have the capacity of 2,200 telephones. About 800 will be installed at present.

BASIN, UTAH—A movement is on foot for the building of a telephone line from Cisco into the different mining camps of the La Sal district. The principal promoter is J. H. Clark, of the Inter-State company in Gold Basin. The new line will run direct from Cisco to Richardson, and from there through the country *via* Porcupine ranch to Gold Basin, over the Wilson mesa. A branch line will then be extended from Porcupine to Miners' basin and over the range into Beaver basin. Half of the necessary capital has been already subscribed and work is to be started soon.

NEWARK, N. J.—The Glen Ridge borough council recently authorized Mayor Brewer to sign a contract with the New York & New Jersey Telephone Company, by which the latter is to take charge of the fire alarm system of the borough. The contract, dated January 1, 1905, will hold for one year, with a covenant for renewal for four years more, providing the borough council gives three months' notice of its intention to renew. The company is expected to place underground conduits through the streets of the borough with two wires in them to connect with the fire-alarm boxes. At the expiration of the contract the wires are to remain the property of the telephone company. The company contracts to make all repairs and furnish all material for them at cost, plus ten per cent. The council is to pay the company the yearly sum of $420, payable in monthly installments of $35 each.

Digitized by Google

PERSONAL MENTION.

MR. THOMAS J. GATES has been appointed assistant city electrician of Norfolk, Va., after a competitive examination, in which he was successful over seven other candidates.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, Ill., is to assist Comptroller Edward M. Grout, of New York city, in his investigation into the cost of gas and electric lighting supplied to the city.

LORD KELVIN has consented to be nominated as president of the Faraday Society, to succeed Mr. J. W. Swan. The Faraday Society is the British association devoted to the interests of electrochemistry and electrometallurgy.

MR. H. J. CURI has been appointed general contract agent of the Missouri & Kansas Telephone Company, with headquarters in Kansas City. He was for many years connected with the Bell telephone service in Pittsburg, Pa.

MR. R. L. ADAMS, manager of the Gadsden, Ala., exchange of the Bell Telephone Company, has been made district manager for all the exchanges in the section of Alabama, including Gadsden, Huntsville, Rome, Springville, Chattanooga and Anniston.

MR. R. R. COLLINS, manager of the Silverton, Col., exchange of the Colorado Telephone Company, has been promoted to be district manager of the company's lines in Blanco and Routt counties. His headquarters will be at Steamboat Springs, Col.

MR. BAYARD G. ECKARD has been appointed superintendent of the Easton, Pa., municipal electric light plant. He is a graduate of Lafayette College, and at the time of his appointment was in the New York office of the Westinghouse Electric and Manufacturing Company.

MR. L. K. BURGE has been appointed superintendent of transportation of the Lake Shore Electric Railway Company. He has been superintendent of the eastern division of the road and relieves Mr. R. R. Strehlan, who became general manager of the Springfield & Xenia Railway Company.

MR. W. S. KEMP, who has been connected with the Brookline National Bank for the last ten years as cashier, has become associated with the Holtzer-Cabot Electric Company, of Boston, assuming the duties of secretary and treasurer, a position made vacant by the resignation of the former treasurer, Mr. Ira A. Foster.

MR. P. E. MITCHELL has been appointed general superintendent of the Knoxville, Tenn., Electric Light and Power Company to succeed Mr. W. C. Woolfolk, resigned. Mr. Mitchell has been acting as superintendent for some months past. He will have general supervision of both the railway and lighting departments.

MR. S. C. MIDBERRY, electrician in charge of the Virginia Passenger and Power Company's power plant, in Richmond, Va., has resigned to take up new work in New York city. Mr. Midberry was presented with a handsome seal ring by his associates. He is a graduate of Union Polytechnic Institute, and the students' course at the General Electric Company's works, Schenectady, N. Y.

MR. ALFRED J. THOMPSON, for a number of years actively associated with the Crocker-Wheeler Company, has accepted a position with the Allis-Chalmers Company, and will make his headquarters in New York city. Mr. Thompson possesses the rare quality of being able to close large deals for electrical machinery, and is one of the best-posted men in this line. His wide acquaintance in the field and thorough knowledge of the electrical business will make him a valuable addition to the enterprising staff that the Allis-Chalmers Company has gathered around it.

EDUCATIONAL.

BULLETIN OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The bulletin of the Massachusetts Institute of Technology, dated December, 1904, has been issued. It contains a historical sketch of the institution, list of officers, courses in instruction, register of students, alumni associations, statistics of alumni, particulars of the Lowell School for Industrial Foremen and the Lowell School of Design, titles of theses for the class of 1904, and an alphabetical list of officers and students.

ELECTRICAL LECTURES AT UNION COLLEGE—A course of lectures in electricity will be given during the year 1905 at Union College, Schenectady, N. Y., under the auspices of the department of electrical engineering. A partial list of lectures and titles, subject to change, follows: January 17, J. Harden, "High Temperatures;" January 24, C. P. Steinmetz, "General Transformer, Frequency Converter, Etc.;" January 31, W. S. Moody, "Transformer Practice;" February 7, M. O. Troy, "Constant Current Transformer;" February 14, Dr. Whitney, "Principles of Electrochemistry;" February 21, C. P. Steinmetz, "Science and Engineering;" February 28, J. Harden, "Electrochemistry in Agriculture;" March 7, A. G. Davis, "The Engineer and the Patent Law;" March 14, O. Jungren, "Underlying Principles of the Steam Turbine;" March 21, C. P. Steinmetz, "Prime Movers;" March 28, A. L. Rohrer, "Cost of Power;" April 4, W. I. Slichter, "Some Characteristics of Railway Motors;" April 11, S. T. Dodd, "The Development of the Railway Motor;" April 18, W. B. Potter, "Electric Railways;" April 25, C. P. Steinmetz, "Lightning, and Lightning Protection;" May 2, M. O. Troy, "Condensers;" May 9, W. S. Andrews, "Radium;" May 16, C. P. Steinmetz, "Unsolved Problems."

ELECTRICAL SECURITIES.

So much had been said and written prior to the opening of the new year concerning the first of January, 1905, being a post from which would be started a general spurt in business activities, that the passing of that date leaves one somewhat in doubt as to whether these predictions were well based. It is a matter of fact, however, that the condition of security values, the first week of the year, is decidedly strong, with no apparent tendency toward retrogression. While there is a feeling in some quarters that new legislation may cause unsettlement of some forms of industry, the consensus of opinion is to the end that no radical change in administration will be inaugurated. If any changes are made the process will be gradual, and with due consideration to conserve, if possible, the interests of all concerned. Recent reports of railroad earnings continue to evidence a condition of prosperity. In the iron and steel industry there is a little disappointment, owing to a shrinkage in the demand, particularly for steel rails. This may mean either that roads are still carrying out the conservative plans initiated last year, or that orders for new work are being held up until the question of raising the funds for them has been settled.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 7.

New York:	*Closing.*
Brooklyn Rapid Transit	59¾
Consolidated Gas	196½
General Electric	187
Interborough Rapid Transit	170
Kings County Electric	193½
Manhattan Elevated	166½
Metropolitan Street Railway	115½
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	195
Boston:	*Closing.*
American Telephone and Telegraph	146
Edison Electric Illuminating	250
Massachusetts Electric	58½
New England Telephone	139
Western Telephone and Telegraph preferred	99
Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	17¾
United Gas Improvement	105¼
Chicago:	*Closing.*
Chicago Telephone	143
Chicago Edison Light	168
Metropolitan Elevated preferred	60
National Carbon common	41½
National Carbon preferred	110
Union Traction common	9½
Union Traction preferred	39½

The South Side Elevated carried in December 88,789 passengers, a decrease of 5,148; for the year, 83,323, an increase of 845. Metropolitan for December carried 120,588 passengers, an increase of 106; for the year, 115,196, an increase of 1,762. Northwestern Elevated carried in December 78,263, an increase of 2,004; for the year, 70,041, an increase of 2,091.

Digitized by Google

ELECTRIC LIGHTING.

CAMDEN, OHIO—The Camden electric light plant has been sold to E. C. Eikenberry for $3,000.

SEATTLE, WASH.—The Seattle Lighting Company has completed plans for new substation buildings. Work will be commenced soon.

MAHANOY CITY, PA.—The Mahanoy City Light, Heat and Power Company has sold its entire plant to the Shenandoah Electric Illuminating Company.

LITHONIA, GA.—The new electric plant of the Panola company, whose power-house is about six miles from Lithonia, has been placed in operation.

MANITOWOC, WIS.—Work will be started at once on the erection of a $200,000 electric plant for furnishing power and heat, the West Side Electric Company, of which ex-Mayor William Rahr is head, having been granted a franchise.

PITMAN GROVE, N. J.—The plant of the Pitman, Clayton & Glassboro Electric Light Company has been sold to M. K. Treichler, of Philadelphia, for $20,000. The plant is a valuable one, and with it go franchises for lighting several towns in the vicinity.

STURGEON, MO.—At a meeting of the board of aldermen a committee consisting of W. S. Harris, J. W. Hulett, O. D. Gray and P. I. King, was appointed to visit Missouri cities and ascertain the cost and advisability of bonding Sturgeon for the installation of an electric light plant.

CHAMBERSBURG, PA.—At a special meeting of the borough council Burgess Sharpe submitted a message vetoing the ordinance authorizing the sale of the Chambersburg light plant to the Chambersburg Light, Heat and Power Company. The chief reason given for the veto is that the price is inadequate.

WILKESBARRE, PA.—Plymouth has been selected as headquarters for the new light company, which recently acquired control of the plants at Nanticoke, Plymouth, Edwardsville, Kingston, Luzerne, Dorranceton and Forty Fort. C. A. Geist and Charles B. Kelsey, who are at the head of the new combine, promise many improvements.

CLEVELAND, OHIO—The Cleveland Electric Illuminating Company in bidding for the work of furnishing arc street lamps to Cleveland for 1905, lowered its price $1.44 per lamp a year. At present the city is paying $75 per lamp a year for arc lights. The new bid of the company is $73.56 per lamp. Since Cleveland has 1,211 lamps the lower price means a saving of $1,743.84 a year.

SALIDA, COL.—Plans are practically complete for the erection of a power plant at Arborville, on the south fork of the Arkansas river fifteen miles north of Salida. The work is being carried on by the Edison Electric Company, of Salida. Ten carloads of machinery, consisting of turbine wheels and piping, have been ordered. The enterprise will involve the expenditure of $75,000 and is backed by local capital. The plan is to furnish cheap electric power to Salida.

NORWICH, CT.—A petition is to be presented to the general assembly at its next session by G. O. Jackson, E. W. Higgins and C. W. Comstock for the right, under the name of the Uncas Power Company, to manufacture, generate, transmit, deliver and sell electricity for any and all purposes in the towns of the county, with the exception of Norwich and New London, and for the right to distribute and sell electricity in Norwich and New London to the amount of not less than twenty-five horse-power per customer. The plant is to be located in Norwich.

NEW HAVEN, CT.—The controlling interest in the Haverhill Electric Company, much of the stock of which is held in New Haven, has been acquired by the same interests that control several gas and electric companies in Massachusetts, including the Springfield Gaslight, the Malden Electric and the Suburban Gas and Electric companies of Revere and Winthrop, Mass. The Haverhill company is capitalized at $150,000 and is a growing and prosperous concern. It pays an annual dividend of eight per cent. The directors of the Springfield Gaslight Company, who now control the Haverhill and other companies, are C. H. Terney, of Hartford; F. P. Royce, Oakes Ames and H. P. Ward, of Boston, Mass.; P. F. Thompson, of New York; Herbert C. Warren, Edwin Bradley and Samuel A. York, of New Haven. The Haverhill company is to be operated as heretofore, and it is stated that no consolidation of plants is planned.

OBITUARY NOTICE.

MR. LOUIS R. SWIFT, toll manager for the Chicago Telephone Company, died on December 31, 1904, at his home, 995 West Oakin street, Chicago, Ill. Mr. Swift was born in Baton Rouge, La., July 28, 1858. He had been a resident of Chicago for twelve years.

LEGAL NOTES.

GENERAL ELECTRIC COMPANY FILES SUITS—A suit was commenced by the filing of a bill of complaint on December 24, 1904, by the General Electric Company against the Moline Incandescent Lamp Company, of Moline, Ill., for infringement of the General Electric Company's patent No. 532,760, issued on a method of sealing the filament support or stem of incandescent lamps to the neck of the lamp bulb. A suit was also commenced on January 6, 1905, by the filing of a bill of complaint against Charles T. Jaeger, doing business in New York city under the name and style of the Jaeger Miniature Lamp Manufacturing Company, for infringement of patent No. 422,219, covering apparatus for exhausting incandescent electric lamps.

MARYLAND TELEPHONE COMPANY CAN ENTER LIGHTING FIELD—Judge Sharp, in circuit court No. 2, Maryland, has sustained the demurrer entered by the Maryland Telephone Company in the suit of Alexander Brown against it, to prevent the company from carrying on an electric lighting business in the city of Baltimore, Md. The opinion was a lengthy one, and went into details of the controversy to a considerable extent. The complainant alleges that the act, under which the Maryland Telephone Company claims the right to do a lighting and power business in Baltimore, did not grant to the corporation any such right, and that if such right had been granted by it the Maryland Telephone Company has never made use of it, and by so doing has practically renounced the benefit of it. The telephone company contended that it had never renounced the benefits from the act of 1892, and that ever since 1896 it had conducted its telephone business, and had at all times asserted its rights to all the powers contained in the act of 1892. The principal question in the contention, according to the court, was the right of power invested in the Maryland Telephone Company under the act of 1892 of the Maryland assembly, and the court was of the opinion that the corporation had been accorded the power to engage in an electric lighting business in connection with its telephone business, and therefore sustained the demurrer filed to the bill of complaint.

THE SUIT OF THE BROOKFIELD GLASS COMPANY SUCCESSFUL—The Brookfield Glass Company, Brooklyn, N. Y., has been successful in its suit against the Elmer Glass Works, of Elmer, N. J., restraining the latter company from infringing a patented press owned and controlled by the former company. Some time ago a suit was brought by William Brookfield against the Novelty Glass Manufacturing Company, of Elmer, N. J., for infringement of the Kribs patent. The Novelty company contended that the Kribs patent was invalid, and that the press of the Novelty company did not infringe. The court decided against the Novelty company, holding that the patent was valid, and that the Novelty company had infringed. A decree was entered for a perpetual injunction and for an accounting against the Novelty company. This accounting is now proceeding. The property of the Novelty company was shortly after sold out under foreclosure, and the Elmer Glass Works organized. The Elmer Glass Works used two forms of press, which are designated as the Duffield press. The Brookfield Glass Company then instituted proceedings against the Elmer Glass Works, making a motion for a preliminary injunction restraining the Elmer Glass Works from using both forms of the press. The court directed that a preliminary injunction be issued against the Elmer Glass Works, restraining it from using the second form of the Duffield press. The court did not grant the preliminary injunction against the first form of the Duffield press, because there seemed to be some doubt about its infringement, and held that where there is any doubt as to an infringement the question must be left to be determined at the final hearing of a case.

Digitized by Google

ELECTRIC RAILWAYS.

SPRINGFIELD, OHIO—The Springfield & Xenia traction line has been sold to the bondholders represented by H. B. McGraw, of Cleveland, Ohio, for $225,600.

KNOXVILLE, TENN.—A building permit has been issued to the Knoxville Traction Company for an addition to its power-house, which it is estimated will cost $20,000 for the building alone.

RALEIGH, N. C.—At an adjourned meeting of the board of aldermen a franchise for the use of the streets of Raleigh for sixty years was granted to the Durham Passenger and Power Company.

BATTLE CREEK, MICH.—The Grand Rapids, Battle Creek & Inland Lakes Traction Company has filed its acceptance of the franchise offered by the city council. The franchise has been amended and an entirely different route will be taken.

LOCK HAVEN, PA.—A trolley line is being surveyed between Clearfield and Curwensville with a view of extending the line on through to DuBois. The work of constructing this line will begin as soon as spring opens. It is expected that it will be extended to Woodland and the Clearfield County home.

SAN MARCOS, TEX.—Judge B. G. Neighbors, of San Marcos, is authority for the statement that the construction of an electric line from San Marcos along the San Marcos river, touching at Martindale, Fentress, Staples, Prairie Lea and terminating at Luling, is reasonably assured. Outside capitalists are behind the plan.

WELLINGTON, KAN.—A. O. Boyle, president of the Arkansas Valley Interurban Railway Company, has filed a bond mortgage for $2,100,000, to secure the funds for construction. This company, together with the Kansas & Oklahoma company, has franchises in Wichita, Wellington, Winfield, Arkansas City and several small towns which the road will connect.

LITTLE ROCK, ARK.—S. J. Norman, secretary and treasurer of the North Arkansas Electric Railroad and Power Company, states that eighteen miles of grading has been done through Searcy and Newton counties, starting at Mount Hersey, and that the line has been surveyed for sixty-five miles. It is proposed to build the road for 132 miles instead of fifty miles, as at first planned. The terminus is not yet announced.

CHICAGO, ILL.—Articles have been filed by the Chicago & Southwestern Traction Company, the principal office of which is to be located in Chicago. The company purposes the construction of a road from Morris, in Grundy County, to Yorkville, in Kendall County. The capital stock is $400,000, and the incorporators, who are to constitute the first board of directors, are William T. Kopf, Charles A. Newton, Albert J. Claussen, Frederick W. Hill and Horace W. Nichols, Jr., all of Chicago.

BALLSTON, N. Y.—The Ballston Terminal Railroad, an electric freight line operating between Ballston and Middle Grove, a distance of twelve miles, has been sold under foreclosure proceedings. The property was bid in by Thomas F. Barrett, representing A. S. and A. N. Chandler, of Philadelphia, holders of the defendant company's bonds. The company was reorganized as the Eastern New York Railroad Company, with a capital stock of $100,000, and operation of the line will continue. The principal business of the road is supplied by eleven paper mills in the Kayaderosseras valley.

LEXINGTON, KY.—Master Commissioner Webb sold at public auction recently the franchises of the Bluegrass Consolidated Traction Company, which proposed to build interurban electric lines on numerous turnpikes throughout the Bluegrass section of the state. The company was incorporated by George B. Davis, of Detroit, Mich., with a capital stock of $7,000,000. Mr. Davis failed to build the line proposed, and his creditors brought suit against the company for a total sum of about $20,000. The assets of the company consisted of its franchises in Fayette, Clark, Woodford, Franklin, Madison, Jessamine and Montgomery counties and some railroad ties. The franchises were all bought by Clifford D. Bebee, of Detroit, for $2,457.

BOSTON, MASS.—The state railroad commissioners have authorized the consolidation of the Worcester & Southbridge, the Southbridge & Sturbridge and the Worcester, Rochdale & Charlton Depot street railway companies, the controlling in all of which has been acquired by the New York, New Haven & Hartford Railroad. The new system, which will be known as the Worcester & Southbridge Street Railway Company, has received permission to increase its capital stock by $100,000, to be used in purchasing the outstanding stock of the Southbridge & Sturbridge and Charlton Depot roads on a share-for-share basis. The original Worcester & Southbridge road and the Charlton Depot company went into the hands of receivers about a year ago, but were subsequently reorganized.

INDIANAPOLIS, IND.—The directors of the new Indianapolis & Ohio Valley Company, which was recently incorporated with a capital stock of $50,000, have elected officers. It is announced that work on that part of the proposed road between Rockport and Cannelton will be begun immediately. The line will be 150 miles in length. It will go from Indianapolis to Rockport, passing through Nashville, Bloomington, Bedford, Mitchell, Paoli, West Baden, French Lick, Jasper, Ferdinand, St. Meinrad, Evanston, Grand View, Troy and Tell City. The directors include J. H. Larimer, A. E. Fauve, M. E. Fauve and Butler Smith, all of Indianapolis, and Peter Backer, of Troy, Ind. The promoters say they have obtained options on the proposed right of way and that the farmers along the route are subscribing for stock and doing all they can to aid the project.

NEW COMPANIES.

NEW YORK, N. Y.—The Detroit Gas and Electric Fixture Company has been incorporated by J. M. Ehrlich, C. A. Cappock and H. J. Joel. The capital is $10,000.

NEW YORK, N. Y.—The Seaboard Electric Equipment Company has been organized by S. B. Smith, New York, and D. H. Patton and D. G. Patton, of Yonkers. The capital is $50,000.

WASHINGTON, D. C.—Herman G. Weinert, Charles L. Sharrow, Harry Pole and James T. Kinsler have organized the International Boat Steering Electric Company, capitalized at $25,000,000.

KOKOMO, IND.—The Kokomo Electric Construction Company has been incorporated. The capital stock is $20,000, and the directors are G. W. Norwood, C. O. Scott and George H. Margolff.

JERSEY CITY, N. J.—The Rock Island Battery Company has been incorporated to engage in a general contracting business. The incorporators are L. B. Dailey, B. S. Moritz and J. M. Mitchell, of Jersey City.

ITHACA, N. Y.—The Davis-Brown Electric Company has been incorporated to deal in electrical supplies. The company is capitalized at $20,000, and the incorporators are William J. Davis, L. H. Brown and E. A. Denton.

JERSEY CITY, N. J.—The Rock Island Battery Company has been incorporated with a capital of $75,000, to engage in a general electrical business. The incorporators are Louis B. Daily, Stafford Mantz and Joseph M. Mitchell.

WEST HOBOKEN, N. J.—The General Light Supply Company has been incorporated by Ludwig Engel, Max Heyman and Aaron Smith, with a capital stock of $10,000. The company will deal in and manufacture lighting and heating apparatus.

NEW YORK, N. Y.—The Schaper Construction Material Company has been incorporated to deal in material for telephone and other electric lines. The capital stock is $25,000. John H. Schaper and George Schaper, of Brooklyn, and August R. Ermisch, of Long Island City, are the directors.

HARTFORD, CT.—The New England Electrical Supply Company, of Waterbury, which will handle all kinds of electrical supplies, has been incorporated with a capital stock of $25,000. Alden M. Young, of New York, and A. O. Shepardson and W. G. Morse, of Waterbury, are the incorporators.

MEMPHIS, TENN.—The Boardman Electrical Construction Company has been organized with F. E. Boardman as president and general manager, and J. H. Hart as vice-president. The new company has purchased the entire electrical construction branch of the Electrical Supply Company's business.

Digitized by Google

INDUSTRIAL ITEMS.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., is calling attention to its specialties with a series of calendar blotters containing sayings from "Aleck, the Electrician."

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, is distributing bulletins No. 29 and No. 30, describing, respectively, "Divided Circuit Two and Four-Party Selective Magneto Telephones" and "Cut-in Station." These bulletins describe some new and valuable apparatus. The bulletins will be sent to interested parties upon request.

THE REPLOGLE GOVERNOR WORKS, Akron, Ohio, has recently improved its water-wheel governors in general efficiency and workmanship 100 per cent. It has a full line of new mechanical governors, from which can be selected a machine that will meet any of the requirements at present known in water-power development.

THE COMMERCIAL ELECTRIC SUPPLY COMPANY, 1007-1009 Market street, St. Louis, Mo., is distributing a daily reminder and pocket diary for 1905. It contains, in addition to the usual information included in such books, a number of tables of interest to electrical men, such as incandescent wiring tables, volts lost at different per cents of drop, etc.

THE MICA INSULATOR COMPANY, 218 Water street, New York city, announces that, owing to the advanced cost of materials used in the production of "Micanite," it is compelled to withdraw all its former prices. The company will be pleased to send its new price list for 1905 on request. Discounts and prices on special goods will also be furnished upon application.

THE CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, is distributing to its patrons a very useful blotter. The company announces that it has ready for delivery a number of direct-connected units, alternators, direct-current generators and motors, engines, boilers, street railway cars, and equipments. The company makes a specialty of electrical and steam machinery.

THE ILLINOIS STEEL COMPANY is about to begin an extension of its works, at Joliet, Ill., at a cost of $100,000 to accommodate the business of the Continuous Rail Joint Company of America. The latter company is a New Jersey corporation with headquarters at Newark, N. J. It has extensive works at Troy, N. Y., but has found its western business requires a plant nearer the centre of trade, and for that reason has entered into the arrangement with the Illinois Steel Company.

THE LE VALLEY VITAE CARBON BRUSH COMPANY, 125 East Forty-second street New York city, has issued a new catalogue descriptive and illustrative of the Le Valley Vitae carbon brush. This brush was the first introduced on the market as a permanent self-lubricating brush, and the company states that it is conceded by electricians generally to be the acme of perfection. Any machine, no matter how overloaded, will work satisfactorily with it. The brush is made in different grades, for all kinds of stationary machines.

THE HOLOPHANE GLASS COMPANY, 15 East Thirty-second street, New York city, and 211 Jackson Boulevard, Chicago, Ill., will be pleased to send its descriptive literature upon request. This company has recently produced a series of elaborate booklets concerning lighting and lighting effects. The Holophane Glass Company will unite its Chicago and New York offices on January 15, 1905, in the Glackner Building, West Broadway and Fulton street, New York city. It will occupy the eighth and ninth floors, and will carry there a large stock, to ensure prompt deliveries.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports a very brisk demand for small exchange switchboards of the type usually known as private branch exchange switchboards. Four equipments of this kind have recently been shipped to Topeka, Kan., and one equipment to Fort Worth, Tex. Among the recent shipments of small exchange switchboards of the magneto-call type the following destinations are given: Lebanon, Ind., one 100-line switchboard; Berne, Ind., one 100-line switchboard; Waverly, Ill., one 100-line switchboard; Tallahassee, Fla., one 100-line switchboard; Atkins, Ark., one 100-line switchboard; Brookville, Kan., one 100-line switchboard; Hamilton, Ga., one 100-line switchboard.

THE H. W. JOHNS-MANVILLE COMPANY, New York, has just placed on the market two additions to its line of asbestos packings. These are known as "Kearsarge" spiral high-pressure piston and valve rod packing, and "International" hot water pump packing. The "Kearsarge" spiral packing is the "Kearsarge" asbestos and rubber-wound cloth coil packing, well known to the trade, put up in spiral form to meet the growing demand for that type of packing. It has proved its merits as an efficient and durable packing on piston and valve rods, against high pressure, high temperature, and high speed. The "International" is a specially prepared and treated packing for use on pumps handling water at high temperatures, and on piston and valve rods of engines against wet steam. This material has been tested under actual working conditions for over a year and has been found to be satisfactory in every respect for the service mentioned. The manufacturer has prepared attractive literature descriptive of these two packings which it will be glad to send to anyone interested.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has been awarded the contract for two 1,000-kilowatt turbo-generator outfits for the Haverhill, Mass., Electric Company, to be used in lighting and power work in that city; also one 1,000-kilowatt outfit with exciter for the Springfield Electric Light Company, Springfield, Mass.; also a 300-kilowatt turbo-generator with exciter for the Northern Electric and Manufacturing Company, of Montreal. The Springfield Electric Light Company's contract also included two 500-kilowatt rotary converters, and four 300-kilowatt transformers. The company has closed a contract with the Ontario Power Company for an alternating-current generator, with a rated output of 10,000 horse-power at eighty-five per cent power-factor. The generator is of the revolving-field, two-bearing type, designed for direct connection to water-wheels; it generates three-phase current at 12,000 volts and twenty-five cycles, and runs at a speed of 187.5 revolutions per minute. Other apparatus included in the contract are twelve 3,000-kilowatt oil-insulated, water-cooled transformers, wound for 12,000 and 60,000 volts; two 375-kilowatt exciters, and complete switchboards. It has also received an order through its agents, Takata & Company, of Tokio, Japan, for thirteen direct-current generators, each of 62.5-kilowatt capacity, and thirteen spare armatures. Each generator will be driven by a 125-horse-power steam engine, and the thirteen engines will be supplied by the Westinghouse Machine Company. The Westinghouse Electric and Manufacturing Company has sold to the International Paper Company for use in its plant at Berlin, N. H., one 250-kilowatt alternating-current generator of the revolving armature type, three 40-horse-power alternating-current motors with switchboard, transformers, etc. It has also sold to the Detroit United Railway Company, of Detroit, Mich., a 1,500-kilowatt railway generator, and a 250-kilowatt booster set. These machines are in addition to four other large railway generators of an aggregate capacity of 5,000 kilowatts, which the Westinghouse company has already installed for the Detroit company. Other street railway contracts just closed by the Westinghouse company include fifty four-motor car equipments to be used by the Cleveland Electric Railway Company, of Cleveland, Ohio, for city and suburban service. The motors will be of the new Westinghouse type, 101-B. It has sold to the Syracuse Railroad Construction Company, Syracuse, N. Y., apparatus for equipment of the Rochester, Syracuse & Eastern Railroad. The contracts include two 1,500-kilowatt turbo-generator outfits which will generate current at 3,300 volts, three-phase and twenty-five cycles. Each turbo-generator will be furnished with a fifty-kilowatt exciter mounted on the turbine shaft. The equipment also includes two 500-kilowatt rotary converters, and six 400-kilowatt rotary converters; twenty-four transformers, with a total capacity of 6,500 kilowatts, a thirteen-panel switchboard for the main generating station, and three substation switchboards of five panels each, as well as protective and detail apparatus. Motor equipments included in the contract call for twelve quadruple equipments of Westinghouse 110-horse-power motors, as well as eight quadruple and two double equipments of motors of other sizes.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 3. NEW YORK, SATURDAY, JANUARY 21, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Trees for Wireless Telegraphy ... 97
Telephone and Telegraph Statistics ... 97
The Cost of Street Lighting ... 98
The Candle-Power of Searchlights and Flashlights ... 99
The Automobile Shows ... 99
Telephone Line Engineering, by C. J. H. Woodbury ... 100
Automatic Fire-Alarm ... 103
Fourth Annual Chicago Automobile Show ... 103
The Manufacture of Air-Insulated Cables, by Emile Guarini ... 104
The Therapeutic Importance of Electric Light ... 106
A High-Frequency Alternator ... 107
City Street Lighting at Sewickley, Pa.; a Successful Six-Glower Nernst Lamp System ... 108
The Combination of Dust Destructors and Electricity Works Economically Considered, by W. P. Adams ... 110
Electrical Notes from Europe, by C. L. Durand ... 114
BOOK REVIEWS ... 116
Engineering and Commerce ... 117
Automobile Shows in New York City ... 118
Regular Meeting of the American Institute of Electrical Engineers ... 118
Independent Telephone Association of Wisconsin ... 118
A New System of Electrical Distribution for Electric Railways ... 119
ELECTRICAL PATENTS ... 120
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 122
INDUSTRIAL SECTION:
The "Liberty" Tube Cleaner ... 124
The "Tuxeda" Bronze Union ... 124
A Portable Electric Power Plant ... 125
Some Notable Allis-Chalmers Literature ... 125
The "Little Giant" Hand Punch ... 125
New Telephone Apparatus from the Connecticut Telephone and Electric Company ... 125
Skeleton Bells ... 129
CURRENT ELECTRICAL NEWS ... 131

TREES FOR WIRELESS TELEGRAPHY.

An ingenious suggestion was made recently by Major G. O. Squier, of the signal corps of the United States army, which, if it proves practicable, will be of great service to the signal corps. Major Squier says that as a living organism may form a part of an electrical circuit, it is possible to utilize a tree as the aerial of a wireless telegraph system. Connections should be made near the ground and where the branches begin to spread, by the simple method of driving in two iron nails to which the receiving device is attached. If the plan works well in practice there will always be suitable aerials for army use, except in a very barren country. Probably a tree is not as efficient as a metallic wire properly suspended, but as the distances to be covered in army signaling will never be great, this is a small matter. A more important point is the deduction that if a tree can be used in this way with good results, it would seem to follow that an intervening forest adds to the difficulty of transmitting messages over land. It may, in some cases, make the operation of a wireless system, under such conditions, practically impossible.

TELEPHONE AND TELEGRAPH STATISTICS.

A recent bulletin issued by the Department of Commerce and Labor, Washington, D. C., covering the telephone and telegraph systems of the country, forms the first complete summary of these industries which has been made in this country. The year covered is 1902, and this should be remembered when considering the total development, for the growth during the past two years has been large.

A study of the tables contained in this bulletin reveals some very interesting conditions. In the first place, there were over sixteen times as many telephone systems in operation as there were telegraph systems. This, of course, is only to be expected when one considers the different fields which the two systems of communication occupy. However, the growth of the telephone has been far more rapid than that of the telegraph, for the former, although only about half the age of the telegraph, has over three and one-half times as much wire, and the par value of the capital stock and bonds outstanding is more than twice as great. The telephone gave employment to over seventy per cent of the wage-earners, paid over sixty-five per cent of the wages, and received sixty-eight per cent of the total revenues, paying nearly the same percentage of the total expenses reported for both systems.

Under the head of telephone service, three systems are recognized in this bulletin: commercial systems, including all systems operated by individuals, firms or corporations for revenue; mutual systems, including systems operated through mutual arrangement between the persons deriving benefit from the service, primarily the benefit of the owners; third, independent farmer or rural lines having no regular exchange or central office. The first of these was by far the most important, and during the year covered by the report had in operation nearly ninety-four per cent of the total number of telephones, while the mutual systems had in operation a little less than four per cent, and the independent or rural lines but a little over two per cent. Taking the total population of the continental United States for the year, as estimated by the Bureau of Census, it is found that there was an average of one telephone to every thirty-three inhabitants.

One of the most interesting tables contained in this bulletin is that giving what we may call the geographical development of the telephone. This shows a very great variation, some localities apparently having an excessive development, while in others there would appear to be ample room for growth. For instance, the average population per telephone, as indicated in this table, was thirty-four; the average number of messages per capita was sixty-five, while the average number of messages per telephone for the year was 2,190. Running over the list of states

Digitized by Google

it is noticed that in certain of them the population per telephone is much above the average. The number of messages per capita is below the average, but the number of messages per telephone is greatly in excess; and it is noticed also that these exceptional conditions come in the same geographical location. For instance, Alabama has less than three-quarters of a telephone for every 100 inhabitants (the average for the country is 2.95). The number of messages per capita is only twenty-four, yet the number of messages per telephone is 3,279. For Georgia the corresponding figures are 1.11 telephones per 100 inhabitants, forty-two messages per capita, and messages per telephone, 3,774. In Louisiana there were only 1.22 telephones per 100 inhabitants. The messages per capita were forty-seven, and per telephone, 3,888. For Mississippi the number of telephones was only 0.95 per 100 inhabitants; the messages per capita, thirty-eight, and the number of messages per telephone, 4,009. Tennessee gives the following figures: 1.75 telephones per 100 inhabitants; sixty-two messages per capita, and 3,557 messages per telephone. This shows that there was a great use of the telephone facilities at that time existing in the South, even though the people did not use the telephone individually as much as in other sections. They suggest that this offers a good field for telephone development.

Another striking group of states is that of the Middle West, including Indiana, Michigan, Ohio, Illinois and Iowa. In these states the messages per capita were much above the average. The number of telephones per 100 inhabitants was above the average, yet in every case the number of messages per telephone does not vary much from the average. Evidently these states have acquired the telephone habit to a marked degree. The large number of independent companies in these states doubtless has some influence on the averages, particularly where it is necessary for one person to have two instruments.

Telephone development in the states of the Far West shows some interesting features. California, for instance, leads all the states in the number of instruments per 100 inhabitants, this being 7.15—over twice the average. The people of California also use the telephone freely, but there are so many instruments there that they are used less than the average number of times. Practically the same conditions obtained in Oregon and Washington, although to a less degree. In these states the independent companies are few in number, which makes the development all the more remarkable.

These averages may be somewhat affected by the large cities, but a table giving the same statistics for the principal cities of the country shows that, in general, the averages for these do not vary much from those for the entire country. In New York, for instance, there are less than the average number of telephones per 100 inhabitants, this being only 2.56. Chicago, Philadelphia, St. Louis and Boston show a somewhat greater number of instruments, notably Boston, where there are about five and one-quarter telephones for every 100 inhabitants. The conditions in San Francisco are analogous to those of California in general, but are even more marked, for there are in that city over eleven telephones per 100 inhabitants—more than three times the average number.

The conditions in New York state show that although there are more telephones per 100 inhabitants than the average, the messages per telephone and per capita are less than the average. It is interesting to note that, taking the state as a whole, the telephone development outside the city of New York is greater than in the city, a condition which might not have been expected.

New Jersey shows an interesting state of affairs. The number of telephones per 100 inhabitants was only 2.5; the number of messages per capita, only twenty-nine, and per telephone, only 1,127. In other words, New Jersey is below the average on all three counts. The telephones there are used less than in any other state. Possibly this may be accounted for by the proximity of two large cities—New York on the east, and Philadelphia on the west.

These conditions, of course, refer only to the year covered by the statistics, and conditions to-day, in some sections at least, will be different. The smallest number of messages per capita is seventeen, for South Carolina, and the highest number is 131, for Ohio. Six states show an average of over 100 messages. In addition to South Carolina, the only other state and territory showing an average of less than twenty messages per capita are North Carolina and Indian Territory. It would seem, in general, that where there are few telephones per 100 inhabitants there are fewer messages per capita, but more messages per telephone. Of course, the use of the telephone will vary somewhat with the character of the industries of a state.

THE COST OF STREET LIGHTING.

At the enquiry held last week by Comptroller Grout, to determine whether the price charged the city of New York for arc lights for street lighting is excessive, some important points were brought out. It was shown that the figures of fifty-four dollars and fifty-six dollars per arc lamp per year stated to be the cost to the city of Chicago (Ill.) for operating lights from its municipal plant did not include any allowance for taxes, depreciation or interest on the investment. Obviously, it is unfair to compare such figures with prices charged by a private company.

Another point which was brought out, and which does not seem to have received sufficient notice, was the statement that the city of Chicago has now contracted with a local electrical company for 600 street arc lights at $103 per year. This is for overhead service. It has further contracted for such additional street lights as may be necessary, and where these are supplied by underground conductors, the price per year is $136. Comparing these figures with the price offered by the New York company, of $130 per lamp per year for overhead service, and $146 for underground service, the difference is considerably less than the advocates of municipal lighting have held. It should also be remembered that the conditions in New York differ from those in Chicago, which might easily explain the slightly increased cost of lights for the former city.

Digitized by Google

THE CANDLE-POWER OF SEARCHLIGHTS AND FLASHLIGHTS.

The daily papers announce that St. Catherine's Lighthouse, Isle of Wight, has been fitted with a flashlight, the brilliancy of which is estimated to be 15,000,000 candle-power. On nights when the atmosphere is favorable its beam is probably visible from the French coast. It is said that this light replaces one of 3,000,000 candle-power.

The practice of rating searchlights and other lights in which the distribution of light is altered by means of reflectors or lenses should be abandoned, since it means nothing at all, although it may convey the impression that a certain light is exceedingly powerful or that its light may be seen at a very great distance. Photometric measurements are based upon the law that the intensity of illumination at any point varies inversely as the square of its distance from the source of light, and this law is based upon the assumption that the light is allowed to distribute itself freely in all directions. Where the distribution is altered in any way, the candle-power rating should be accompanied by an explanation of how the measurement was taken.

With searchlights or other lights intended to throw a beam for a great distance by means of lenses or reflectors, practically all the light from the arc is made to pass out from the lamp in one direction. This beam is made up of nearly parallel rays, and under such conditions, the intensity of illumination does not decrease as the inverse square law, as the measurement is made further and further from the lamp. For instance, should the intensity be measured at, say, 100 feet away, and be found to be 1,000,000 candle-power, and another measurement be made 200 feet away, there will be little difference in the intensity of illumination at the new point, and hence a rating of 4,000,000 candle-power would be indicated. The absurdity of such a system of rating is evident. Supposing that the rating usually given is modified by stating the distance at which the measurement has been made, the result would still be unsatisfactory because by varying the size of the beam of light the intensity of illumination can also be varied. To be completely accurate, such a measurement should give not only the candle-power rating and the distance at which the determination has been made, but also the area of the cross-section of the beam.

A somewhat similar condition of affairs existed in the early days of arc lighting, and one still hears of 2,000-candle-power arc lamps, though the expression is generally modified by the addition of the word "nominal." As a matter of fact, no commercial arc lamp gives 2,000 candle-power. In fact, it does not give 2,000 candle-power in any one direction. One story of the manner in which this old rating came to be accepted is to the effect that an enthusiastic salesman was told that the maximum candle-power given by his lamps in any one direction was about 500 candles. If, then, he argued, his lamp would be placed upon a street corner, it would give 500 candles down each street, and hence was a 2,000-candle-power lamp. On the same basis, those lamps which were not placed at intersecting streets should have been rated only at 1,000 candles, and those placed where a greater number of streets intersected should have been rated higher. This rating was dropped some time ago, and the lamps are now rated according to their energy consumption; which is satisfactory in one way, but it does not fix rigidly the amount of light which will be obtained from the lamp, since this varies with the quality of the carbon used. A soft carbon gives a whiter light, and generally more light, than a hard carbon, though the former is consumed more rapidly than the latter. However, since this matter of the carbons is beyond the control of the maker of the lamp, the rating of the lamp itself in watts is sufficient, and it would seem better to adopt a similar method of rating searchlights and lights intended for lighthouses. If desirable, to this rating there might be added a statement of the distance which the beam will carry and be effective.

THE AUTOMOBILE SHOWS.

The opening of the two important automobile expositions in New York city last week has concentrated attention upon the state of the art in the design of the horseless vehicle. The fifth annual automobile show, opening at Madison Square Garden on the evening of January 14, brought together probably the most remarkable display of automobiles the world has ever seen. The recent automobile show at Paris is described as magnificent, but those who have been there and know what is assembled in New York city, do not hesitate to give first place to the latter. The firms selling imported machines engaged separate space in the Herald Square Music Hall, and under the designation of the "Importers' Automobile Salon," on January 11, presented to the public a fine display of vehicles.

A notable feature of the machines on exhibition is the extent to which care has been exercised to produce the most brilliant and striking finish. In the underbody, in the coach, the upholstering, the hood, the brass and nickel parts—all have been finished and refinished until it seems as though perfection were near at hand. And in this direction the foreign makers are fast losing the vantage ground of supremacy. Not many years ago it was the boast of the foreign automobile designer that no matter what might be done in power the American maker could not approach them in lines of design or in beauty of finish. As the matter stands to-day, however, as far as mere appearance goes, the carriages of both foreign and domestic makers stand about equal in popularity.

The city block upon which Madison Square Garden stands has been fringed with automobiles during the week of the show The gasoline machine has, of course, predominated, and this has served to accentuate its objectionable characteristics. The streets resound with the noisy cough of the exhaust and the atmosphere reeks with the vile odor of the burned gases. Notwithstanding these features, the gasoline machine easily outnumbers both the steamer and the electric.

There is, however, no diminution in the ranks of those who prefer the electric carriage. This machine is beyond doubt the ideal, in point of view of appearance, noiseless running, and ease of handling. The battery makers are improving their product, and getting greater mileages per pound of cell. As charging facilities are improved and supplying stations become more numerous and less widely separated, the electric vehicle must increase in popularity.

The showing at the exhibitions in electrics was very satisfactory and was an indication of the high degree of excellence to which the American maker has aspired.

Digitized by Google

TELEPHONE LINE ENGINEERING.[1]

BY C. J. H. WOODBURY.

The wonders of the telephone as the most subtle of physical apparatus, yet so simple as to be the only electric device operated without skill, an invention without precedent which has also escaped improvement, has worthily been the theme of frequent portrayal, which has also been devoted to that concentration of applied science upon the switchboard and the transmitter, each of them essential adjuncts in the development of the telephone system.

The salient characteristic which justifies all commercial applications of electricity, except those of industrial chemistry, is that it overcomes the impediment of distance, and it is essential that the conductors spanning these long extents, free from direct supervision, shall be as permanent as possible in order to maintain conditions of constant service.

The amount of capital amassed in the approximately 4,000,000 miles of line construction necessary to connect together in a unity the subscribers of the Bell telephone system is of itself a warranty as to the importance of the subject; while the rapid depreciation to which most of this property is subjected requires both technical skill and business judgment to decide upon the most judicious methods of construction of this vast plant, amid varying circumstances of natural conditions and commercial use, in order to reach the most economical point of investment.

Analyze the general problem as one may, and standardize the general methods to cover a wide range of circumstances, yet there are exigencies and varying conditions which require the exercise of that type of constructive engineering which "does things."

The application of mathematical principles is essential to any constructive work which is not merely a repetition of precedents, and the ordinary precedents of safe construction have been established upon the wrecks of past failures perhaps for generations agone.

The increase of every commercial application of electricity to meet the demands to supply service to patrons has been so great that an essential portion of every problem in constructive electricity must take into consideration provisions for future growth as well as the inevitable depreciation.

POLES.

Although forty-five per cent of the wires are on poles, the total extent of the pole lines exceeds the length of the underground conduits, as the latter are used only in cities where the conduits contain a greater number of lines to reach the concentration of patronage. The extent of the pole lines is shown by the fact that in the Bell telephone system there are approximately 6,300,000 poles, and about 1,000,000 are required annually for replacement and for extension of lines.

The stresses to which a telephone pole is subject are the result of many and variable combinations of live and dead loads upon a beam fixed at one end and loaded near the other end. There is scarcely anything in engineering construction so actively the subject of depreciating conditions. The top is exposed to the weather, and the important section near the surface of the ground is the portion most energetically attacked by decay. The wood is assailed by animal life, whether it be gnawing by horses in town, or the perforation by woodpeckers in remote districts. Poles in wild countries are bitten by bears in search of bees, whose humming is imitated by the vibration of wires, and it is said that in India the tigers use the poles to sharpen their claws upon after the manner of their second cousins, the domestic cat, but with so much more vigor that the poles become weakened.

Antiseptic methods for treating poles as a preventive against decay and the attacks of insects have not been so general in the United States as in Europe, as the relatively sparse settlement and distances between cities having the elaborate plant necessary for treatment would make the transportation of the poles for treatment and back to the sites where they are to be used a prohibitive expense.

However, poles treated by creosoting have been used in this country wherever transportation conditions between the sawmill, the treating plant and the sites where they are to be used will permit.

A pole line is not designed merely on the basis of the stresses to which the pole is subjected in drawing the wires to the necessary tension, for in most northern climates the sleet will at times form upon the wires until they become icy cylinders perhaps three inches in diameter, and the problem is not that of the mere added weight, for the force of the wind blowing against this icy sail applies a greater horizontal load, which combines with gravity and produces a resultant force in a diagonal direction, greater than either of the contributing units.

An ice-laden line swayed by the wind may be successfully resisted by the poles until the oscillations of the pendulum reach a synchronism with that of the vibration of some pole on the line which responds in like manner to the cumulative impact across the direction of the line, until it breaks this individual pole. Then adjacent poles are relieved of the pull on one side, and the excessive unbalanced stress breaks them.

The most undesirable occurrences in connection with the wreckage of aerial lines are the disturbances resulting from the contacts of different electrical systems with each other, when the various lines are so near as to collide, when one or both break.

The remedy against the liability of such crosses is the simple one stated by a judge of a United States court, in which the decree was given that the distance between the high and low potential lines should be equal to that of the highest pole, so that in the event of the falling of a pole the wires would come short of reaching the other line. In many instances congestion of electric service and narrow streets prevent any such wide separation, and it becomes necessary to take every precaution for substantial construction.

It is necessary for such different lines to cross the others' routes, and in such instances provision against collision is made by the use of extra heavy construction, thoroughly bracing and guying the poles, and arranging against overhauling of the lines in case of their breakage; also guarding the wires so that those on the upper line could not fall over the ends of the cross-arms in case of their separation from the points of support.

As high-tension wires are of larger diameter and fewer in number, their poles should be higher at the crossover.

The crossover span should be so short and at such height that in case of breaking next to an insulator, the remaining portion of the span wire should not be long enough to reach to the lower line.

The necessary height of poles, or the impracticability of placing them in such positions as to provide for the short crossover spans, may sometimes render it unfeasible to adopt this construction, and a grill of hard-wood slats placed at frequent intervals across a pair of steel wires or cables between the two spans interposes a screen which prevents a broken wire on the upper span from reaching the lower span.

In some instances, where there are but few wires in each line they are attached to the same pole, and the contact is prevented by a framework carrying guard

[1] Abstract of a paper read before the Franklin Institute, Philadelphia, Pa., January 12, 1905.

Digitized by Google

wires below the upper line. It is not as a general principle advisable to use a single-pole crossover.

AERIAL WIRES.

The tension on a line suspended between a pair of horizontal supports varies with the sag and is at a minimum when the sag amounts to seven-twentieths of the span, and the tension increases whether the sag is greater or less than this proportion.

For example, with No. 12 hard-drawn copper wire, weighing 173 pounds to the mile, and being 0.104 inch diameter, and having a span of 130 feet, the minimum tension of three pounds would occur if the sag was forty-three feet six inches, while it would slowly augment with increase in the sag, and if nature had furnished a chasm deep enough for the experiment, it would be expected to reach its breaking tension of 550 pounds at a depth of 16,470 feet, or 3.17 miles.

On the other hand, the increase in tension proceeds rapidly as the wire is drawn to approach a straight line, the breaking tension occurring at a sag of one and one-half inches.

As a comparison with this instance of the stresses in a local line, in the case of the No. 8 hard-drawn copper wire, 0.165 inch in diameter and weighing 435 pounds to the mile, as used on long-distance telephone lines, when the span is 150 feet the minimum tension occurs at a dip of fifty-two feet six inches, when it is only eight and three-fourths pounds, and in like manner, as in the foregoing instance, its breaking stress of 1,328 pounds would be reached at the slightly less dip of 16,100 feet, or 3.04 miles, still too great to admit of confirmation by direct experiment; but if the wire was pulled until the sag was 2.2 inches, it would require the breaking load of 1,328 pounds.

It is desirable that the wires should be drawn tight enough to prevent them from swaying against each other; but it is important that they should not be drawn so tight that the contraction during extreme cold weather should cause the wire to break.

HARD-DRAWN COPPER WIRE.

The electrical advantages of copper over iron could not be utilized for aerial wires, because commercial copper has so little resilience that it will continually stretch under its own weight and become attenuated to an extent that it will break, until Thomas B. Doolittle produced the hard-drawn copper wire which is now in universal use on aerial lines. The treatment consists in omitting the annealing processes during the latter portion of drawing the wire, but it deviates from the usual method by attenuating the wire by smaller gradations at the latter die-plates. Its electrical conductivity is practically the same as that of commercial wire drawn from the same ingots, the slight increase being due to the change in the molecular condition of hard copper.

The relative cost of iron and copper wire is not a measure of the comparable expense of such lines in actual service, as copper does not have an oxide of high resistance, and its life has not yet been determined. The value of copper scrap from wrecked or reconstructed lines is about two cents a pound less than that of new wire, while galvanized iron line wire costs about four cents a pound, and when taken down is of no value and is generally thrown upon a dump.

The rusting of iron wire at the joints adds materially to the resistance of the line.

LONG SPANS.

Where lines traverse mountainous districts or water-courses it is frequently necessary to build spans of great length, using either one of the special bronzes or steel wire for the purpose.

Long spans are frequently strung in cases of emergency, as when the flood of June 2, 1903, carried away the bridge crossing the Kaw river at Kansas City, Mo., and also the wires attached to it, a span of wires 900 feet in length was immediately suspended between high spars erected on either bank.

The most spectacular work in line construction has been done among the mountain ranges of the West.

Lines have been built against the face of cliffs bordering deep canyons, where it was necessary to incline the poles so that the tops carrying the wires overhang the deep abyss, in order to avoid icicles and avalanches falling down the precipice.

In building telephone lines through this mountainous country, a couple of poles are slung like panniers on the sides of two or three mules tandem, and these sure-footed animals will carry them along the rough trails.

The wire is wound in great lengths in connecting coils, which are placed on the sides of the saddles of a train of pack mules, which are thus connected on one side by wire from coil to coil, around the front of the foremost mule and thence back along the other side of the train.

By removing the last pair of coils and unreeling, and thence in turn to the next coil, the pair of wires for a metallic circuit can be laid down along a route.

The Mosquito pass, near Leadville, Col., was crossed at an elevation of 13,130 feet by a line of poles which were set only fifteen feet apart at the more exposed places, but even this construction did not resist the storms of winter.

Telephone lines were afterward maintained through this Alpine exposure by an expedient as far out of the ordinary as the celebrated venture of Lord Timothy Dexter in sending warming-pans to the West Indies, and that was by replacing the line of poles by submarine cable carried to this elevated site in continuous coils, as in the case of wire transportation over the mountain trails upon a train of mules, and laid in trenches among the rocks to avoid any disturbances from avalanches.

There have been instances when it was necessary to make expeditions to these altitudes in severe weather to make repairs.

The rough valleys through which the routes pass are picturesque in summer, but in winter the snow accumulates to such depths that linemen attend to their duties on snow-shoes, reaching the lines on twenty-five-foot poles as if they were wire fences.

Imogene Basin, Col., at an elevation of 13,700 feet, is crossed by a span of 950 feet, which inclines at an angle of twenty-seven degrees. Near Telluride and the Tomboy mines, ravines are crossed by similar long spans. A surveying party, arranging for the extension of some of these lines, found the snow to be twenty feet deep in these basins in the middle of July, while avalanches had rolled down opposite sides of a valley, leaving a narrow pass bordered by snow and ice one hundred feet in height.

These lines running from the valleys up to great elevations on the mountains are charged with atmospheric electricity, particularly in winter, which is discharged to earth by bridging retardation coils across the lines and grounding the central part of the coils.

The surveying party noted that these disruptive discharges of static electricity occurred about sixteen times a second, producing a continuous sound which could be heard by one near to the wires. The mountain appeared to be enveloped by static electricity, the poles and the engineers' transit glowed with St. Elmo's fire, and an irritation was felt at the head and the hair would fly up if the hat was removed.

This electric envelope did not appear to extend to the ground, as one was entirely free from any sensations when lying down, but if, while in such a position, a

Digitized by Google

hand was raised to about three feet above the ground, a sharp sputtering sound of static electrical discharges would occur.

Useful as the telephone may be in affording facilities for communicating between different portions of a city, there are other methods of reaching one's townspeople—messenger, mail, or, like the leader in a child's game, "send myself"—but there is no equivalent for the question and the answer which can be exchanged between persons fifteen hundred miles apart, their voices reaching each other in less time than if they were conversing across a room; or, to give a concrete example, the time for telephonic transmission over the 1,064 miles between Boston and Chicago is 0.006 second, while the distance that the voice is transmitted through the air in that time is six and one-half feet.

There are many thousands of miles of telephone lines without poles, for the business of lumbering and the wood-pulp industry is conducted over telephone lines traversing the forests from tree to tree through the wilds.

By the use of the telephone the methods of log-driving have been changed for the better. The facility of communication between different gangs along a stream enables the logs to be conveyed without the disturbances caused by jams, which can be prevented by prompt action, and also avoids the destruction of timber, which would otherwise result from the use of dynamite to relieve these jams.

Smaller and more rapid streams, hitherto unsuited for lumbering, have been utilized by the construction of dams, which husband and release the water as may be considered necessary by the men perhaps miles below, who speak through the telephone to those operating the gate at the dam.

One of the most useful applications of the telephone is in connection with the life-saving service, whose telephone lines extend along the shore, and the patrolman carries a small portable telephone which he can connect at fixtures upon the side of frequent poles, and in this manner communicate to the life-saving station for routine report and to summon help in case a vessel is in peril off the shore.

UNDERGROUND CONDUITS.

The number of wires necessary to supply the patronage in cities so far outnumbered the possible capacity of pole lines along the streets that it became necessary to place them underground, and this required the development of the underground conduit and the telephone cable as new arts.

While fifty-five per cent of the telephone exchange wires are underground, yet the great number of wires in these conduits in comparison with those upon poles makes the number of miles of pole lines throughout the country seventy times the length of the streets occupied by underground conduits.

While no other ratio may give an adequate impression of the predominant use of the telephone for communication over long distances, yet in comparison with steam railroad rights of way in the United States the length of Bell telephone pole lines exceeds that of the railway system by over twenty-six per cent.

The first experimenters upon underground systems attempted to make them water-tight, and also insulators, such as a solid mass of asphalt concrete in which wires, frequently without insulation, were imbedded.

The lack of satisfactory results caused the Bell Telephone Company to begin the development of the work under Mr. Joseph P. Davis, chief engineer, on the principle of providing a conduit of substantial construction containing ducts in which the cables could be placed or withdrawn, and relying upon the conduit merely to provide a protection against injury.

Underground conduits have wrought a great change in the housing of the telephone central station plant, as the rigidity of an underground system requires that the distributing centres should be of equivalent permanency, and the telephone plant could not in such cases be subject to the mutations of hired property, but must own the buildings.

Therefore fireproof buildings have been constructed by telephone companies all over the country, until the Bell telephone system owns the greatest number of fireproof buildings of any single interest in the country, and its holdings of buildings and land in cities make it a vast realty enterprise.

If the underground conduits remove conductors from vicissitudes of decay of poles, and exposure to storm and the hazards of foreign currents, yet the underground conduits have their share of mishaps.

Breaks in water pipes or sewers disturb the foundations of these conduits, rain-storms flood them, illuminating gas percolates into them waiting to be ignited by a spark from a horse's shoe at some leak around a manhole cover, or it may be lighted by men going to work in a manhole with a lantern looking for trouble—and finding it.

The superficially attractive proposition of joint conduit systems, particularly in connection with a scheme of municipal conduits for all electric wires, has been attended by serious occurrences.

Crosses among high-tension conductors in cables occur from time to time, and if the wires of signaling systems were exposed in the narrow limits of a manhole, they would be disabled.

In one city where an inclusive conduit was laid by the municipality, the work was fortunately in good hands, and the manholes were built very large, with the cables of various classes placed on supports upon opposite sides of the manholes, and the cables containing high-tension wires were enveloped with split underground tile conduit tied together.

The attempt of a municipality to force a Bell telephone company into an exclusive underground conduit system under circumstances which were considered to expose its cables to hazardous conditions, gave rise to litigation in which the contentions of the telephone company were fully sustained by the supreme court of that state.

CABLES.

The necessity for cables was coincident with the decision that underground conduits must be constructed on the "drawing-in" and not on the "built-in" system, and at about the same time it was foreseen that aerial cables must replace the open wiring in cities wherever there were a great number of local wires, on account of their compactness and greater resistance to storms. For electrical reasons, it is necessary that open wiring must be used for long telephone lines.

The first telephone cables, both aerial and submarine, are believed to have been those used at Philadelphia in 1881, and at that time experimental constructions were being made at Providence, R. I., Brooklyn, N. Y., and Boston, Mass.

In the latter city parallel rubber-covered wires, giving conditions of such great electrostatic capacity that a mile was the utmost limit of telephonic transmission, were tried, but when about a third of a mile was inserted in a telephone line, subscribers complained that their instruments were becoming worn out, as they could barely hear; and the induction between the parallel wires was so great as to transmit cross-talk between the various circuits.

The induction was stopped by placing the wires in twisted pairs, but the prob-

Digitized by Google

lem of insulation with a low static capacity required long experimentation by many persons. Mr. W. D. Sargent, of Brooklyn, tried paper insulation and found that the static capacity was reduced and the transmission correspondingly improved, which Mr. T. D. Lockwood found to be due to the occluded air among the loosely twisted fibrous paper, and not to the paper as an insulating material.

Mr. John A. Barrett, of New York, was intimately engaged upon experimentation and manufacture of cables, and to him are due many improvements in cable design.

At this time Mr. W. R. Patterson, now of Chicago, was working along independent lines, and made a form of hydraulic press for drawing on the lead cable sheath, which is still in use as the standard method of manufacture, although many changes of detail in the conductors have been introduced, with the result of improving telephonic transmission to over five times that of the first cables using twisted pairs.

Cables are applied for miscellaneous other uses outside of conduits wherever the lines need protection against water, moisture or accidental violence. They are used for submarine lines at bridge draws and river crossings, where they appear to be the especial targets for fouling anchors and snarling propellers. The cables across the Mississippi at New Orleans become overlaid by the soft viscous mud of the river, which is so tenacious that it is impossible to pull them up again.

They are applied in tunnel work and in mining, and have even been led to a stranded steamship. At Honolulu there are special facilities for laying temporary cables to vessels anchored in the harbor, furnishing them with telephone service when in port. In all United States seaports, vessels moored to wharves can promptly obtain temporary telephone service, for which wires already are placed upon the wharves ready to be extended to telephones to be installed in the cabin.

The modern office buildings are provided with channels in the walls for telephone wires, and also parallel grooves under the floors in multiples of three feet from the front side of rooms, so that wires can be run from the wire entrance of the building up through the floors to positions convenient to reach desk telephones, for as the telephone connections are made in less time than any other service, such as passenger elevators in buildings, or attention by salespeople in stores, so it takes too much time for the average business man to step to the telephone many times a day, and the electrical mountain must go to the commercial Mahomet, by placing the telephone on his desk.

These laterals and distributing pipes conveying the cables branching from the main system are sources of trouble in cold climates, for water penetrates them, usually by backing up from a flooded manhole, and by freezing in the space between the pipe and the cables, crush them until the insulation becomes impaired.

The former course required the expensive method of using a portable steam boiler, generally a city fire engine, to blow in steam from twelve to thirty-six hours to melt the ice, and then cut out the cable, which must be replaced by another one.

The Chicago Telephone Company equipped a wagon with step-down transformers and conductors which could be attached to the electric light wires and furnish a current of seven hundred amperes at a low voltage.

THE RATE OF TELEPHONE DEVELOPMENT.

It has been the endeavor to submit, as far as facilities for illustration provide, some of the obstacles presented by natural conditions to the construction and maintenance of telephone lines, in order to secure an appreciation of the engineering skill which has overcome these obstacles to the extension of the telephone service which now knits together in one system over 26,000 different settlements throughout this country.

The establishment of this vast plant from small beginnings was attended for some years with a rate of increase which may appear slow in the light of later events, until the full development of long line service unified the whole in one connecting system, the value of whose service is far in excess of what could have been derived from isolated plants in separated towns.

These wider facilities endowed the telephone service with a higher value whose worth was appreciated, and the installation of telephones became stimulated to such a degree as to tax the resources of the various departments engaged on the work.

During the last five years the number of telephones in the system has increased at a greater rate than ever before. This increase has been building upon itself like compound interest at the usurious rate of twenty-nine per cent a year, and compounding each year at this rate would double the number in two and three-fourths years, or the number of telephones has actually increased over three and one-half times during the last five years.

Each of these instruments as soon as installed comes into full service for connection with other instruments, and thus reciprocally each new telephone adds to the availability and, therefore, the value of those with which it may be in communication.

During this last five years these additions of twenty-nine per cent a year have required corresponding amounts for the enormous increase in construction of a new plant, which is entirely separate from the maintenance and repairs of the existing property.

> Truly the fabric of mental fleece,
> Resembles a weaver's masterpiece,
> Where a thousand threads one treadle throws,
> Where fly the shuttles hither and thither,
> Unseen the threads are knit together,
> And an infinite combination grows.
> GOETHE—FAUST, Sc. IV.

Automatic Fire-Alarm.

According to the *Manufacturer*, Philadelphia, an automatic fire-alarm has been invented by a Danish scientist which will act only when a sudden wave of heat is generated in an enclosed space. The alarm is not influenced by an evenly created high temperature as would be caused by intense summer heat, or the artificial heat used for warming buildings.

The alarm consists of a small glass tube bent into a U-shape, with closed ends. It is half filled with mercury, and the upper part contains a highly volatile liquid. One end of the tube is enclosed in a non-heat-conductor, so that a sudden rise in temperature affects only the exposed end. A wire is fused into both ends of the glass, and reaches the mercury when the latter is in its normal position, and a continuous electric current then passes through. If a sudden wave of heat strikes the instrument it affects only the unprotected part of the tube, and the volatile liquid expands, forcing the mercury into the covered end and severing the electrical connection, thus setting in motion an alarm.

Fourth Annual Chicago Automobile Show.

The fourth annual Chicago (Ill.) automobile show will be held from February 4 to February 11, 1905. It is expected that a large number of manufacturers of automobiles, both foreign and domestic, will exhibit at this show. The manager is Mr. S. A. Miles, New Southern Hotel, Chicago, Ill.

Digitized by Google

The Manufacture of Air-Insulated Cables.

By Emile Guarini.

FOR some years past the study of electric insulating means has acquired considerable extension, and not a day passes, so to speak, without some new composition being introduced which, the inventor fondly hopes, will be destined to quickly drive all other insulating mediums from the market. On the other hand, patient and exhaustive experiments are being carried out in almost all electrical works with a view to determining the extent to which confidence may be placed in such insulating means, the losses resulting from their use, the maximum potential they will bear under continuous or alternating current, the most suitable form that may eventually be given to such a medium, and how it will act both inside and out on fine and rainy days, etc. The great interest attached to this subject is explained by its great economic importance in connection with the transmission of high-tension currents. In this case a few hundred volts, more or less, could easily have a vital influence upon the capacity and efficiency of the whole line, because, in many instances, if the tension could be slightly increased without giving rise to losses of current, then—should the consumption increase, for example—it would not be necessary to lay down a new conductor (which is often very expensive) in order to cope with the augmented demands for current. Insulating means have, consequently, extreme importance in connection with modern electrotechnics. Unfortunately, the more they are improved the dearer they become. There are certainly some insulations which cost but little; there is even one which can be had gratuitously—namely, air in a dry state. The only regrettable point is that it will not stand high tensions, but it is highly suitable in the case of low voltages. Hence, for some time past attempts have been made to utilize it. The process of insulating these cables, as effected for some time past in Messrs. Siemens & Halske's cable works, at Nonnendamm, where air is used as an insulating medium in connection with the manufacture of telephone cables, is interesting.

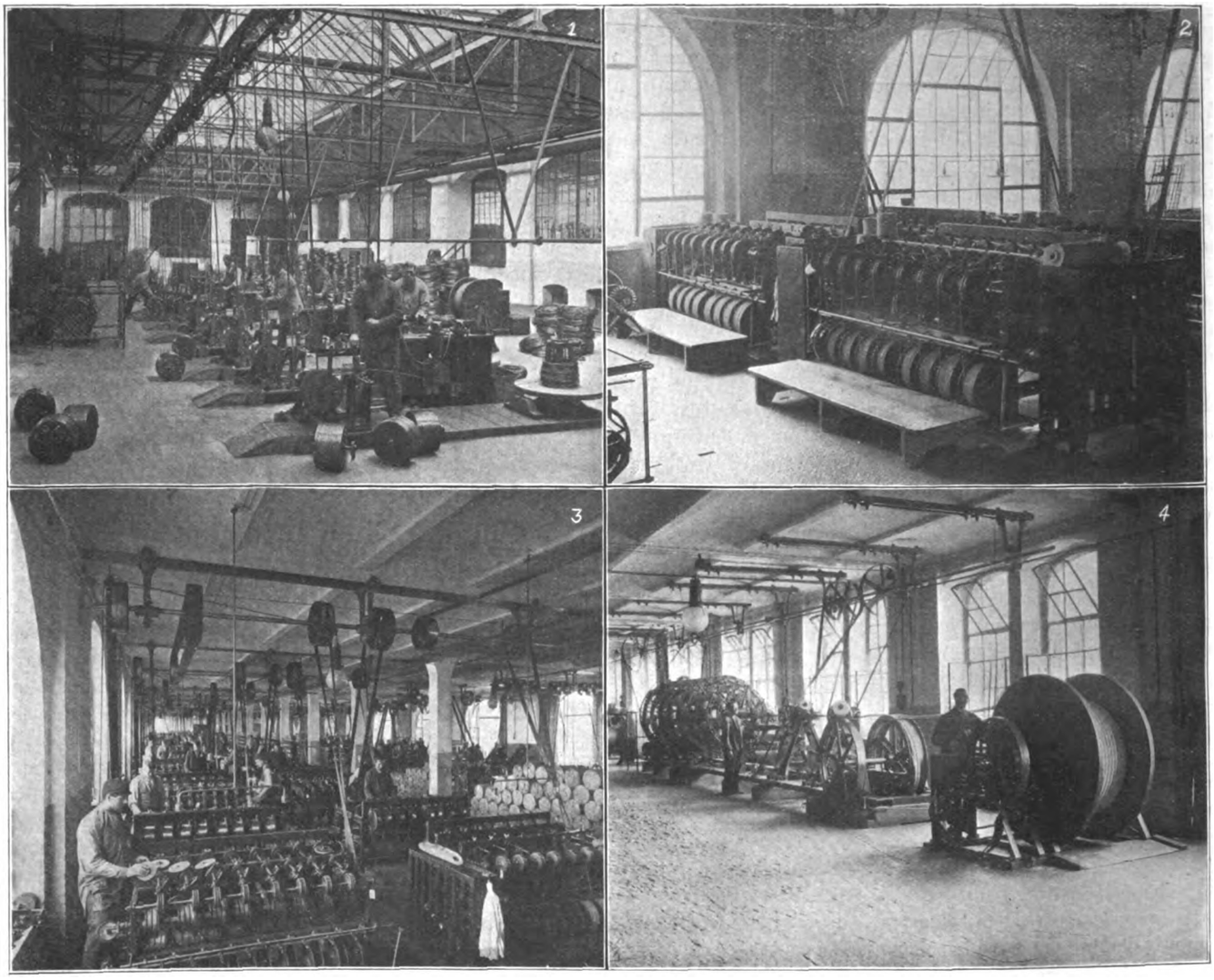


FIG. 1.—ROLLING UP COPPER CORE WIRES. FIGS. 2 AND 3.—WIRE-COVERING MACHINES. FIG. 4.—TWISTING OR CABLING MACHINES.

After having been wound on reels by machines placed in front of the warehouse, the copper wires intended to form the core of the cables pass from the copper warehouse, situated on the ground floor of the northern wing of the central

Digitized by Google

building of the works, to the cable-making room, where there are machines for making cables arranged parallel to the central building. The drums of the cable-making machines turn out the cores of the cables ready covered with wire, and send them to the firing rooms, and then to the lead pressing room, where the wires receive their leaden jackets. From this room they pass to the testing vats, arranged parallel to the pressroom. Here the cables, and more especially their leaden jackets, are tested under water as to their water-tight, or more accurately speaking their insulating, qualities. This room is situated on the ground floor of the central building. On leaving the testing vats the cables pass direct to the armoring machines, where they receive their protective covering against all mechanical deterioration. This covering is formed of a network of iron wires or strips. The room where this operation is carried out is situated on the ground floor of the southern wing of the works. Fig. 1 shows the method of rolling up the copper wires used to form the cores of the telephone cables; these come in the form of bundles from the wire-drawing machines, and are wound upon the reels, by the aid of which they are placed upon the machines to be subsequently used. Figs. 2 and 3 show the covering machines, by means of which the wires are covered with a series of paper layers. A special guide-carrier device leaves a space between the copper conductor and the layer of paper. This space is filled with air, and forms one of the insulating layers of cables. The wires, after having been covered with paper, are automatically wound upon forms in such a way that each wire forms a core. Two of these cores are then made into a cable by means of a special machine, one of them serving as the outward and the other as the return conductor. The commencement of a cable, thus formed, is now again wound upon a reel. The bobbins or reels, thus formed, are then put into twisting or cabling machines, by the aid of which the coils are transformed into cables (Fig. 4).

Usually the various layers of these twisted cores are concentrically arranged. In the case of cables of the more solid type they are again surrounded with a fine layer of material with a view to imparting greater cohesion to the cable.

The cable is then wound upon a drum, from which it passes to a drying arrangement where it is dried for a considerable time in vacua. The drying is effected partly by means of heating coils, and partly by means of the exhaust from the drying drum. Fig. 5 shows this drying device opened; Fig. 6 shows the drying device closed, and also a condenser.

When the drying is completed the cable is given a smooth seamless coating of lead. Fig. 7 shows a lead press, of the

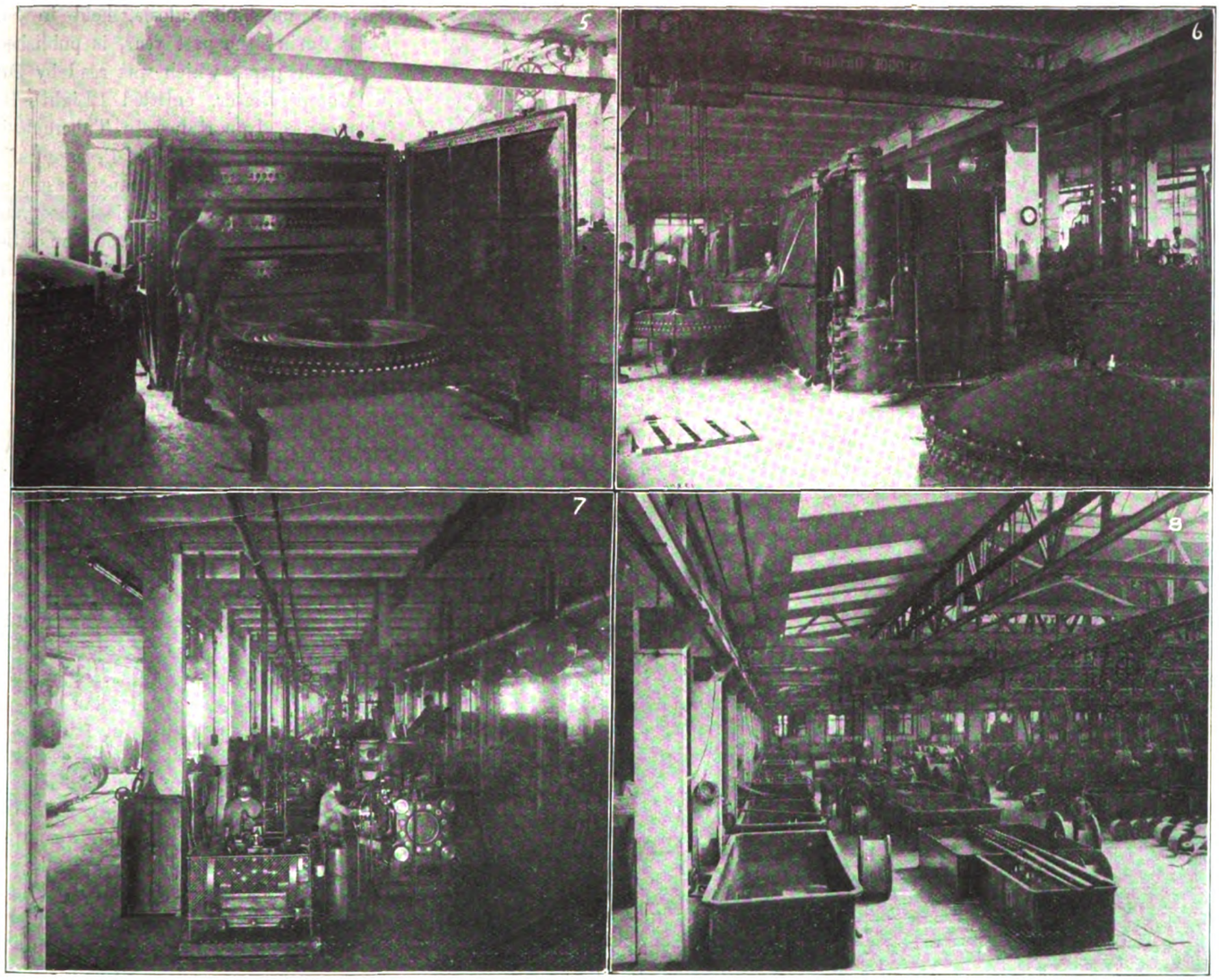


FIG. 5.—DRYING DRUMS, OPENED. FIG. 6.—DRYING DRUMS AND CONDENSER. FIG. 7.—HOT TYPE LEAD PRESS. FIG. 8.—VIEW OF TESTING-TANKS.

Digitized by Google

hot type, as used for this purpose. The cable passes through it from right to left.

Fig. 8 gives a view of the testing

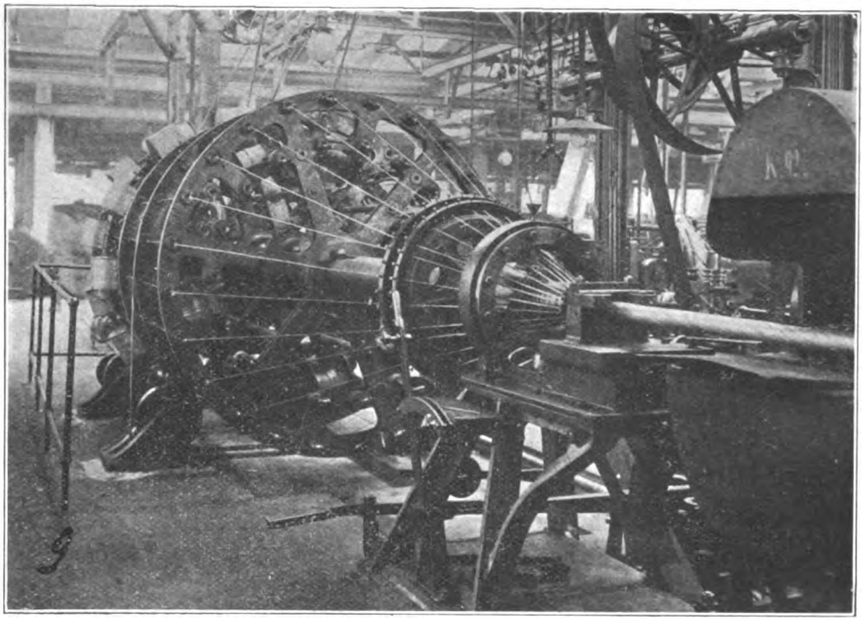


FIG. 9.—FRONT VIEW OF ARMORING MACHINE.

tanks. In order to test the impermeability of the covering of lead the cable is immersed in water, so that only the ends are left free; these are to be connected up to the measuring wires. If the meter shows a defect in the lead the cable is removed, dried again, and then given a fresh coating of lead, whereupon the same test is again applied. If the results obtained are favorable the cable is then armored by winding it round with a layer of iron or steel wire.

In order to protect the leaden jacket from all chemical influences, there is always placed beneath this layer of wire a layer of insulating paper, and then another elastic layer of jute fibre. Upon this the armoring is then adjusted (Figs. 9 and 10).

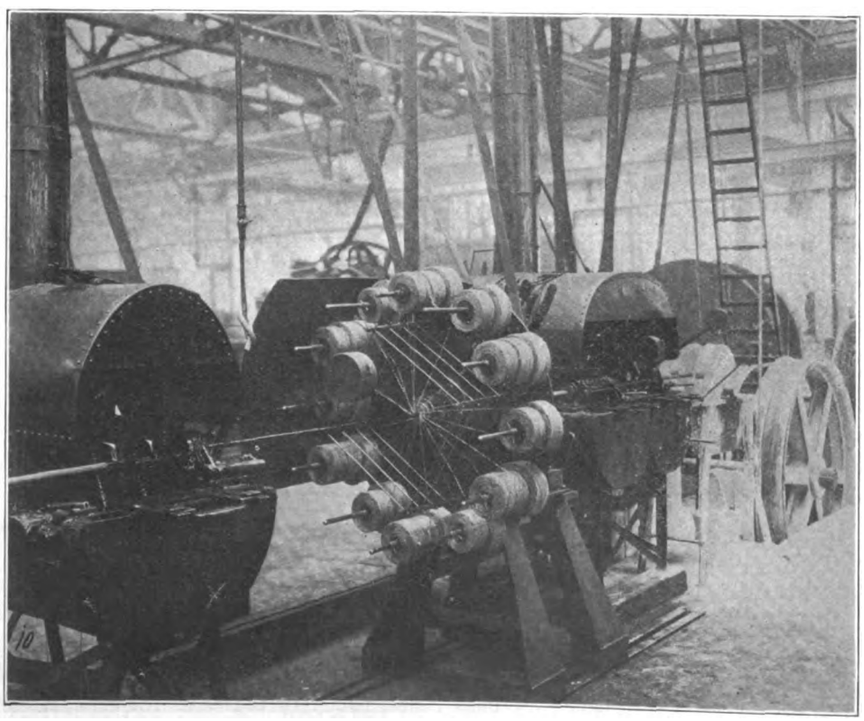


FIG. 10.—REAR VIEW OF ARMORING MACHINE.

If the cable is intended for subterranean use the armoring is well asphalted and protected by means of fireproof jute. In order that the coating of asphalt may harden quickly, and to prevent the layers of cable upon the drum from sticking together during transport, the cable is finally passed through a vat filled with lime water. Fig. 11 shows the whole of such an armoring machine. This completes the processing of the air-insulated cable.

The Therapeutic Importance of Electric Light.

In the transactions of the American Congress on Tuberculosis, held in St. Louis during the past year, is published a valuable paper which was read by Dr. J. Mount Bleyer, entitled "Light—Its Therapeutic Importance in Tuberculosis as Founded upon Scientific Researches."

The first part of this paper dwells at some length upon the physical theory of light, and then passes to a discussion of the effect of light upon organic life, and the influence of the solar rays upon chemical combination and precipitation. The author discusses the question of the value of light in treating disease, and shows how solarization by the sun or electric arc should be effected, and the physiological and physical influence which these rays have.

A review is given of the experimental researches with the electric light upon greenhouse plants, Siemens's conclusion being quoted, that the electric light can be profitably employed in horticulture and that in the future "the horticulturist will have a means of making himself practically independent of solar light for producing a high quality of fruit at all seasons of the year." It is shown that growth can be hastened by the addition of electric light to daylight, and that injury does not necessarily follow continuous light throughout the twenty-four hours. The electric light often deepens the green of leaves, the tints of flowers, and sometimes intensifies flavors and aids to produce good seeds. Siemens believed that the addition of the electric light enables plants to bear a higher temperature in the greenhouse than they could otherwise.

Deherain found that, when using the electric arc, it was necessary to screen the plants with a clear glass globe, or otherwise serious injury followed. When this is done the greater part of the injurious rays emitted by the arc is modified, and the arc contains enough rays to maintain full growth of the plants for two and one-half months. The light, however, is too weak to enable sprouting seeds to

Digitized by Google

prosper, or to bring adult plants to maturity.

Dr. Bleyer then passes to the use of arc chromolumes, an arrangement for producing violet rays of light in an electric arc, as an adjunct to the treatment of tuberculosis. His specially constructed electric arc lamps for producing these rays have undergone some modification since they were first brought out in 1896. It was found that the concentration of light is important, as this gives greater penetrating power. The lamp has also been much simplified. These rays have a great penetrating power, and when they are passed through the chest wall they enable negative plates to be prepared in less than fifteen minutes.

Dr. Bleyer has used these colored rays in treating tuberculosis of the lungs with most successful issue in sixty cases. He believes that electric arc solarization can be considered one of the greatest tonics and bacteria destroyers. Of the sixty cases treated, he reports forty cured, and in twenty the disease was arrested to such an extent as the pathological changes present when they came under treatment would admit. He believes that his experience shows that such light rays play an important rôle in the treatment of this disease.

The lamps are now made in different types, suitable for different classes of supply. The alternating-current lamps for high tension and low tension are constructed to operate automatically or to be regulated by hand. In order to get a steady, pure light spot, these lamps are provided with a concave mirror which enables the light to be thrown out in parallel rays. Any part of the pulmonary apex or any other portion of the anatomy can be treated by means of these. For the low-tension, direct-current lamp the focal lines are created by a Mangin mirror, somewhat on the principle of the search-light. The lamps are made in different sizes, using from 10 to 100 amperes, the smallest lamp having a focal length of three and one-half inches, and the largest a length of seventeen and one-quarter inches. The lamps are provided with a screen and hood carrying a shutter in front for cutting down the size of the light spot, and they are provided further with a chromolume consisting of a sheet of blue glass cut in strips, which cuts out all the heat rays of the beam of light. The paper concludes with a number of details concerning the construction and use of these lamps.

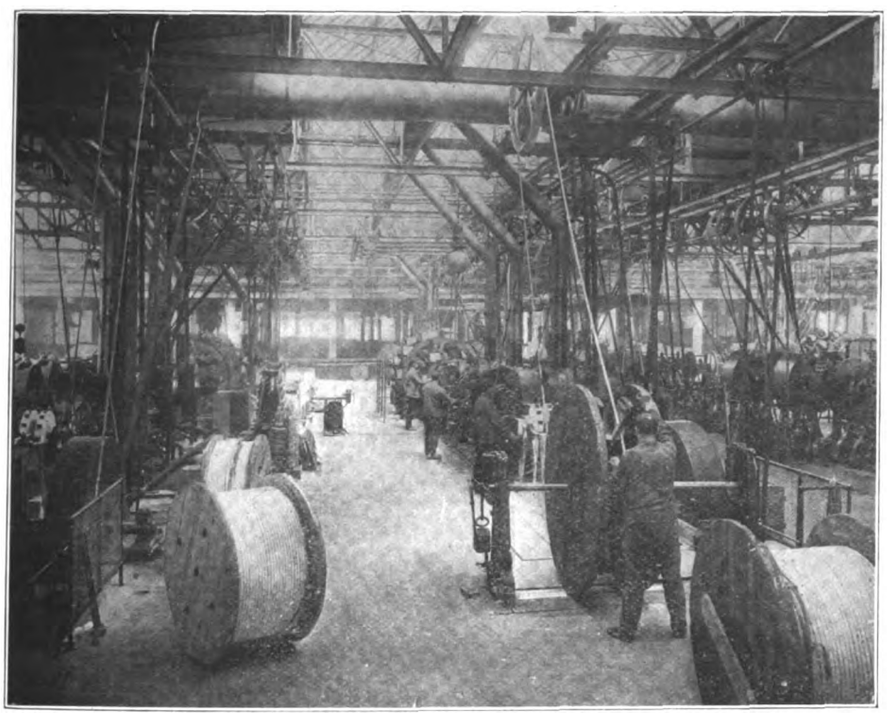


FIG. 11.—GENERAL VIEW OF ARMORING MACHINES.

A High-Frequency Alternator.

A paper on "A High-Frequency Alternator" was read by Mr. W. Duddell before a meeting of the London Physical Society, held on December 9. The author described and showed in action a high-frequency alternator which he had constructed in 1900 for some experiments on the resistance of the electric arc, and with which frequencies up to 120,000 periods per second had been obtained. The alternator consists of an inductor, built up out of ferrotype plate, having V-shaped notches cut in its edge so as to have flat-topped teeth. Surrounding the inductor is a laminated ring having two inwardly projecting poles, the clearance between these and the teeth of the inductor, which formed the air-gap, being less than 0.1 millimetre. The ring is wound so that a direct current flowing round the winding tends to produce lines of force from one pole to the other through the inductor. The number of lines of force varies from a maximum when the teeth of the inductor are opposite the poles, to a minimum when the poles are in front of the spaces. This variation in the total number of lines of force produces alternating electromotive forces in any winding either on the pole-pieces or on the ring itself; the movement of the inductor through the distance between two consecutive teeth producing one complete period. One winding on the ring could serve to carry both the direct field current, which magnetizes the ring, and the alternating current produced. In practice, owing to the great importance of any self-induction in the alternating-current circuit, it was found advisable at high frequencies to use separate windings for the two currents. At the highest frequencies the best results were obtained with coils having a few turns of wire fixed right on the tips of the poles. The alternator is driven by means of a figure-of-8 belt drive from two phosphor-bronze discs. Each of these discs is belted to a double-grooved pulley fixed on the shaft of a direct-current driving motor. With this method of drive the inductor was run for several months at speeds between 30,000 and 40,000 revolutions per minute, and the spindle of the inductor alone could be easily run at 60,000 revolutions per minute. Using inductors having 30, 60, 90 and 204 teeth, the author obtains small alternating currents having frequencies from a few hundred periods per second up to 120,000 periods per second. An illustration will perhaps convey some idea of how high a frequency of 120,000 periods per second really is. In plotting curves for ordinary frequencies of 50 to 100 periods per second, a scale often adopted is ten inches for 100 periods. If it were attempted to plot a curve up to 120,000 periods per second to this scale, the curve paper would require to be 120,000 inches, or nearly one-fifth of a mile long. Many difficulties were encountered with the centrifugal forces on the driving belt, and the author finally obtained the best results with a spliced cotton cord. Working drawings of the alternator, characteristic curves, and its wave-form are given in the paper. During the construction of the alternator bicycle wheels were used to drive it, and curves are given showing the very large power taken to drive these wheels, owing to air friction.

Digitized by Google

City Street Lighting at Sewickley, Pa., a Successful Six-Glower Nernst Lamp System.

The Sewickley (Pa.) Electric Company may truly be considered the pioneer in the use of the Nernst lamps for street lighting; in fact, the installation, which is the first of its kind in this country, was made before the organization of the Nernst Lamp Company.

The town of Sewickley, with a population of 4,000, is located on the north bank of the Ohio, twelve miles west of Pittsburg. In its general beauty, modern conveniences and the high standard of the community, it probably ranks first among Pittsburg's suburban towns.

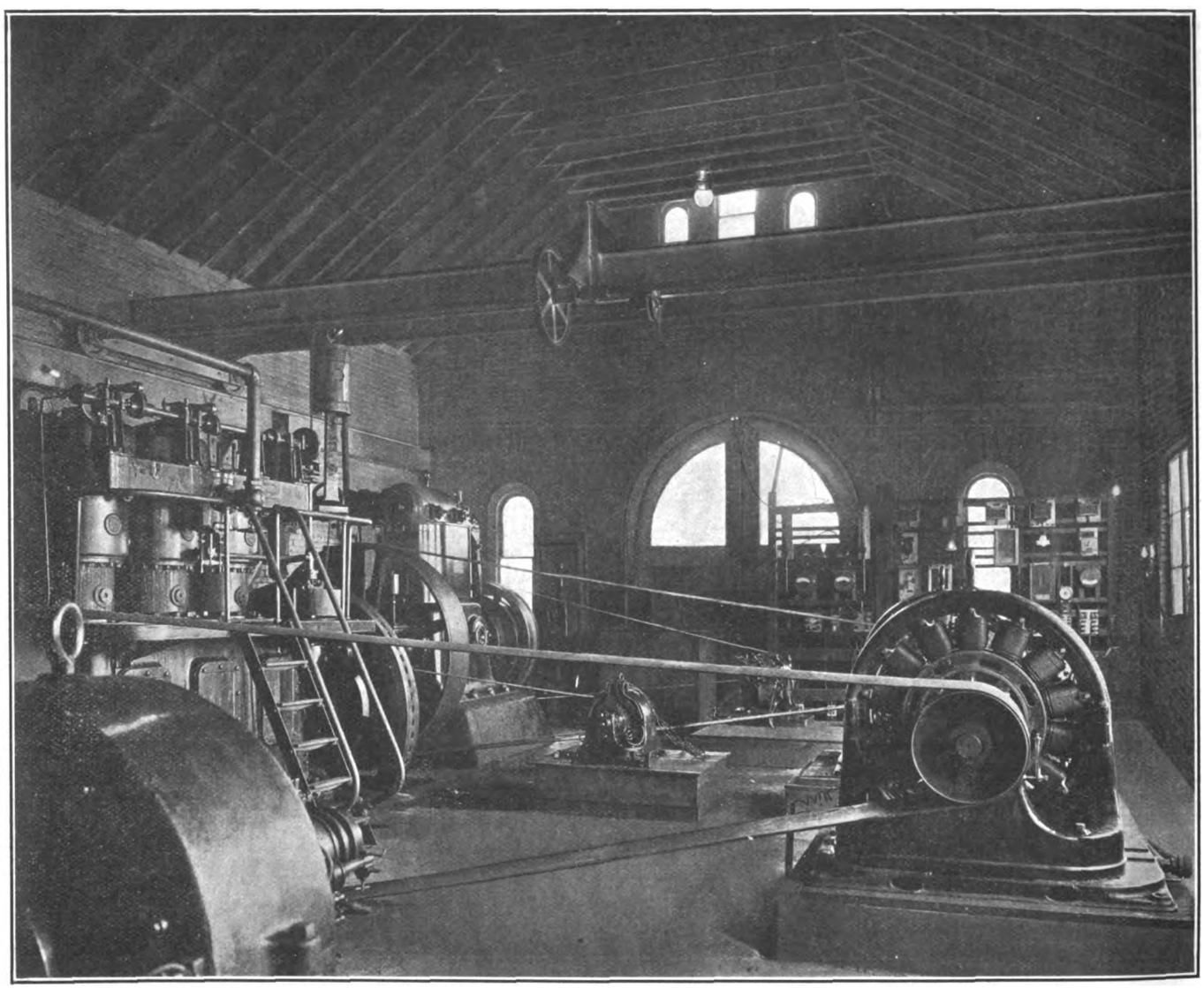


FIG. 1.—INTERIOR VIEW OF POWER PLANT, SEWICKLEY, PA.

At present the installation consists of ninety six-glower lamps of the outdoor type, equipped with clear eight-inch globes. Fig. 1 shows an interior view of the power plant which is located at the extreme south edge of the town near the river. It not only supplies current for the street, business and residential lighting, but also furnishes power to operate the city waterworks. The electrical equipment consists of three Westinghouse alternators of 60, 90 and 90-kilowatt capacities, belted to three Westinghouse three-cylinder gas engines of 85, 175 and 150-horse-power capacities, respectively, thus giving three separate units controlled from a common switchboard of up-to-date pattern. Each alternator is separately excited from its own exciter. The switchboard connections are such that the load may be shifted from one machine to another, and all three machines excited from any two exciters should the third fail. The interior of the plant is effectively lighted with four six-glower lamps at twenty-foot elevation.

The sixty-kilowatt unit, carrying through the day a small commercial load and at night the street-lighting system, generates single-phase current of 16,000 alternations, at a pressure of 1,100 volts, which is transmitted over a pair of No. 4 lines suitably protected by lightning arresters at different points, to a number of transformers, varying in capacity from one to seven and one-half kilowatts. These are distributed over the system, each supplying current to one or more lamps at 220 volts from their secondaries. Fig. 2 is a diagram of the system showing the location of the lamps and transformers.

As may be seen from the accompanying street views, Fig. 3, standard arc lamp practice is followed in the suspension of the lamps, the latter being supported well out near the centre of the street at an elevation of from twenty-two to twenty-five feet, the lamps being lowered to the ground for trimming by means of the pole pulley as shown. Owing to the smaller size and less weight of the Nernst as compared with arc lamps, the mast-arms used are much heavier in their construction than is necessary, but as a part of the original arc system these were draughted into service to save further ex-

Digitized by Google

pense. While the elevation of the lamps is less than that recommended for six-glower lamps, a greater height was impracticable, owing to the dense foliage lining the streets during the summer season.

and care of the lamps are left to the company's lineman, who devotes one-third of his time to this work; the remainder being spent on his regular duties as lineman. It is estimated that the total cost of maintenance, including interest and

small boys of stone-throwing propensities. Reports indicate that the system as a whole gives good satisfaction, and is considered superior to the former system, due to the light being more natural and pleasant in quality; an absence of "flicker"

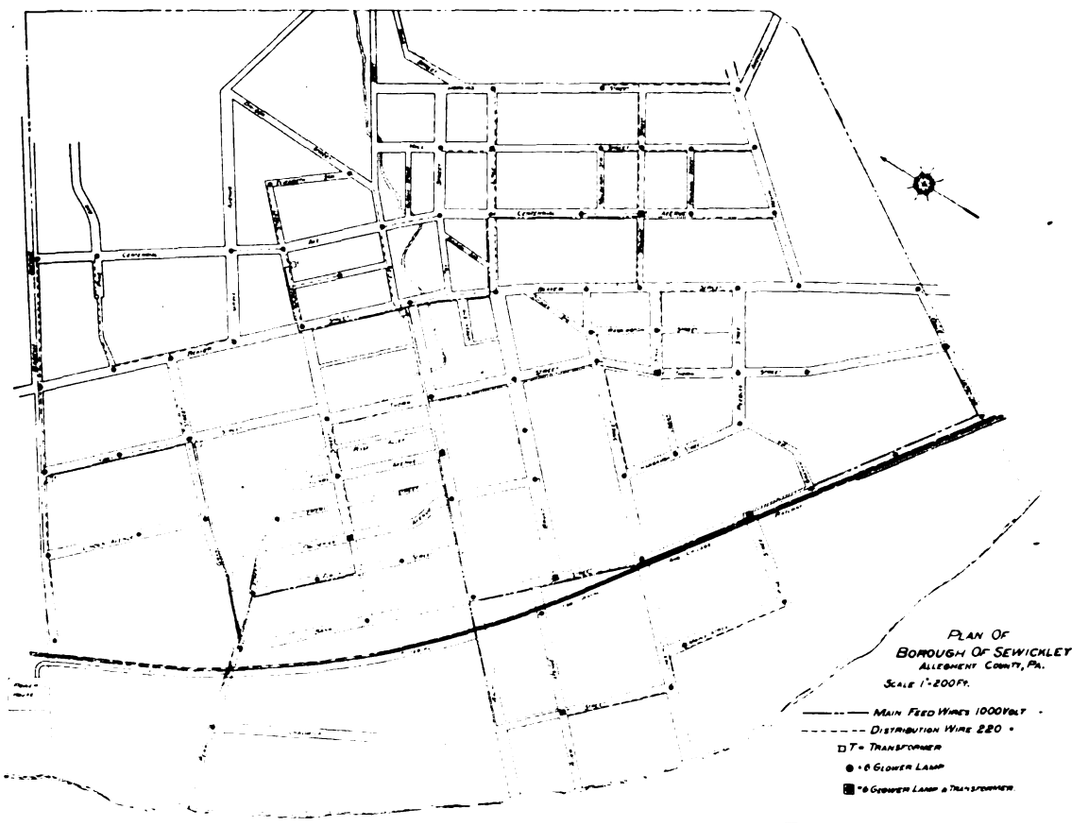


FIG. 2.—DIAGRAM OF SYSTEM, SHOWING LOCATION OF LAMPS AND TRANSFORMERS.

The distance between lamps ranges from 150 feet in the business districts to 800 feet in the outlying streets.

Since the installation was made about

depreciation, is one-half cent per kilowatt-hour. In this connection, it may be mentioned that there is an estimated saving of seventy-five per cent in the yearly cost

or wandering tendency of the light and elimination of shadows; the number of "outages" are comparatively few as some light is still obtained from the lamp, even

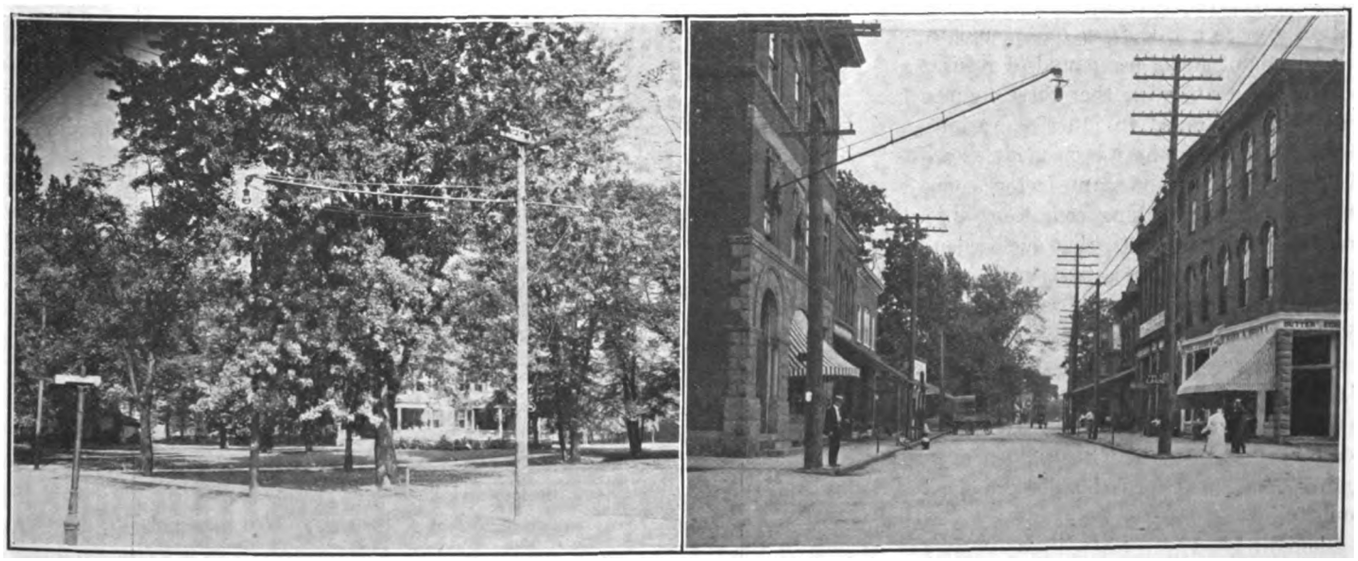


FIG. 3.—STREET VIEWS IN SEWICKLEY, PA., SHOWING METHOD OF HANGING NERNST LAMPS.

five years ago, the performance of the lamps has entirely fulfilled the claims made by the manufacturer, both as to lighting effects obtained and the maintenance cost. The complete maintenance

for glassware incurred under the preceding arc system. There are two reasons for this: one, that the Nernst glassware is cheaper; the other, that the lamp being smaller, is not an easy target for

though two or three of the glowers are broken, and in the discharge of his duties the trimmer is not exposed to dangerously high voltages as in the series arc system.

Digitized by Google

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED—II.[1]

BY W. P. ADAMS.

I will now proceed to lay before you the results of investigations I have recently had occasion to make while preparing a large scheme for combined works. While gathering information as to the actual quantities of electricity generated from refuse over a period of one year from the larger London and provincial installations, it became apparent that the average figures recorded in table B did not represent the ultimate value of the refuse. To take an instance, the electricity works at Fulham are alternating, and the day load is small even in winter. In summer the load is still smaller, and the peak load of short duration. Where some 120 tons of refuse are burned per diem, any substantial increase in the rate of burning during the peak is, as I have indicated, inadmissible; at Fulham there is no increase. It was therefore plain that if an all-the-year-round figure of some twenty-six units per ton was obtained, this value must at times be largely exceeded, for it was certainly not reached in summer and on the small day load. I therefore set to work to plot out curves so as to gather some indication of the ultimate value to be anticipated. One curve led to another, and I have now to show you quite a representative collection. I shall only have time to deal with the five London combined undertakings and one or two provincial.

Specially arranged tests of steam generation give as a rule from one pound to two pounds of steam per pound of refuse, and on the assumption that these figures could be maintained in practice, various ingenious estimates have been made showing fine values; but so many factors come into play under working conditions that are non-existent in tests, that such calculations may well be received with some scepticism. Under ordinary working conditions from twenty to forty units per ton are often obtained, and occasionally claims are made that better values are being secured and from fifty to sixty units per ton are mentioned with diffidence, as figures that will probably be received doubtfully.

Shoreditch—The Shoreditch vestry adopted the first combined destructor and electricity works to supply more light, more power to the inhabitants. Their

[1] Abstract of a paper read before the Institution of Electrical Engineers, London, England, December 15, 1904. The first portion of the paper was printed in the ELECTRICAL REVIEW, January 7.

TABLE B—ELECTRICITY OBTAINED FROM REFUSE.

	Name of town.	Year.	Tons of refuse burned.	Other purposes besides generating electricity for which steam is supplied.	Is steam for electricity generated from refuse measured separately?	Coal burned in electricity works.	Coal used for gen'g steam for other purposes.	Quality of coal. Name.	Quality of coal. Cost per ton in bunkers.	Lbs. coal per unit generated independently of destructor. Winter.	Lbs. coal per unit generated independently of destructor. Summer.	Lbs. coal per unit generated independently of destructor. Av'g for year.	Average steam used per unit generated. Coal.	Average steam used per unit generated. Ref. use.	Units generated exclusively from coal.	Units generated exclusively from refuse. Total.	Units generated exclusively from refuse. Units used in fan motor.	Units generated exclusively from refuse. Net total.	Estm'd ultimate value if all heat utilized in gen'g. Tons.	Estm'd ultimate value if all heat utilized in gen'g. Units generated.	Units per ton of refuse burned. During year, net.	Units per ton of refuse burned. Jan., '04, engrs' estimate.	Units per ton of refuse burned. All refuse utilized. (Est'd.)
London	Shoreditch	1902-3	25,729	Baths and laundry Library heating Deep well pump	No.	Tons. 6,876	Tons. 676	Welsh smokeless.	21/8	....	....	9	Lbs. ..	Lbs. ..	1,420,000	688,938	100,000	588,938	26,000	1,000,000	21	31	88
	"	1903-4	28,901	Clinker hoist Disinfector	..... Yes.	1,344 2,341	..... None.	Welsh smokeless.	19/6 20/11	.... 5.3-6	 6-8	8 7.13	50	60*	879,000 780,219†	849,140 1,108,627	105,000	744,140 1,108,627	 42,000	 1,060,000	28.5 28.3	40	40
	Stepney	1902-3	41,260	Brick-making plant Clinker-wkng. plant	No.	1,920	.....	Derbyshire.	18/5	8	12	9.4	50-60		451,185	791,200	.....	791,200	36,000	1,870,000	26.2	45	52
	Fulham	1902-3	30,300	None																			
	Hackney	1902-3	34,006	None	Sometime.	1,255	None.	Scotch.	18/6-14/8	4.5	6.7	5	27-35		563,584	1,380,399	124,228	1,256,176	38,000	2,498,000	37	45	64
	Bermondsey	1902-3	18,806	Baths and washhouses	No.	400	400	Welsh steam. Hard steam.	21/2 (Estl mtd.) 16/3	(Estl mtd.)	9.4	50	Nil.		496,157	496,157	25,600	410,557	14,000	1,300,000	29.8	:	86.5
	Woolwich	....	6,535	Disinfector and brick- None [making	.....	.....	.....	Smudge.	7/-	7	11.8	11.4	....	....	274,500	196,000	.....	196,000	6,500	260,000	30	40	70‡
	Shipley	1902-3	7,105	None	No.	1,402	.....	Welsh.	24/9	....	....	....	....	....	167,000	90,000	27,000	.....	7,500	127,000	12.8	:	40
	Beckenham	1901-2	7,010	.....	No.	1,277	.....	.....	.....	....	....	....	....	....	55,491	398,862	.....	398,862	13,500	.....	29.6	:	57
	Partick	1902-3	13,500	None	Sometime.	225	.....	Scotch bitumen.	8/-	....	....	9.1	....	105	98,268	266,000§	.....	.....	6,700	266,000	40	:	40
	Nelson	1902-3	6,658	Disinfector and mortar	No.	1,040	.....	Burry slack.	8/8	....	....	28	....	80	140,000	140,000	.....	140,000	5,500	182,000	25.5	:	56
	Mexborough	1903	5,496	None [mill	No.	75	.....	Slack.	8/-	10	....	12	....	....	140,000	140,000	.....	140,000	8,000	450,000	15.3	:	80
	Gloucester	1902-3	7,900	None	No.	1,200	None.	Slack.	10/-	5-6	10-12	15	....	....	180,000	119,591‖	Est. 30,000	119,582	8,000	450,000	15.0	:	80
	Grays	1902*	2,386	None	No.	848	.....	.....	.....	8-10	9-14	9.5	....	....	82,200	33,606	.....	35,606	2,507	75,000	21.0	:	17
	"	1902-3	2,883	None	No.	326	.....	Coal.	17/6	....	....	9.0	....	....	98,500	50,100	.....	.....	.....	.....	.....	:	:
	St. Helens	1901-2	10,864	3 mortar mills and steam winch	Yes.	60¶	.....	Coke breeze.	6/6	....	....	....	....	....	1,0?8,998	401,818	64,000	337,818	.....	.....	31	:	33
Provinces	Wimbledon	1902-3	9,000	Sewage pumping and hospital heating	No.	.....	5	.....	21/6	....	....	....	....	....	.....	None.	.....	.....	9,000	300,000	....	:	33
	Accrington	1903-3	11,945	None	No.	8 6	.....	Local steam.	10/6	5	....	6.5	....	....	100,642	126,000	.....	122,000	12,000	250,000	10.6	..	21
	Bangor	1902-3	2,505	None	No.	700	None.	Coke.	18/3	....	....	17.2	....	....	91,427	43,513	6,000	37,513	2,500	62,500	15	20	21

* 15% for fans and clinker hoist. † Including 44,000 from 140 tons burned at destructor. ‡ Winter only. § Including 7,800 units generated in destructor turbine. ‖ Assuming ⅓ refuse burned usefully.
¶ Coke breeze taken = half value of coal = 80 tons. * January-December.

Digitized by Google

wisdom has often been called in question. Besides the awkward arrangement of the accounts, another matter which gave rise to no little controversy was the impression gained, how I know not, by some vestrymen and others, that the works would be able to supply all the requirements of Shoreditch without the use of coal—a very

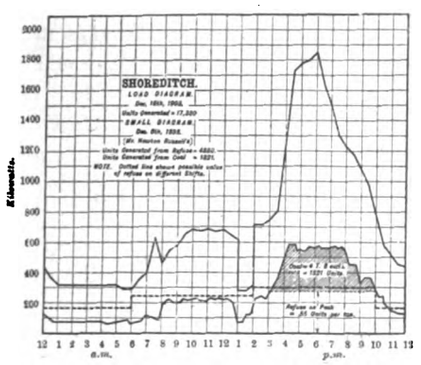


FIG. 2.—LOAD DIAGRAM, SHOREDITCH, DECEMBER 16, 1903

evident absurdity. I hope it is now generally recognized that only in the case of new works starting on a small load, can a combined works be expected to run without coal, and that the second year of running is almost certain to bring a larger load than the destructor can cope with unaided.

As to the results obtained in the generation of electricity from refuse-raised steam, I have little to add to Mr. Russell's figures

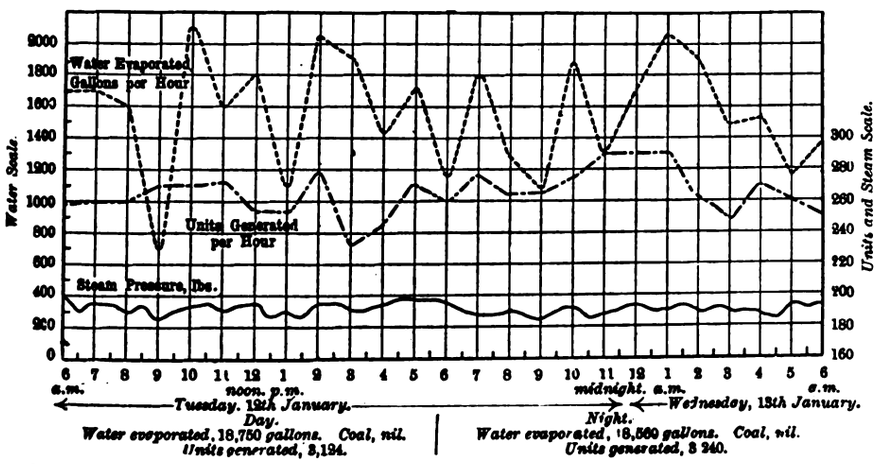


FIG. 3.—CHART SHOWING TWENTY-FOUR HOURS' RUN OF STEPNEY DESTRUCTOR, WATER EVAPORATED, STEAM AND UNITS GENERATED. BOILERS 1, 2, 3, 4, 5. FURNACES 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. NINE-INCH STEAM MAIN.

of 1899 given to the Institution of Civil Engineers, for under the conditions of working it has not been possible to separate between refuse and coal-generated units. I have one curve, however, that is of interest; Fig. 2 shows the output for December 16, 1903, and is a typical winter day load. Below is plotted Mr. Russell's historical curve of a day's test in 1899; it will be observed that the maximum value of the refuse was fifty-five units per ton, and that during the test the full value of the refuse was not obtained owing to the smallness of the load for the greater part of the day. The dotted line shows the rate of burning now in vogue throughout a winter day, assuming a value of fifty-five units per ton. It will be seen that the load has enormously outgrown the capacity of the refuse, and that therefore its full value should now be obtained. The summer load is also considerably beyond the capacity of the refuse. At the time of Mr. Russell's test all steam was being used for generating electricity, while this is not the case now; in fact, a large and unknown quantity is supplied to the baths and washhouses, heating apparatus in the library, and to a deep-well pump. The whole of the exhaust steam is supplied to the baths gratis, and live steam, which is supplied *ad libitum*, is credited at £248 per annum. Steam for library heating is credited at £15 per annum; and that supplied to the deep-well pump at the baths at one shilling per hour. The whole credit for these purposes amounted for the year ending March 31, 1903, to £302. When it is remembered that the Shoreditch baths are among the largest in London, and that the average coal consumption at the baths at Islington, Camberwell, St. Mary's, Westminster, and St. George, Hanover square, amounts to £700 per annum, it will be seen how inadequate £248 per annum is for Shoreditch.

I have endeavored to arrive at some idea of the true value of the electricity generated in the year from refuse. I do not think, in the light of Mr. Russell's figures for the test year, I should be justified in taking the average coal consumption per coal-generated unit at more than nine pounds—eight was the figure in the test year. Allowing £700 as the value of steam given to the baths, and accepting £15 for library heating and £39 for pumping as fair allowances, some 6,376 less 676 tons of coal will give 1,420,000 units generated, leaving a balance of 633,958 (out of a total for the year of 2,053,958) as generated from refuse, or twenty-one units per ton net—*i. e.*, after deducting units supplied to fan motors: this result was exceeded in the test year by some 7.5 units per ton

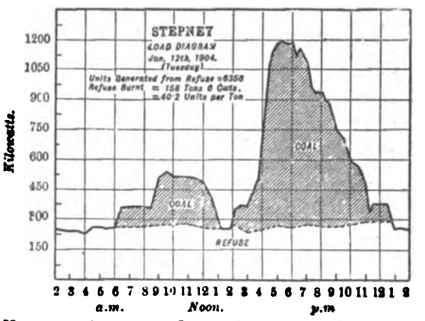


FIG. 4.—STEPNEY LOAD DIAGRAM, JANUARY 12, 1904.

Two shillings per ton is allowed by the scavenging department for destroying the refuse; adding this to other receipts and deducting the total cost of destruction, a balance of £3,755 remains, and this was debited to the electricity works as the coal value of the refuse. At nine pounds of coal per unit generated the coal cost is 1.04 pence; £3,755 represents 1.42 pence per refuse generated unit—a considerable overcharge.

If 1.04 pence be correct, the total charge would be £2,750, which is equivalent to 25.6 pence per ton of refuse burned; on this basis the scavenging department should allow Mr. Russell two shillings and fourpence halfpenny per ton instead of two shillings. Assuming also that the baths should pay £700 per annum instead of £258, and adding £201 for the disposal of trade refuse, the revenue without credit from the scavenging department would be £3,705, or 34.6 pence per ton of refuse burned; should the library heating and deep-well pump credits be inadequate, this figure should be increased.

Stepney—Stepney does not present the same difficulties as Shoreditch, as the whole of the steam available outside the destructor is supplied to the electricity works. The destructor at Stepney is independent of the electricity works and is under the management of the surveyor, Mr. Jameson. The buildings are on the same site, and the steam main between them is about 200 feet in length. The destructor furnaces are of the same type and general arrangement as at Shoreditch—twelve Manlove Alliott cells and six Babcock boilers. The blast is from steam-

Digitized by Google

driven fans and there are no economizers, the boiler feed is therefore cold; besides the fan engines and a steam-driven clinker hoist there is no other machinery at the destructor. The generators at the electricity works are direct current, with high-speed, vertical engines, non-condensing; the exhaust steam is partially utilized by feed heaters, and separate steam mains are provided for the destructor steam; generally one generating set is run throughout the day (twenty-four hours)

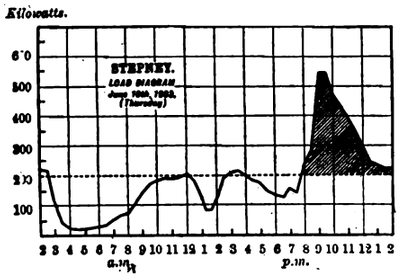


FIG. 5.—STEPNEY LOAD DIAGRAM, JUNE 18, 1903.

on destructor steam alone. A small battery only is in use.

The whole of the steam available from the refuse is not utilized at present, owing to the system of running on one generator. During hours of light load this takes the whole output of the works, and as the load varies the steam generation is varied to suit; when the load is light the surplus heat from the cells is by-passed to the chimney. It will be seen that in course of time this waste should cease, as the generator will always be running at full load; even then some waste may occur, as often the available heat at the destructor is considerably in excess of the capacity of the one generator.

On January 12 and 13, 1904, Mr. Jameson took a set of readings at the destructor and set them out in the form of a curve (Fig. 3), which I am privileged to reproduce. The upper line gives water evaporation per hour, the middle line kilowatts, and the lower steam pressure. Seeing that for several hours during the day the heat from the furnaces had to be by-passed to prevent blowing off, the regularity of the steam pressure is very creditable, the extreme variations being from 185 pounds to 200 pounds. The variations in the supply of feed water are very considerable, and would appear to confirm my opinion that with larger load and a more elastic method of utilizing the steam higher results would be obtained electrically. The results, however, are fairly satisfactory in view of the manner of working and bearing in mind that economizers are not used, that the feed is cold, and that the engines are run non-condensing. The output for the twenty-four hours gives 40.2 units generated per ton, the water evaporated 1.05 pounds per pound at a feed temperature of about fifty degrees Fahrenheit, and a water consumption of 58.7 pounds of water per unit generated. This figure of water consumption includes boiler feed-pumps, fan engines, clinker hoist, and also condensation in the 200 feet of steam main. The water consumption in the electricity works averaged about forty-three pounds per unit generated, including steam to boiler feed-pumps, in the same week—the various losses therefore represent twenty-seven per cent of the total steam generated; assuming that the fan-blast could be run on ten per cent and the clinker hoist five per cent, the remaining twelve per cent represents condensation losses. Mr. Tapper states that the steam is often very wet. The water evaporated by the destructor during the year gave an average figure of 72.5 pounds per unit generated.

To illustrate the relation between the refuse value and electricity works load I have prepared a diagram for January 12 (Fig. 4); the uniform value of the refuse throughout the day is noticeable, and it will be seen that only during the small hours of the morning and the dinner hour can the refuse steam be counted upon to carry the station output. It would appear from this diagram that the ultimate value of the refuse had been realized, but with a different system of running I think we may fairly conclude from Mr. Jameson's figures that a better result may be anticipated; in summer also there are several big gaps in the load, as the curve for June 18 (Fig. 5) will indicate. The solid line is the station output, and the dotted line the approximate value of the refuse under the present arrangements. The quantity of refuse destroyed and also its quality in summer and winter are unusually uniform, and Mr. Jameson considers that its average value all the year round may be taken at 1.2 pounds per pound from and at 212 degrees Fahrenheit. The load curve for the year (Fig. 6) is remarkably like the day curve for its uniformity; the small difference between the summer and the winter values is readily accounted for by the gaps in the summer load referred to. It would appear that the present value of 28.5 units per ton would readily rise to forty, the ultimate value estimated by the engineers, and if improved methods are adopted this might easily reach fifty.

It is a convenience to the electricity works when the whole load of the station is being carried by the destructor to be able to rely upon the supply of steam, and when variations in the load or quality of the refuse results in a shortage of steam, coal is burned in the destructor boilers; in the year under review 290 tons were so burned, and probably with better economy than if steam had been kept up in coal-fired boilers. The destructor costs come out second best in the London combined stations, and it is of interest to observe that the costs at the old destructor on the same site came to about three shillings and sixpence, or about one shilling per ton more. The present credit by the electricity works to the destructor is 0.5 penny per unit generated. During the year 1902-3 the charge was first 0.3 penny, and then 0.5 penny, the average working out at 0.403 penny; seeing that the cost of coal per unit generated during the same period was 0.8 penny, the credit was hardly adequate, as the committee has recognized by fixing the price at 0.5 penny. The capital charges on the destructor installation, including boilers, pumps, steam pipes, etc., amount roughly to 0.2 penny per unit, so the benefit of the destructor steam is divided

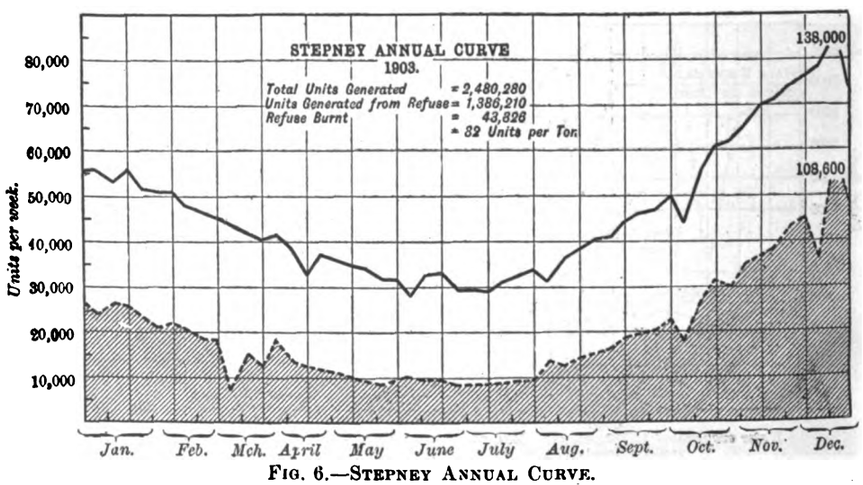


FIG. 6.—STEPNEY ANNUAL CURVE.

Digitized by Google

equally between the destructor and the electricity works.

As the two works are, to all intents and purposes, independent undertakings, there are no savings in capital cost; on the contrary, assuming that one boiler would have been required in any case for the destructor and two of the remaining five have been saved to the electricity works, three extra boilers have been put down; there is also some extra cost in the steam mains between the works and in the pumps and water-softening apparatus. The old destructor chimney stack, though a source of saving at the first, is not so now, as a second stack has been built for the electricity works.

Fulham—These works were started in December, 1900, and the first supply of steam from the destructor boilers was given in February, 1901. The electricity works plant is two-phase alternating, the engines are horizontal by Musgraves, and, so far as possible, are run condensing. In addition to three 300-kilowatt generators there are three 100-kilowatt direct-current exciters, used largely for lighting the works and driving motors on the works. There are five twenty-horse-power, electrically driven, centrifugal pumps, one deep-well, twenty-horse-power electric pump, four ten-horse-power motors for driving mechanical stokers and coal conveyer, two five-horse-power motors for driving economizer scrapers, and there has recently been added a thirty-horse-power Bellis engine operating a fan at the base of the chimney stack for assisting the draught; this runs continuously, sometimes non-condensing. The destructor consists of twelve Horsfall cells in two groups of six, arranged back to back in threes. Between the two groups there are six Babcock boilers. Mechanical stokers are provided, and much care has been taken to render the fronts of the boilers air-tight when under steam from destructor gases. The main flue is of considerable length. Blast is provided to the destructor cells by steam jets of the usual Horsfall type, and on test the steam consumption was 17.8 per cent of the total steam generated. Economizers are provided in the main flue. At the outset the six destructor boilers were the only boilers installed; three marine-type dry-back have been added. In addition to the electric generators, a supply of steam is given to a steam disinfector some forty yards away, also to a clinker-crushing and brick-making plant. The clinker crusher is driven by an eight-brake-horse-power, simple, vertical engine. This engine is run fifty-four hours per week, and is supplied through eighty feet of one and one-quarter-inch steam pipe not lagged; it probably does not take less than fifty pounds of steam per brake-horse-power-hour. The brick-making plant takes an unknown quantity of steam; the disinfector is generally in use some hours every day, and, although not liberal, £150 per annum is a fair charge for steam supplied. The Bellis fan engine is supplied through 100 feet of branch piping, and probably takes thirty pounds of steam per brake-horse-power on the average; this plant was started in October, and has been running continuously since November, 1903.

I have gone into some detail with regard to the plant installed, as this has an important bearing upon the results. The steam-raising test when the plant was newly installed gave 1.15 pounds of steam per pound of refuse. The load was absorbed electrically, and an average of sixty units per ton was obtained throughout a day's run.

The water consumption is not often measured, a large part being taken from a deep well in the works, but a test was taken in October, 1903—when the destructor was not running—from 2 P. M. on Saturday to 9 A. M. on Monday, and the average water consumption was fifty-nine pounds per unit generated. The steam disinfector, the brick-making plant and the clinker-crushing engine were shut down during this test, but the Bellis fan engine was in use.

In the case of Fulham my investigations began with a curve for the year 1902-3 (Fig. 7). The average units per ton given me by Mr. Fuller over the year ending March, 1903, amounting to 25.5, aroused my curiosity as to the relative figures obtained in summer and winter. I judged from the arrangement of the plant and the smallness of the day load in summer that probably 25.5 units would be largely exceeded, and when the curve was set out and the carefully estimated coal value filled in, my suspicions were amply confirmed. I have taken great pains to obtain correct coal values, and although the average works out at nine pounds per unit generated, I am satisfied that this is correct. In the earlier part of the year—from June to September—I have ample evidence to show that twelve pounds of coal were used per unit generated. From September to November the condensing plant was out of use, and the coal consumption has been taken at ten pounds per unit; from November onwards eight pounds is the ascertained figure; and, in view of the water-consumption test in October, 1903, I have taken this value in all the later day-load curves. I wish to draw special attention, while this annual curve is before you, to the increasing value obtained as the output grew. It is also important to observe that the whole of the coal consumed on the works has been plotted, and that steam supplied to the clinker, brick plant and disinfector is not accounted for in the diagram. The Bellis fan engine had not been installed at that period. The large dip in December is caused by the Christmas holidays; the big rise between January 15 and 22 is due to the switching on of 100 extra arcs for the street lighting. This increased public lighting load has doubtless some bearing on the fine results now obtained. In view of the undoubtedly very heavy water consumption when the destructor is working, fifty-three units per ton throughout the week is a very fine record figure.

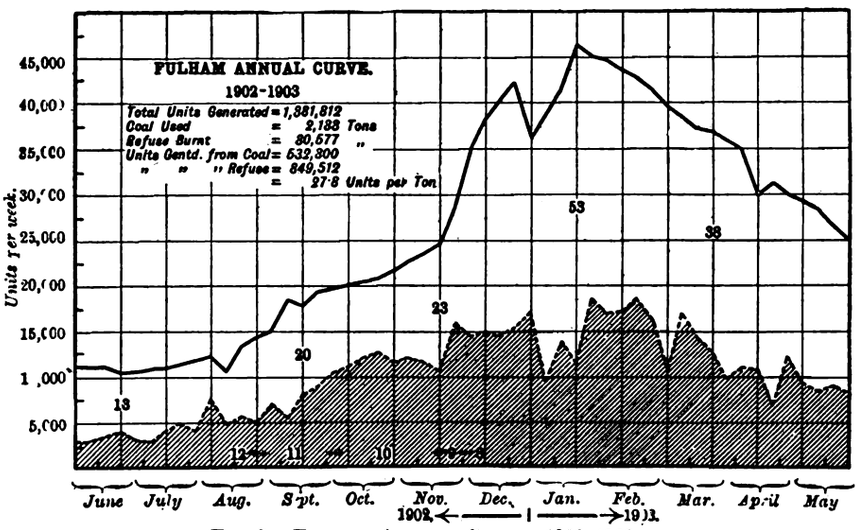


FIG. 7.—FULHAM ANNUAL CURVE, 1902-1903.

(To be concluded.)

Digitized by Google

Electrical Notes from Europe.

By Our Special Correspondent.

THE annual Paris automobile show, which was held in the latter part of December, has been even a greater success than last year's exhibition. It was held as usual in the vast Palace of the Champs-Elyseés. The number of exhibits was larger than that of last year and all agree that it is the finest display of automobiles which has been as yet seen in Europe. Progress is to be noted along the well-known lines of construction, and there are also a number of novel features to be observed in the way of transmission mechanism from the motor to the rear wheels of the car. The great majority of the automobiles are of the gasoline motor type. Some stationary engines were noted, however, which use heavy petroleum. Steam is employed in two leading systems, the Serpollet and the Chaboche among the light cars and also on the Scotte tractors. The electric systems show a great variety this year and it is evident that the inventors are seeking for new methods. The combined petrol-electric system, in which the gasoline motor drives a dynamo, and the latter charges a battery of accumulators on the car, seems to have gone out of favor this year, and in place of this we have a number of systems of electric transmission from the petrol motor to the rear axle. Some of the electrical firms which entered the field by constructing petrol-electric cars have now gone into the manufacture of petrol cars of the ordinary type. This is the case with the well-known Compagnie L'Industrie Electrique, of Geneva. It is also to be noted that several of the large electrical firms are now commencing to build gasoline cars. The Westinghouse company has an exhibition of the new Westinghouse-Schmid automobiles this year and the Allgemeine company, of Berlin, has a display of the new cars which are now being built by a branch firm, the Neve-Automobil Company. Among the electric automobiles several were noticed in which the system of electric transmission is used. The petrol motor, instead of being connected with the rear wheels by a mechanical transmission device for changing the speed, now uses a dynamo and an electric motor to accomplish the same result. The dynamo is mounted on the shaft of the petrol motor and generally runs at constant speed. The field and armature circuits are run into a controller and from there a circuit passes to a motor placed in the rear of the car. The current which the dynamo delivers is varied by the controller, and the motor on the rear wheels can be run at any desired speed. This gives an easy control of the car. The Krieger company has now abandoned the use of accumulators and brought out a new car which was one of the attractions of the show. It works on the above general principle, but has two small motors in the rear, one against each wheel, and the latter are thus independent. The Cardinet system uses a single motor for operating both rear wheels.

Another type of car which deserves mention is known as "La Magnetic." It uses a mechanical transmission from the petrol motor to the rear wheels, but the mechanical device is operated by means of a series of electromagnetic friction clutches. The speed of the rear shaft is changed by throwing different sets of gears in and out of play by a magnetic clutch mounted on each gear, which allows it to run loose on the shaft or to be coupled rigidly to it. This gives a great ease of movement in the manœuvre of the car. Different companies have tried to adapt the magnetic clutch to automobile mechanism, but this is the first time that the attempt has met with success.

It will soon be necessary to reorganize the system of operating the traction lines in the city of Paris and the suburbs, and the minister of public works recently appointed a special commission to find out what will be the best method for carrying this out. The main causes of the change lie in the fact that the concession of the Compagnie Générale des Omnibus will soon expire and that the opening of the Metropolitan subway has also changed the conditions of traffic considerably. The commission appointed by the minister held its first meeting not long ago and proposed two different solutions for the problem. In the first, all the city omnibus and tramway lines would be turned over to the city of Paris, which would then give a certain number of concessions for operating the lines. The suburban lines would be transferred in like manner to the department of the Seine. In the second case, the city and department would be divided into a certain number of sectors by imaginary lines passing from the centre to the circumference. The traction lines of each sector would be operated separately under a series of concessions granted by the city, while the department of the Seine would give concessions for the suburban lines in the same way. Before taking any definite measures, however, the minister decided to appoint a commission of experts to visit the different cities of Europe and find out what methods are employed.

Three-phase motors are now used in a number of cotton factories in Spain belonging to the Marquis de Larios. It was decided not long ago to run the factories by electric power in place of steam and at present two of the mills have been equipped with electric motors. The current is taken from a plant belonging to the Chorro Distribution Company, which is now operating a large hydraulic station in the gorges of the Chorro at forty miles from the city of Malaga. Current is sent to the city over a 25,000-volt overhead line and the voltage is lowered by substations in the city to 2,500 volts. The two cotton factories which now use the current are located at 2,600 feet from the primary substation. It is expected to equip the whole number of factories with electric motors, representing a total of 5,000 employés, and an annual economy of power of twenty per cent will thus be obtained. Each of the two factories in question has a special substation, and the current is finally lowered to 400 volts for supplying the three-phase motors. These range from three to 150 horse-power, and there are about seventy-five running at present, representing a total of 2,500 horse-power.

Among the recent hydraulic plants in the mountain region of France may be mentioned the Bournillon station which is located on the Bourne, a rapid mountain stream near Grenoble. The stream is fed by a number of springs and a head of 102 metres has been obtained, with a mean flow of 2,500 litres per second or a total of 2,500 horse-power. A canal 1,800 metres long and a penstock 1.20 metres in diameter bring the water to the turbine plant. The latter has been built to receive six turbine-dynamo sets. Three of these have now been placed in the station and the remainder will be installed after the

Digitized by Google

next increase is made in the plant, as it is proposed to utilize another 300-metre fall. The turbine has been furnished by A. & H. Bouvier, of Grenoble, who carried out all the hydraulic work. The dynamos are built by the Schneider company. A current of 3,800 volts is generated by the machines and this is sent to step-up transformers and raised to 3,500 volts. A long-distance overhead line carries the current through the surrounding region, where it is used in different industries.

The new light and power station which is building at St. Denis, in the suburbs of Paris, will be one of the largest in Europe. The electric outfit is supplied by Brown, Boveri & Company. The station is laid out on the three-phase system. It will contain four steam turbine and alternator sets, using the Brown-Boveri turbine which is now proving so successful in different European plants. These groups are to furnish 5,000 kilowatts each. The speed is 750 revolutions per minute and the voltage 5,000 at twenty-five cycles. Smaller turbine sets will be used for the exciting current. Each of the latter will supply 300 kilowatts at 200 volts, running at 2,700 revolutions per minute. The station will also have two motor-generators of 375 kilowatts each, which will furnish part of the exciting current. A large battery of Tudor cells having 1,300-ampere-hours capacity will be used as a reserve for the exciting current and also for starting up the motors which operate the boiler feed-pumps.

Each of the steam turbines is provided with a steam-operated oil-pump which distributes oil under pressure to all the working parts. The turbines are built to operate at a pressure of twelve atmospheres at the inlet. Superheated steam will be used, at a maximum temperature of 360 degrees centigrade. Under these conditions the turbines show a consumption on test of 6.8 kilogrammes of steam per kilowatt-hour. At present the station building is 200 by 70 feet, but it is laid out so that its length can be increased to 300 feet and over, as it is expected to install a number of 10,000-horse-power units in the future.

A new system of road locomotives has been brought out by the Siemens-Schuckert company. It is now in use very successfully on a line running through the valley of the Veischeide as far as Belstein. Current is taken from a double overhead line by a pole and a form of sliding trolley which is adapted to the purpose. The locomotives are equipped with two Siemens-Schuckert motors of twenty-five kilowatts each, and weigh 6.5 tons. They can carry a load of two tons. The locomotive draws a train of three trailers, each of which can carry a net load of 5.5 tons. The present system is controlled by the Schiemann company, which is specially engaged in operating this form of train. One feature to be noticed is that all the cars are connected to the locomotive or with each other by a coupling device somewhat resembling that which is used on the Renard auto-train in Paris. Part of the motive power is transmitted through the coupling to the wheels of each car so that it becomes self-propelled to a certain extent. This gives it the advantage of passing around curves in the same path with the locomotive, and it does not obstruct the track. On the other hand, the dead weight of the locomotive can be made smaller.

Single-phase current is now used upon a railroad line in Germany. It is said to be the first example of the use of single-phase motors for traction in Europe. The line runs from Mederschonweide to Spindlerfeld. The equipment which has been supplied by the Union Gesellschaft consists of a locomotive-car and a train made up of passenger cars. It makes an average speed of twenty-five miles an hour and consumes thirty watt-hours per ton-kilometre. At present there is but one train running upon the road along with the ordinary trains, but if successful, there is no doubt that other trains will be used. The train makes a daily run of 150 to 500 kilometres. Up to the present it has already covered a distance of 30,000 kilometres. In this connection it may be remarked that it is proposed to use single-phase motors on a part of the local railroad in the north of France between Nivelles and Braine l'Alleud. The length of the road to be operated on the single-phase system is about fourteen miles. The Société Nationàle, which now has control of the lines, wished at first to apply the three-phase system and opened a concourse for different projects. But none of these proved satisfactory and a second series was opened for single-phase systems. The latter are now under consideration.

A somewhat novel form of mercury vapor lamp has been brought out by a Berlin firm. It uses two carbons which form an arc and mercury vapor is supplied to the arc from the lower part of the lamp. To carry this out the two carbons are placed in the top and bottom of a glass tube and are separated in the centre to form the arc. The tube is here enlarged in the form of a globe. In the annular portion around the lower carbon is placed the mercury which is vaporized by the heat and fills the tube. A solenoid at the upper part controls the top carbon, while the lower carbon is fixed. The length of the arc varies in different sizes of the lamp and ranges from thirty to one hundred and fifty millimetres. One advantage of the new lamp is that it starts up quickly. It is said to give a very good quality of light which contains red rays. It consumes but a small amount of energy, or 0.5 watt per candle-power.

An extensive system of tramways in the neighborhood of Leeds is now operated by the Wakefield & District Light Railways Company, which obtained the concession for a number of lines. These have a total length of thirty miles at present, but it is expected to increase the length to seventy-five miles before long. These lines connect the Leeds traction system with the lines at Wakefield and run through Ossett, Oulton and other localities. An arrangement has been made so that the cars can run directly to the centre of Leeds. Current is supplied by a large generating station which has been recently erected at Wakefield. It is equipped with Dick-Kerr machines of 400 kilowatts, run from Howden engines. Distribution is carried out at 6,300 volts and there are two substations which supply 200 volts for the traction lines. The substations are connected with the main station by underground cable. The car trucks are equipped with Dick-Kerr motors. It is expected that there will soon be fifty cars or more running on the lines. It will be noted that the system is controlled by a private company, while the Leeds and the Wakefield systems are each operated by the municipality.

The lighting of the new Munich Theatre has been carried out on the most modern plan. The three-phase current which is received at 5,000 volts is reduced to 250 volts direct current by two rotary sets which work in connection with a large battery of accumulators. The wiring of the theatre is carried out on the three-wire system, using 220 volts between outside wires. A very complete arrangement of light is used for the stage effects and all the circuits are controlled from a large keyboard. The hall is lighted by fourteen arcs which are hung from the ceiling, and by incandescent lamps. There are 3,438 of the latter and forty-two arcs in the whole of the theatre. The scenes are shifted by two five-horse-power motors which are placed on either side of the stage.

C. L. DURAND.

Paris, January 7.

Digitized by Google

BOOK REVIEWS.

"Maxwell's Theory and Wireless Telegraphy." Part I—Maxwell's Theory and Hertzian Oscillations, by H. Poincaré, translated by Frederick K. Vreeland. Part II—The Principles of Wireless Telegraphy, by Frederick K. Vreeland. New York. McGraw Publishing Company. Cloth. 255 pages. 6 by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

In a just review of this book, parts i and ii should be considered separately. Each part is complete without the other, and the book as a whole belongs among the important works on this subject. In regard to H. Poincaré's work (part i), it should be stated at the outset that it well exemplifies the traditional clearness of French scientific writers. Maxwell's great generalizations, the very "Principia" of modern electrical science, and Hertz's classical experimental verifications are treated with a simplicity and brilliancy of style that is well preserved in Mr. Vreeland's translation. It may be said that part i successfully declares the great electrical truths of Maxwell's theory in the language of every-day life and that one who reads it with intelligent attention will be prepared to understand the presentation, in part ii, of that wonderful application of the experiments of Hertz which we call "wireless telegraphy." As stated in the preface, no attempt is made in part ii to settle questions of priority of invention, nor to describe the myriad forms of apparatus, but the six chapters proceed to inform the reader, in concise terms, upon the broad underlying principles of the art of wireless telegraphy. The division of the subject into lessons having a natural sequence and the treatment of specific cases (theories, circuits and apparatus) so as to emphasize what is essential, are well calculated to equip the reader to understand other more detailed publications of systems and improvements. The explanations are greatly aided by happy use of fragment diagrams prepared so as to afford instructive comparisons between representative systems as the work proceeds. The value of the work as a means of preparing the reader for a careful study of existing systems is especially shown in the chapter on "Selective Signaling" at the end of the book. The tuning problem itself is clearly stated in modern terms, and the various attempts at its solution are traced in logical order. Perhaps a too rigorous brevity of statement obtains where the claims of rival systems are set forth; and the book is somewhat at fault in assigning credit for work in selective signaling, the important basic patents of Stone being omitted from mention. The advances due to the use of closed oscillating circuits with condensers of large capacity compared to the antennæ, and the probable development and limitations of selective systems, are set forth with the aid of well chosen mechanical analogies and illustrations. A good index adds greatly to the usefulness of the work.

"Electric Furnaces and Their Industrial Applications." J. Wright. New York. Norman W. Henley Publishing Company. Cloth. 288 pages. 6 by 8½ inches. 57 illustrations. Supplied by the ELECTRICAL REVIEW at $3.

This work shows evidence of being very hastily thrown together by collecting much that is good and considerable that is not from scientific and technical periodicals and from patent specifications. The introductory historical chapter was evidently an irksome task, as no attempt is made to credit those early workers who, despite the handicap of primary batteries, laid much of the foundation of discovery on which the present art rests. Even the discoveries of calcium carbide and carborundum and the names of Wilson, Acheson, Heroult and a host of others are not mentioned till later in special chapters, and the reader is left, after the first chapter, with an idea that Siemens suggested the electric furnace and Moissan discovered all the modern products, including the two carbides above mentioned. The author touches the high temperatures attainable and their measurement in an entirely inadequate manner, giving no idea of the difficulties of even the roughest approximations. Temperatures of 2,000 degrees to 3,500 degrees centigrade, based on guesses, are given with the weight of demonstrated fact. The translation from centigrade into Fahrenheit is particularly amusing, the book abounding with such figures as 3,632 degrees Fahrenheit, 2,757 degrees centigrade, etc. The author's classification follows the usual lines. His general remarks repeat the story of the inefficiency of steam as a prime mover, and the marvelous cheapness of water power which only costs " the interest on capital outlay for plant and maintenance." The same might be said for a tide motor or a windmill. The availability of water power in electric furnace industries might well have received much more thorough treatment. Throughout the work the author compresses descriptions of real operative processes into too narrow a space, while he makes room for much matter which has never passed the bounds of patent specification. He is seemingly impressionable for ingenuity of design, without being willing to exercise a critical judgment as to its practical value. The chapter on arc furnaces occupies six pages, and shows four sketches taken from patents, with the usual description of the parts A, B and C, the tap hole E, and the flue F. Not a single arc furnace, from the many successful ones used in various industries, is shown or described in this chapter. The chapter on resistance furnaces and processes occupies nearly thirty pages with five illustrations, and is in some respects the best in the book. It takes up a little of the early historical work, and, in general, gives due credit to pioneers. Calcium carbide occupies about fifty pages, and here again the illustrations fail to show modern practice. Neither the Bradley, Bullier, Heroult nor Rathenau furnaces are illustrated, and only a poorly chosen illustration of the Horry furnace is given. When an industry has assumed the proportions of that of carbide manufacture the reader may rightly expect to receive some idea of how a real furnace looks, its size, arrangement and auxiliary devices, rather than a sectional sketch illustrating the inventive kernel, not the industrial fruit. The section on iron and steel production, including references to other processes, is very well handled, and gives the reader a good idea of the place of electric furnace methods in metallurgy, where quality of product is the chief consideration. The manufacture of phosphorus might well have been included in the foregoing chapter where the analogous arsenic process is described. Glass-making, which has progressed little, if any, beyond the experimental stage, scarcely deserves a separate chapter. The section on electrolytic furnaces is an extremely condensed reference to processes involving the electrolysis of fused salts. In view of their great commercial importance these processes should have received more extended treatment. A short section devoted to miscellaneous processes, including the production of cyanides, silicides, artificial emery, etc., closes the chapters devoted to practice real and proposed. The remaining chapters relate to laboratory research furnaces, including the wire-wound types, to a few details of operating technique, theoretical considerations and measurement. The subjects are merely touched upon, and in some cases could have been placed in the early part of the work with advantage. The book would gain greatly by the introduction of systematic references to original articles and patents, and by more illustrations.

Digitized by Google

Engineering and Commerce.

Mr. James Swinburne not long since delivered a striking address before the students of the Institution of Electrical Engineers, of Great Britain, an abstract of which was published in the ELECTRICAL REVIEW for December 10, page 975. The following interesting comment on the address appeared in the *Electrician* (London), December 30:

I was engaged in the supervising and directing of a test on an 8,000-horse-power synchronous motor during the small hours of the day, and having a few minutes to spare I took up the *Electrician* of November 18, in which you reprint Mr. James Swinburne's address to the students of the Institution of Electrical Engineers, entitled "Some Difficulties in Getting On." The early hour of the day, the strenuous work which had yet to be accomplished by my assistants and myself after we had been working for almost twenty-four hours continually, all this "unpaid-for" devotion did not harmonize with Mr. Swinburne's advice to the students—to take "a money view of everything." The address began to interest me, and I read it carefully, taking pains to keep it from my assistants for fear that they might take a "money view of the situation" and refuse to stay working in their clothes for another twelve hours needed to finish the tests on this largest of electric motors in the world.

Mr. Swinburne's address is entitled "Some Difficulties in Getting On." If this address were delivered to a heterogeneous class of students, not only of engineering, but of law, and of medicine, and of all other branches of human knowledge that can be studied at our colleges, the address might have been very much to the point. It is undoubtedly true that if you want to get on in the world you had better not study engineering or any other scientific pursuit. If Mr. Swinburne objects to the use of the word "scientific," let me say that knowledge is by no means desirable for getting on, and that I hold strongly that the adage attributed to Bacon, that "knowledge is power," requires emphatic qualification.

"Knowledge is power" in the hands of him who can wield it and put it to any use he pleases, but in the hands of most people knowledge is not power, because it controls them, and it is their master while it should be their servant.

When Mr. Swinburne states that "the business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant," Mr. Swinburne is stating merely a matter of fact for which he is in no way responsible. This is a law of the social cosmos against which no amount of railing will avail. This is not due so much to the fact that young men's education now-a-days consists more or less in the study of "Aztec Metempiries," it is due to the fact that both the average student and the average teacher are very average men. Education is given to the boy of very average intelligence by a teacher of very average intelligence, and hence the quality of the knowledge and of the teaching is very average, too. So that, even if knowledge were power, that knowledge which is taught need not be power at all.

Why is it, then, that the engineer is employed by the business man and not *vice versa*? The reason is obvious to any one, although he will be better able to appreciate it if he has read and digested Mill's "Political Economy." It is a fact that capital is the mother of all labor, and that the engineer who wishes to market his ability needs capital, and plenty of it, to turn his ability to account. Shops in which machinery of any kind can be built are expensive, and weekly pay-rolls want to be met, and for all these things the engineer goes to the capitalist, and on account of these things he is the capitalist's servant and the capitalist is his master. This again, is a fact derived from the laws of nature for which the engineer is in no way responsible. "To him who hath shall be given," and as the capitalist can wait for years without starving, the engineer, whose only capital is his brains, wants to live, and therefore has to make a bargain with the capitalist to accept his services. This law of nature which has made capital the mother of all labor, has placed the engineer where he is to-day. The business man without capital is in no better position than the engineer; on the contrary, his position is less enviable, as good business ability is not so rare as good engineering ability, which statement is proved by the fact which Mr. Swinburne can obtain by a study of the social conditions in the United States, that the business man without capital is paid less than the engineer without capital.

When Mr. Swinburne says that "a man's earnings is a rough test of his value to the world," I fear that Mr. Swinburne is making a statement which he learned in the study of "Aztec Metempiries." Money-making is an art just as engineering or medicine is an art. The aim of a great engineer consists in engineering achievement of a high order. The aim of a great surgeon consists in surgical work of a high order. The aim of the money-maker consists in making money of a high order. The standard of measure of greatness in the three professions is different, and hence it is illogical to apply the standard of money-making to these three professions, as money-making is only an incentive to the first two professions, and the aim of the third profession.

When Mr. Swinburne says, "Our leading consulting engineers do not spend a large portion of their lives plotting curves, counting electrons, or even making anything more than arithmetical calculations," I only have to say that—paraphrasing Mr. Swinburne's remark that "electric installation work is merely a sort of electric plumbing"—consulting engineering is mostly jobbing of electric apparatus. The commercial engineer is likely to be neither a first-class engineer nor a first-class money-maker. He is average all the way through, average in intellect, average in engineering, average in money-making. The money-maker of ability will consider him a tyro in money-making; the engineer of ability will consider him a tyro in engineering.

Again quoting Mr. Swinburne, he says, "the engineer will remain in the middle position as long as he takes the middle view and considers engineering as something superior to money considerations, and as long as he looks down on business and commercial methods." Mr. Swinburne here forgets that as soon as the engineer emerges from the position thus outlined for him, he becomes a business man with an engineer's education. But who is going to do the engineering for him after he has entered into the commercial side of engineering? Somebody has to do the engineering work, and to him Mr. Swinburne's criticism will always apply. I have no patience with that cant which we fortunately do not hear so much of now-a-days as we did some fifteen years ago, disparaging the commercial side of engineering work. It is necessary just as much as the purely engineering work is, and to whichsoever a man is best fitted, he should devote himself. But it is due to just such addresses as Mr. Swinburne's that engineering work of enormous commercial value is not duly appreciated by the business man with whom rests the fixing of the compensation for such work. Even engineering work of a very high order is generally underpaid. I do not mean by engineering work of a very high order merely, for instance, designing ability; I mean by it exceptional ability in designing apparatus which is

Digitized by Google

commercial, and executive ability to direct the large number of assistants who are always needed in large manufacturing concerns.

The men who get on in the world are never of the common run. It seems to me that the hardships of the successful men who are engaged in professions requiring study and knowledge like engineering, law and medicine, are greater than the struggles of the business man, for the simple reason that the tools of the successful business man consist in capital, which is easily convertible into the commodities of life.

The work of the engineer is very much like that of the soldier. The soldiers in the army are numerous, the officers are few, the generals still fewer. Money is not the aim of the soldier, of the officer, of the general. The officer who fell in the relief of Lucknow would have made more money if he had stayed in Cheapside running a grocery.

There is much good in Mr. Swinburne's address, but much that is apt to misdirect the young man's mind. In positions requiring engineering ability, we need engineers and not commercial men, and if a man feels in him the faculty for making money, let him turn his ability into the channels of money-making, and not into the channels of engineering. He will be more successful in money-making than he will in engineering.

B. A. BEHREND,
Chief Engineer the Bullock Electric Manufacturing Company.
Cincinnati, Ohio, December 12.

Automobile Shows in New York City.

The fifth annual automobile show, given under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, made a most successful opening on the evening of January 14. The exhibition space in every quarter of the mammoth amphitheatre and in the auxiliary exhibition halls at Madison Square Garden was crowded to its greatest limit.

More than ever this year has use been made of the incandescent lamp for advertising sign purposes. Myriads of incandescent lamps, used for decorative designs of various forms, help out the general scheme of illumination, and render even the remotest recesses of the garden as bright as daylight. The New York Edison Company is a notable user of incandescent lamps for advertising sign display. A mammoth hoarding, fully fifty feet wide and twelve feet high, announces that the company will supply current in any quantity, either for business or pleasure.

Chief among the exhibitors of electric vehicles is the Vehicle Equipment Company, for which the Ranier Company, New York city, is general sales agent. In the exhibit of the Ranier Company there are shown a number of electric vehicles for heavy draught service. There is a five-ton truck built for F. A. Poth & Sons; a one and one-half ton and a five-ton truck for the Wisconsin Condensed Milk Company; a one-ton truck for the Metropolitan Disinfecting Company, and a five-ton windlass truck. This latter truck has a drawing capacity of five tons, and a windlass capacity of five tons. A truck built for Alexander Revell & Company has a capacity of two tons. There are also a one-ton and a five-ton truck, which have been built for Armour & Company, of Chicago. In addition to the heavy-service vehicles there is an electrical hansom, leather upholstered throughout and fitted with every modern appointment. There is also an electric victoria furnished in maroon. At one end of the Vehicle Equipment Company's exhibit booth is a General Electric 55-110-volt, thirty-ampere charging panel with rheostat. There are mounted upon this panel a Thomson voltmeter and ammeter and a starting and load-switch, a mercury vapor alternating-current rectifier, together with the alternating-current line-switch and the direct-current line-switch and pressure regulator.

The Electric Vehicle Company, Hartford, Ct., makes a fine showing of Columbia electric vehicles.

The Pope Motor Car Company, Indianapolis, Ind., exhibits a number of "Waverly" electrics, as follows: model No. 36, speed road-wagon; model No. 27, stanhope; model No. 26C, "Chelsea"; model No. 30, station wagon.

The Studebaker Automobile Company, South Bend, Ind., in addition to its excellent gasoline automobile exhibit, shows a number of new types of electric vehicles. Among these are included an electric victoria-phaeton, an electric runabout, electric stanhope, a 1,000-pound electric truck and a panel-side delivery wagon.

The Baker Motor Vehicle Company, Cleveland, Ohio, exhibits the Baker "Imperial," weighing 850 pounds, and the Baker stanhope, weighing 975 pounds.

The manufacturers of electrical automobile accessories were very freely represented. The Apple ignition apparatus, made by the Dayton Electrical Manufacturing Company, Dayton, Ohio, was shown in operation, the continuous spark given by this apparatus being commented upon and viewed with great interest by those in attendance on the exhibition.

The exhibit of the Edison Storage Battery Company, of Glen Ridge, N. J., attracted a great deal of attention.

There were prominently displayed at different booths about the main exhibition hall detailed parts of the assembly of the "Exide" battery, manufactured by the Electric Storage Battery Company, Philadelphia, Pa.

Among others exhibiting were the following: White Sewing Machine Company, Cleveland, Ohio; Northern Manufacturing Company, Detroit, Mich.; National Motor Vehicle Company, Indianapolis, Ind.; H. H. Franklin Manufacturing Company, Syracuse, N. Y.; C. F. Splitdorf, New York city; the Veeder Manufacturing Company, Hartford, Ct.; National Carbon Company, Cleveland, Ohio; American Coil Company, West Somerville, Mass.; Dow Portable Electric Company, Braintree, Mass.; the Standard Welding Company, Cleveland, Ohio; the Lunkenheimer Company, Cincinnati, Ohio; Electric Contract Company, New York city; the United Electrical Manufacturing Company, New York city; William Roche, New York city; Brown & Sharpe Manufacturing Company, Providence, R. I.; American Novelty and Manufacturing Company, New York city.

The Importers' Automobile Salon, which is being held in the Herald Square Exhibition Hall, Herald Square, New York city, from January 11 to January 24, is composed mainly of exhibits from foreign manufacturers.

The attendance at both the Madison Square Garden and the Herald Square shows has been far beyond the anticipations of either management, and the demand for horseless carriages has been greater than was expected by even the most enthusiastic.

Independent Telephone Association of Wisconsin.

The annual convention of the Independent Telephone Association of Wisconsin will be held at the Hotel Pfister, Milwaukee, Wis., January 25 and 26, 1905. From present indications the convention will be a most successful one.

Regular Meeting American Institute of Electrical Engineers.

The 193d meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh street, New York city, on Friday, January 27, at 8.15 P. M. The subject selected for this meeting is "Central Stations." The following papers will be presented and discussed:

1. "Acyclic (Homopolar) Dynamos," by J. E. Noeggerath, associate; electrical engineer, General Electric Company, Schenectady, N. Y.

2. "Modern Central Station Design as Exemplified by the New Turbo-Generator Station of the Edison Electric Illuminating Company of Boston," by I. E. Moulthrop, electrical engineer, Edison Illuminating Company, Boston, Mass.

Digitized by Google

A New System of Electrical Distribution for Electric Railways.

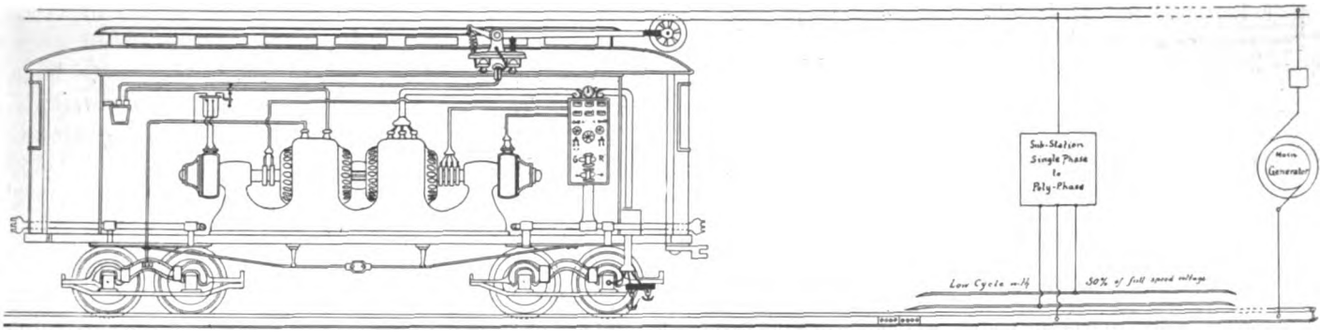
United States patent No. 779,475, for a system of electrical distribution for electric railways, was issued on January 10, 1905, to Mr. Josef Henrik Hallberg. Some of the essential features of this system were brought out last winter at a meeting of the American Institute of Electrical Engineers, when the alternating-current railway motor was the topic for discussion. The system consists primarily of high-voltage, single-phase transmission and low-voltage, polyphase utilization. The patent covers as well the means for converting the single-phase, high-voltage current to polyphase, low-voltage current, and applying the latter to the driving motors. This conversion may be carried out either on a locomotive or in a stationary substation.

Considering first the locomotive, as shown in the illustration, the equipment consists first of a single-phase motor drawing its power from the high-tension line. This motor is mechanically connected to and drives a polyphase generator. The traction motors are polyphase induction motors mounted directly upon the locomotive axles. There is in addition a small direct-current generator used as an exciter for the polyphase generator and for the driving motor, if the latter be a synchronous machine. This exciter may also be used as a starting motor, in which case a set of storage batteries must be included in the equipment; or, if preferred, the battery equipment may be omitted and a small single-phase starting motor used for bringing the main motor up to speed. Thus, under normal operation, the main motor draws power from the high-voltage, single-phase circuit, and this is used to drive the polyphase generator. The driving motors are controlled by varying the excitation of the polyphase generator. This, however, might not give the desired control of the speed of the locomotive, and means are therefore provided which enable the frequency of the polyphase currents to be changed without affecting the speed of the main driving motor. This is accomplished by a special method of winding of the polyphase generator, which enables the number of effective poles to be changed. Thus, assuming the main supply to be at fifty cycles, and the generator to be at full speed, by a commutating field-switch the number of effective generator poles is so varied as to give fifty cycles or twenty-five cycles or any other desirable frequency. In this way the speed of the polyphase traction motors may be changed without the use of inductive or rheostatic regulating apparatus. The latter devices may, however, be used if desirable.

As the system thus outlined contemplates a high-potential transmission system of possibly 20,000 volts, this would not be allowable for urban distribution. It is therefore contemplated to install in cities a converting substation equipped with a single-phase driving motor coupled to a polyphase generator, which will supply to the urban section of the railroad low-voltage, polyphase currents. When a car enters this section of the road the main driving motor and its generator are disconnected from the high-tension line and stopped, and the polyphase induction motors driving the axles are operated by means of the polyphase currents generated in the substation and supplied through suitable conductors. An inductive regulator is provided for controlling the movements of the car on this section of the road. It is contemplated, however, that as the speeds will be lower on the city than on the country section of the road, the frequency supplied to the city section will be lower than that used on the country section.

These, in brief, are the main features of this system. It will be seen that the method of application and control is such that the circuits of polyphase motors are not electrically connected with the high-tension distributing circuit; therefore the former can not affect undesirably the regulation of the generating station, due to the low power-factor at which the axle motors may be operating at times. Moreover, the system of regulation is applicable not only to one set of axle motors, but to a number. In other words, it is adapted to multiple unit control.

The inventor believes that one of the most important features of the system covered by this patent lies in the fact that a locomotive operating in this way requires no commutators on any of the main generators and driving motors. Only one high-voltage conductor along the railway is necessary. This system requires no commutators, brushes, resistances or heavy controlling switches for any main generating or driving machine.



DIAGRAMMATIC ARRANGEMENT OF ELECTRIC LOCOMOTIVE AND DISTRIBUTING SYSTEM.

Some of the broader claims which have been allowed for Mr. Hallberg's system are the following:

A system of electrical distribution for railways, comprising a source of alternating single-phase current, means for converting said current into a continuously symmetrical polyphase current, and polyphase motors actuated by such polyphase current, and adapted to give motion to the motor vehicles upon which they are located.

A system of electrical distribution for railways, comprising a source of alternating single-phase current, means for converting said current into a polyphase current of different frequency, and polyphase motors actuated by said polyphase current, and adapted to give motion to the motor vehicles upon which they are located.

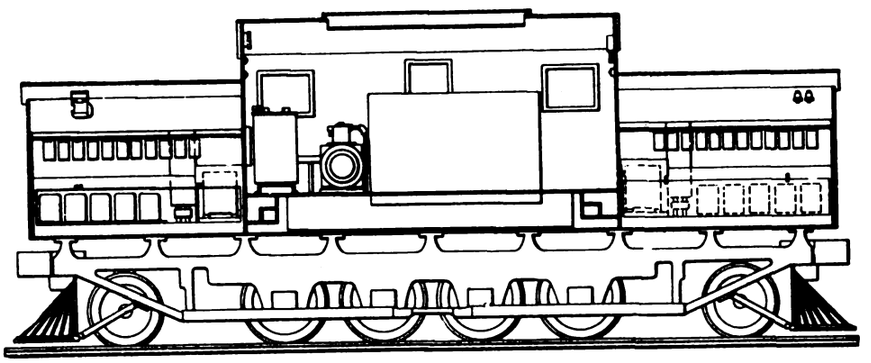
A system of electrical distribution for railways, comprising a source of alternating single-phase current, a trackway divided into sections, means for feeding one of these sections direct from the source of alternating single-phase current, and means for feeding the other section by a polyphase current of lower voltage, converted from a single-phase current.

A system of electrical distribution wherein the main source of energy is a single-phase generator, and wherein the sources of energy which effect the movement of the motor vehicles are polyphase generators actuated by, but electrically independent of, the single-phase generators.

Digitized by Google

Electrical Patents.

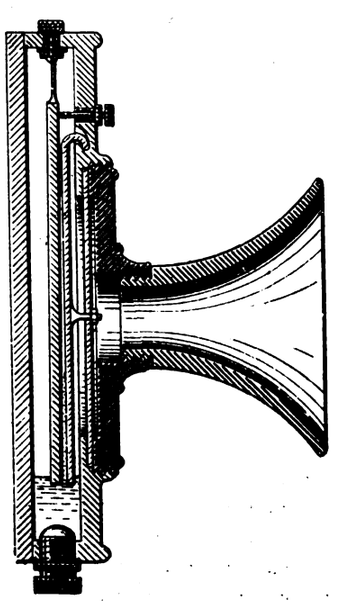
An electric locomotive is the subject matter of a patent (777,693, December 20) recently granted to Edward D. Priest, of Schenectady, N. Y., and assigned by him to the General Electric Company. The



ELECTRIC LOCOMOTIVE.

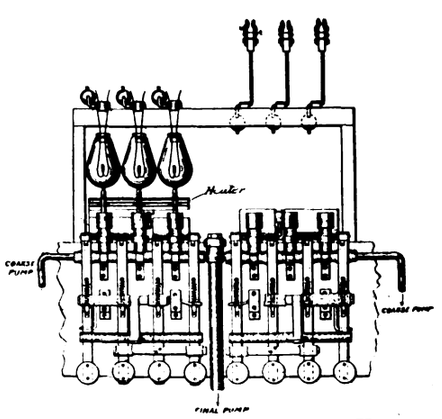
principal object of the present invention is to so organize the cab structure and arrange the controlling apparatus therein that the operator of the locomotive is centrally located while operating the train, has a clear view of the track ahead, and has ready access to all the controlling apparatus and other devices carried by the locomotive without leaving the cab. In this connection it is desirable that the cab be so arranged that when two or more locomotives are coupled together, the operator or operators may pass freely from one locomotive cab to another through covered passageways. A further object is to arrange the sand boxes of the sanding system so as to utilize some of the waste heat generated by current flowing through the rheostats or resistance grids to heat and keep dry the sand in these boxes. The invention consists of an electric locomotive cab which comprises a central compartment or cab proper in combination with covered end passageways leading to said central compartment and smaller compartments on each side of the end passageways for containing certain parts of the controlling apparatus, such as rheostats, contactors, etc. It also consists of the combination in an electrically propelled vehicle of a control system for the motors thereof which includes resistance sections, a compartment in which the resistance sections are located, and a sand box in this compartment so arranged as to be subjected to the heat from the resistance.

Elias E. Ries, New York, N. Y., has obtained a patent (No. 777,808, December 20, 1904) on a telephone transmitter. The invention relates to a new method of transmission of speech electrically, which consists substantially of the utilization of the principle of capillary attraction for controlling the resistance of an electric circuit, instead of using variable pressure, as in the ordinary type. The instrument consists essentially of a reservoir containing a liquid, and two plates which dip into the liquid at their lower edge. One of these plates is attached to the diaphragm situated behind the mouth-piece of the transmitter. The action of sound waves upon the diaphragm causes it to vibrate, and thus causes the two plates to approach and recede from each other, in this way varying the height to which the liquid rises beneath them. The electric circuit is formed between the two plates and the liquid, and the resistance to the current is increased and diminished in proportion to the amount of surface in contact with the liquid between the plates. A wider range of variation in strength of current than is possible in the usual form of microphone is obtained, and the damping of the sound wave by the inertia of the usual carbon or other microphone contacts, which oppose its free motion and demand the exertion of a greater or less pressure of the diaphragm upon them, is overcome. The instrument may be made in various forms. The preferred form has a horizontal reservoir with two bell-shaped plates of slightly different curvature placed horizontally in it. The plates are so shaped that the space between them gradually decreases toward the periphery, thereby producing a large increase in the wetted surface or fluid-covered area for a comparatively smaller movement of the plates toward one another, and thereby causing a great amplitude of variation in the resistance of the circuit when the excursions of the diaphragm are large.



TELEPHONE TRANSMITTER.

William R. Burrows, of Newark, N. J., has assigned to the General Electric Company, of New York, a patent (778,221, December 27, 1904) recently granted to him on an apparatus for producing high vacua. The invention relates to an improved apparatus for producing high vacua, and is designed to facilitate the operations connected with this procedure to enable a larger output of exhausted vessels per operator to be produced than has been possible heretofore. A plurality of groups of lamps are provided for the management of each operator, either of which may be connected with either of two pumps, a preliminary pump by which the exhaustion is roughly effected and a final pump for carrying the exhaustion to a more perfect state, and cocks are provided by which connection may be quickly made with either group. Means are also provided for expediting the chemical exhaustion. Excellent results are produced by providing the apparatus with means for carrying on the exhaustion simultaneously in two groups of lamps, pump connections being provided by which either group may be instantly connected with the preliminary or final exhaust pump.

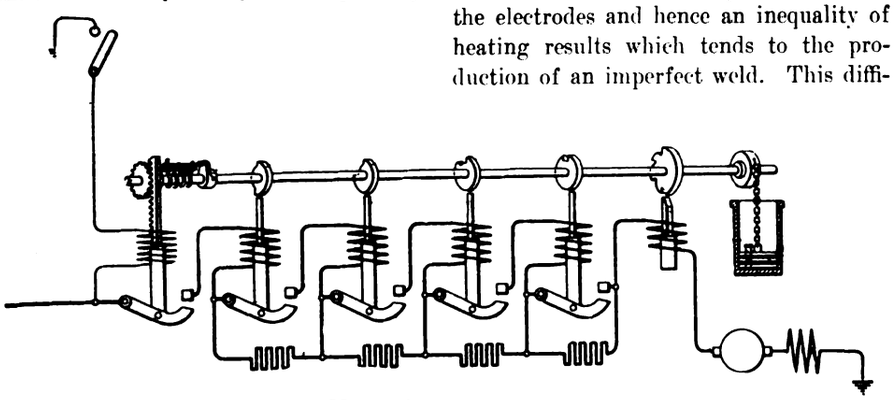


APPARATUS FOR PRODUCING HIGH VACUA.

Eugene R. Carichoff, of East Orange,

Digitized by Google

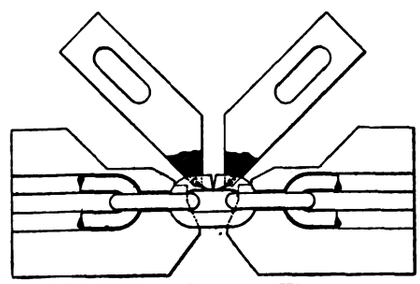
N. J., has assigned to the General Electric Company a patent (777,839, December 20) recently obtained by him on a motor starter. The object of the invention is to simplify the construction and arrangement of a motor starter which will be entirely automatic in its action and will operate to cut out the steps of the starting resistance to a predetermined rate in a positive manner. The device consists of a plurality of separately



MOTOR STARTER.

actuated contacts or switches controlling an electric circuit, preferably controlling the sections of the starting resistance in a motor circuit, the actuating coils of these contacts or switches being successively connected in the controlled circuit each by the operation of the contact next in advance to produce an automatic progression of the contacts together with independently operated means for regulating the progression of said contacts. The invention, also, comprises means for setting the regulating means in operation and a switch for primarily completing the controlled circuit, together with means for controlling the last mentioned switch and regulating means from a distant point.

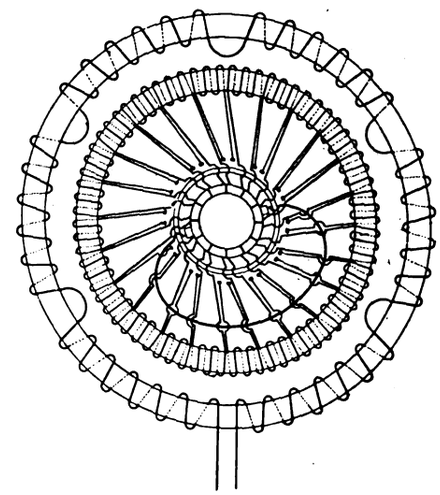
A process of electric welding has been devised and patented (778,269, December 27) by Adolph F. Rietzel, of Lynn, Mass., and assigned to the Thomson Electric Welding Company, Lynn, Mass. The invention relates to improved processes of welding metal by the heating effect of electric currents combined with pressure, and is mainly intended to obviate certain difficulties which arise when the heating current is passed into the parts to be welded at one side by means of electrodes applied thereto in a direction transverse to the line of the welding pressure. A further object of the invention is to obviate certain difficulties which arise in the electric welding of rings, chain-links and other endless forms wherein the weld is made at one side of the ring or link and by a welding pressure applied to the blank in such a way as to tend to develop mechanical stresses or strains in the continuous or unwelded side thereof. When the heating current is passed into the work by tranversely applied electrodes passing heating currents into one side only of the section of metal to be welded and the surfaces to be welded abut throughout or at any but the points farthest from the electrodes, there is a tendency of the work to heat more at the portions nearest the electrodes and hence an inequality of heating results which tends to the production of an imperfect weld. This difficulty is overcome in the present invention by so forming the surfaces where the weld is to be produced that they shall abut initially at their edges or portions farthest removed from the portion where the welding currents are conducted into them, the result of which is that when the current is applied and the pieces are subjected to pressure the heating will begin in those portions which would otherwise, as stated, tend to carry little current and be less heated, after which heating spreads toward the electrodes as the pieces yield and come together. The result is a more uniform heating and a more homogeneous weld. The invention also consists in an improved process of welding metal rings or links by applying pressure to effect the welding of one open side of the link, the



PROCESS OF ELECTRIC WELDING.

other side remaining substantially cold, and in drawing out or reducing the welded side while the pressure is maintained to prevent the link or ring from opening by the strain or stress developed by such pressure and consequent flexure or bending in the cold side. This part of the invention is especially useful in the welding of links, rings, or other endless forms of large cross-section and in which it is necessary to apply considerable force in order to flex or bend the cold portion in order to bring the open ends together and weld them, so that internal stresses or strains of considerable amount are developed which would tend to weaken the welded link if it were employed without first drawing out or reducing the bur or upset of the weld and substantially restoring the welded side of the link to a length which will permit the opposite side to regain its original form.

An electric motor has been patented (778,400, December 27, 1904) by James H. Bryson, of St. Louis, Mo., and the patent assigned to the Wagner Electric Manufacturing Company, St. Louis, Mo. The invention has for its object to secure a motor of large load capacity which at the same time requires but a small starting current. For this purpose a portion of the armature circuits is excluded from active operation at starting, and thus by decreasing the amount of copper



ELECTRIC MOTOR.

in circuit a higher resistance is obtained in the armature, cutting down the starting current. After the motor has started, and preferably after it has attained normal running speed, the armature resistance is reduced by cutting, preferably automatically, additional copper into circuit, thus obtaining a motor of increased load-carrying capacity. At the same time that the additional circuits are cut in the circuit upon which the motor has started is automatically reorganized. The motor consists of a member having a circuit commuted at starting and a second circuit for this member inoperative at starting. Automatic means are employed for simultaneously rendering this second circuit operative and short-circuiting the commutator segments after the motor has started.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Driving of Cotton Machinery by Electricity.

In discussing the advantages of electrically operated cotton machinery, the following summary is given of the chief claims put forward for this method of driving: the subdivision of the various points of application of the power reduces the liability of breakdown and stoppage; the subdivision of the various floors and sections enables any floor, section or group of machines to be operated independently of any other floor, section or group for overtime or night work; short lengths of shafting ensure alignment, and thus save friction losses; the general lighting is improved by the removal of a large percentage of the belts; the flexibility of the system enables the mill to be put in any position relative to the power operating it, so that it may be located with reference to the production only; extensions or alterations may be made without interfering with production; and depreciation and maintenance charges are very much less in the electrical system than in the mechanical.—*Abstracted from the Indian Electrical, Mechanical and Textile News (Bombay), November.*

The Production and Utilization of Ozone.

In this section of a series of articles on "The Production and Utilization of Ozone," Mr. J. B. C. Kershaw describes several types of ozonizer and refers briefly to their actual use for water purification. A modified form of Berthelot tube ozonizer is now employed by Drs. Bone and Drugman at the Victoria University laboratories, in Manchester. This ozonizer consists of a U-tube formed of two thin-walled glass tubes, one inside the other, their surfaces nearly touching, and sealed together at the upper ends. The outer tube has branches for inlet of air and exit of ozonized product. The conducting medium is a slightly acid solution of copper sulphate, the inner tube being nearly filled with this solution. A stout copper wire passes down each of these tubes. These are connected to the positive and negative poles of the coil or transformer supplying the current. The air passes along the narrow annular space between the inner and outer tubes. The yield of ozone is said to be good. Elworthy's ozonizer consists of a box containing ten ozonizing tubes, each consisting of two concentric glass tubes containing a spiral of aluminum wire. The air passes through the annular space in each of these ozonizing tubes, where it is subjected to the silent discharge. The Vosmaer-Libret ozonizer consists of a transformer, the secondary of which is connected to a condenser in shunt, while a choking coil is interposed in series in one of the branches between one terminal of the transformer secondary and one terminal of the condenser branch. The ozonizing apparatus works without any interposition of dielectrics. Goldstein found that it is the ultra-violet rays of light which are chiefly instrumental in the formation of ozone, and he has designed a quartz tube ozonizer which is said to utilize these ultra-violet rays to the fullest extent. Two platinum electrodes are fixed in the ends of this tube. A vacuum is produced in it, and upon allowing the electric discharge to take place between the two electrodes, the usual colored haze appears. If the tube be placed in an atmosphere of pure hydrogen, cooled below minus 100 degrees, almost the whole of the gas is transformed into ozone by the ultra-violet rays, which pass easily through the quartz glass. This condenses upon the outer walls of the quartz glass tube as a blue liquid. The Rosenberg ozonizer employs two electrodes made up of copper gauze (see ELECTRICAL REVIEW, December 3, 1904). Figures are given for the efficiencies of the different systems, Rosenberg's leading with a yield of 184 grammes of ozone per electrical-horse-power-hour. A plant has been erected at Marseilles, France, for purifying the city water by means of ozone. Current is taken at sixty volts, and transformed to 40,000 volts for use in the ozonizer. The air, before being treated, is dried by passing it over pumice-stone soaked in sulphuric acid. The sterilizing tower is brickwork, twenty feet high and ten feet in diameter, filled with flints. The water flows down through this, meeting the ozonized air as it passes up. At Lille-Emmerin a system of purification by means of ozone was installed to deal with the conditions caused by a severe epidemic of typhoid fever. The voltage used here was 30,000. The normal capacity of the plant was thirty-five cubic metres of water per hour, and it is said that the cost of treatment was 2.4 cents per thousand cubic feet.—*Abstracted from the Electrical Review (London), December* 30.

New 30,000-Volt, Steel-Pole, Long-Span Transmission Line.

A new steel-pole line has been constructed and put into service to form a connecting link between the new steam turbine station of the Edison Electric Company at Los Angeles, Cal., and Englewood, a distance of fourteen miles. At Englewood the lines are tied to the United Gas and Electric system, which was recently absorbed by the Edison Light Company. This line is now in successful operation at 15,000 and 30,000 volts, and is the only line of its kind. The poles are of steel construction, commensurate in size, weight and strength with ordinary wood poles, enabling them to be employed in like conditions of a limited space or right of way. They are formed of three U-bars, from three-eighths to one-quarter of an inch in thickness, arranged 120 degrees apart around the axis of the pole, which has the proper taper. The bars are firmly assembled by means of inside and outside collars at right angles to the axis of the pole, and at two or three-foot intervals along its length. Poles up to sixty feet in length are made of continuous U-bars, while those of a greater length are spliced. This construction is simple, enables all parts to be painted, and reduces the number of parts and joints to a minimum. The strength of the pole at no point is impaired by rivets or bolt holes. These poles were set up complete at the factory. They are set ten per cent of their length in a cylinder of concrete just large enough to enclose them, and a ground wire and plate are installed so that it is not possible to receive a shock from the poles in case the insulation of the line is imperfect. As the line leaves Los Angeles the poles are seventy-five feet in length, spaced from 250 to 275 feet apart, and carry four steel cross-arms, each composed of two U-bars ten feet in length, with a hub at the centre to fit the pole, and firmly bolted together with blocks which contain lead-topped standard thread steel pins. The insulators are standard for 30,000 volts, and are of a new design. On the upper cross-arms are two three-phase circuits for the Englewood line at 30,000 volts, composed of No. 4 seven-strand medium hard-drawn copper cables. As the line leaves Los Angeles it carries in addition three 15,000-volt circuits, which branch off after running a short distance. The

Digitized by Google

telephone line consists of two three-strand copper cables supported on steel lead-topped brackets four feet below the lower eventual cross-arm. Much difficulty was met in erecting these poles within the city limits, due to the presence of other pole lines along the way. They were raised by means of wagon derricks. Transposition in the line is effected by simply inverting the cross-arm construction. The description is fully illustrated and shows details of the construction of the pole. At points where severe side strains come upon the pole, the latter is stiffened by means of a truss.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), January.*

The 5,000-Horse-Power Turbo-Alternator at Frankfort, Germany.

In 1901, to meet the additional demand for power in the central station at Frankfort-on-the-Main, Germany, a 5,000-horse-power Brown-Boveri-Parsons turbo-alternator was installed. The turbine is designed to run at 1,360 revolutions per minute at a steam pressure of thirteen atmospheres and 300 degrees centigrade superheat. The single-phase alternator direct-coupled to the turbine has an output of 2,600 kilowatts at 3,000 volts, and a power-factor of 0.8. E. Guarini gives in this article the results of some tests which were made on this turbine, under ordinary working conditions. These were made by the engineers of the Frankfort Electricity Works.

Steam Pressure.	Temperature of Steam at Turbine Stop Valve. Degrees Centigrade.	Load in Kw.	Vacuum in Percentage.	Steam Consumption. Lbs. per Kw.-Hour.	Steam Consumption. Lbs. per I. H.P.-Hour.
12.63	298	1,945	93.2	15.8	9.9
12.8	295	2,518	91.8	15.6	9.45
10.6	312	2,995	90.0	14.7	9.0

It will be noted that the turbine can give a normal output of 5,000 horse-power, corresponding to a terminal output of 3,600 kilowatts. If the output of the machine on the different tests had been increased to 3,600 kilowatts, and the vacuum raised to ninety-four per cent, the turbine would have been much more economical and would have given the following results:

Steam pressure	10.6
Temperature of steam at turbine stop valve, degrees centigrade	312
Load in kilowatts	3,600
Vacuum in percentage	94
Steam consumption per kilowatt-hour	13.3
Steam consumption per indicated horse-power-hour	8.35

The steam consumption of the turbine with an effective pressure of 12.8 atmospheres, 300 degrees superheat and a load of 2,600 kilowatts was guaranteed not to exceed 15.8 pounds per kilowatt-hour. The steam consumption is better than was guaranteed, and the test shows that the turbine runs at least as economically as the best steam engines of the same output. —*Abstracted from the Electrical Magazine (London), December.*

Cable-Laying.

In this communication Mr. James Perry gives some valuable information regarding his experience during the past fifteen years with underground electric cables. He has tried bare copper laid in conduits, the Fowler Waring cable, lead-covered diatrine laid solid in bitumen in wooden boxing, and india-rubber, lead-covered. When cables were first placed underground it was thought sufficient to protect them from moisture by means of a lead sheath, but fourteen years ago Mr. Perry took the precaution of surrounding the cables of this kind he laid with a good thickness of sand wetted with coal-tar. These cables have never given any trouble. On the other hand, lead-covered cables laid solid in bitumen have given much trouble. This is frequently attributed to improper treatment of the bitumen when laying, it being thought that this material is burned, but the author has come to a different conclusion. A feeder which recently gave a good deal of trouble, and which it became necessary for him to take up, consisted of three separate lead-covered cables laid in one box. Upon examination he found numbers of fine annular cracks or joints in the lead sheathing. The bitumen does not adhere to the lead, and in his opinion there is a continuous joint between the whole surface of the sheath and the surrounding bitumen which is available for damp to distribute itself if it can reach this joint from the outside. This it is enabled to do because sudden shocks or vibrations will crack the bitumen, and if water is present it will penetrate into this crack some distance and will prevent its closing again by the flowing of the bitumen. If there are successive vibrations, the tendency will be for this crack to be opened repeatedly, and will result in the destruction of the cable. Further, there is a tendency of the cable to sink through the bitumen to the bottom, and it is necessary to provide some means for holding it up. On the other hand, there is no tendency for the cable to sink through tarred sand, and the tar adheres to the lead covering. The author has not found any tendency of this tarred sand to crack definitely under vibratory shocks, and as the material is cheap, a large quantity can be used to surround the cable. When he has found it necessary to take up any old cables laid on this method, he has found them firmly fixed in a coherent mass of somewhat flexible tar concrete which does not easily break off from the lead. When the sand is distributed around the cable and then is wetted with the tar, the latter causes it to shrink and press around the cable.—*Abstracted from the Electrician (London), December* 30.

Electricity from the Cold Combustion of Hydrocarbons.

If a piece of discharged lead negative plate be made the cathode, and a plate of carbon the anode in a solution of sulphuric acid, and a current be allowed to flow through this arrangement, it will be found that there will be a back electromotive force of about two volts. Nearly half this electromotive force is produced by the anode becoming coated with bubbles of oxygen. Place this anode in a porous pot and surround it by some substance that will take up the oxygen. Under these conditions it should be possible to charge an accumulator negative at about 1.2 volts. Experiments were made to determine the most suitable material for absorbing this oxygen. The best result was obtained with a solution of glycerine and water, acidulated with sulphuric acid, the back electromotive force in this case being reduced by about half a volt. To obtain electricity from the cold oxidation of hydrocarbons it will be necessary to proceed as follows: the primary cell, having a discharged lead negative in sulphuric acid for one element and a plate of carbon in nitric acid for the other, will be connected to a cell as described above, the cathode of the latter being a discharged lead negative. A cell having spongy lead opposed to carbon in nitric acid gives 1.6 volts. If the discharged lead negative gives only 1.2 volts there will be a difference of 0.4 volt between the primary and the secondary cell, so that, besides regenerating the lead negative, work could be done by the current so long as the electromotive force at the terminals of the regenerating cell exceeded 1.2 volts. The nitric acid used in the primary cell could be reoxidized either by the method patented some years ago by Jablochkoff, or by the method adopted in the manufacture of sulphuric acid. There are a variety of hydrocarbon compounds which might be tried in this way, no expensive apparatus being necessary.—*Abstracted from the English Mechanic and World of Science (London), December* 23.

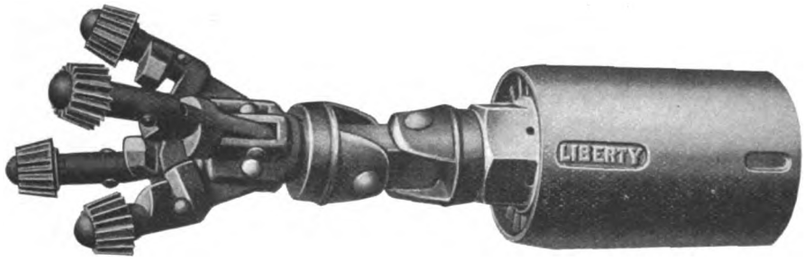
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The "Liberty" Turbine Cleaner.

The Liberty Manufacturing Company, 6906 Susquehanna street, Pittsburg, Pa., is calling attention to the Liberty turbine cleaner. The accompanying illustration shows the apparatus with freely swinging arm head and universal coupling. The company states that this cleaner will stand an unlimited amount of abuse and remove the heaviest scale in a short time and with little expense.



THE "LIBERTY" TURBINE CLEANER, WITH FREELY SWINGING ARM HEAD AND UNIVERSAL COUPLING.

The apparatus is constructed with either ball bearings or thrust bearings, as desired. The shaft revolves within a hard phosphor-bronze bushing, and the bearings are protected from the sediment in the water by being enclosed within the body of the stationary part. The rotor or wheel, as well as the tool attachments, is connected direct to the shaft, thus securing a rigid and durable construction. The turbine is furnished with any or all of the following attachments, as desired:

1. The freely swinging arm head attached directly to the turbine. This arrangement is adapted for scale up to one-quarter of an inch in thickness.

2. Freely swinging arm head is furnished with a universal coupling connecting it with the turbine. This arrangement is used for heavier scale than the first arrangement. It is also used for cleaning bent-tube boilers, the universal coupling permitting the entire machine to pass around the bends, thoroughly removing the scale from all parts of the tube. The advantage of the universal coupling on heavy scale is that the flexibility of the connection of the tool with the turbine relieves the machine from shock, prolonging the life of the wearing parts and reducing the repairs to a minimum.

3. For very heavy scale a drill is generally used, being attached to the universal coupling. The drill is also frequently used for very hard thin scale. This scale varies so much in different localities that no exact instruction can be given as to which of the attachments is the best in all cases. This is usually determined by experiment in each individual case.

Some of the largest power-houses in the world are using the "Liberty" turbine cleaner for cleaning their boilers. The Manhattan Elevated Railway Company, New York city; the Interborough Rapid Transit Company, New York city, and the Metropolitan Street Railway Company, New York city, have adopted the "Liberty" cleaner as their standard, and use it exclusively in keeping their boilers free from scale. The Seventy-fourth street station of the Manhattan Elevated Railway Company has sixty-four Babcock & Wilcox boilers of 525 horse-power each, six of 650 horse-power each, and sixteen economizers, the boilers and economizers containing 26,084 four-inch tubes. The Fifty-ninth street power-house of the Interborough company contains sixty 650-horse-power Babcock & Wilcox boilers, having a total, including the economizers, of 17,640 four-inch tubes. The Ninety-sixth street power-house of the Metropolitan company has sixty-eight 250-horse-power and fourteen 350-horse-power Babcock & Wilcox boilers. The same company has thirty 525-horse-power Babcock & Wilcox boilers in its Kingsbridge power-house. Together with economizers there are 20,000 tubes.

The "Tuxeda" Bronze Union.

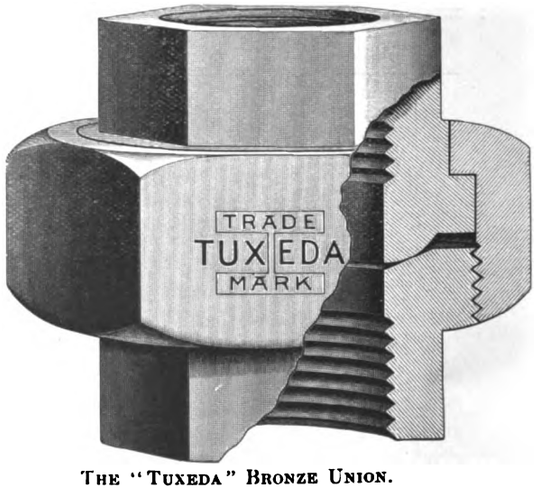
The problem of securing tight joints becomes more and more difficult of solution as higher steam pressures are used and as higher temperatures become necessary. The union connecting the ends of pipes is often a weak point in a plant and may cause considerable annoyance and trouble.

The Tuxeda Manufacturing Company, 39 Cortlandt street, New York city, has placed upon the market a form of union which has been designed especially for high-temperature and high-pressure work. It is made of "Tuxeda" bronze, a special alloy which possesses unusual soundness and high-tensile strength. The design shows full appreciation of the exacting requirements of this special service.

Extremely heavy ends are turned, preventing any spreading. These ends are hexagonal in shape, so that they may be conveniently and quickly manipulated by a smooth-faced wrench without danger of having the edges worn down by the slipping of a monkey-wrench or damaged by the jaws of a Stillson.

The joint is made by a slightly tapered seat, to which is fitted a nose that is rounded and well ground, so that a positive surface of contact is always assured, even if the pipes are out of alignment. This self-seating feature of the union prevents any trouble arising from unequal expansions and deflections of pipes.

These unions are made in sizes up to four inches, and will stand the severest service. They are designed with long and accurately cut threads, and, due to this feature and their general strength and solidity, can be changed about and used



THE "TUXEDA" BRONZE UNION.

over and over again without destroying their effectiveness.

These joints are now being specified by some of the leading engineering firms, which are making sure that the selection of an interior union shall not contribute to a defect in the finished pipe line.

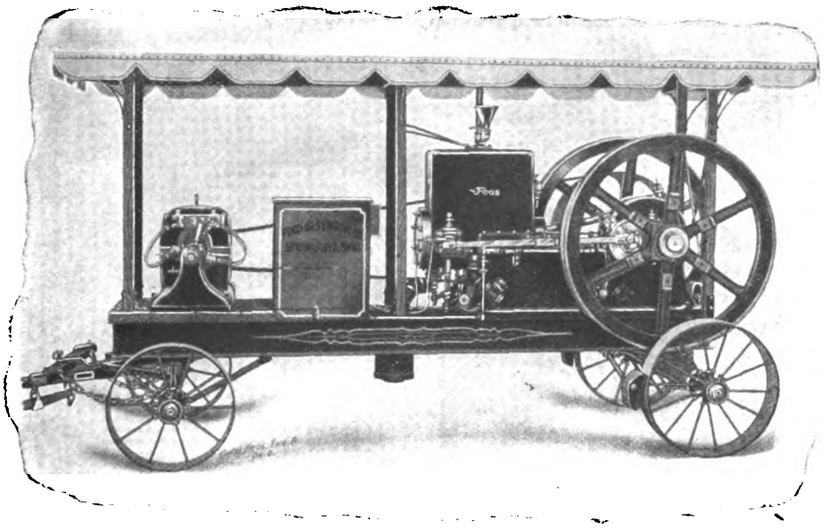
The unions are especially well adapted to drip piping and oiling systems, for use with superheated steam, and for withstanding the action of acids in smelting and mining plants.

Digitized by Google

A Portable Electric Power Plant.

As the gasoline engine becomes better understood by the public, manufacturers naturally develop a broader line of combinations. A new scheme recently offered by the Foos Gas Engine Company, of Springfield, Ohio, and of which a considerable number have been sold is illustrated herewith.

This outfit consists of a twenty-two-horse-power Foos gasoline engine belted to a dynamo of corresponding capacity, and it is entirely self-contained, there being no accessory tanks, batteries or other details. It is mounted on a steel truck, and can be furnished with or without top and curtains. Such a portable plant may be employed to great advantage in operating electric tools, for temporary electric lighting, thawing frozen water pipes, running coal loaders, electric hoists and other contractors' apparatus and for numberless other purposes.



PORTABLE ELECTRIC POWER PLANT.

The gasoline engine is of the regular Foos portable type. The cylinder and water-jackets are of special design and carry a sufficient supply of water to properly cool the cylinder. The water has a free passage to the air and maintains a uniform temperature, requiring no attention except that a bucket of water must be added occasionally to make up the loss due to evaporation. The cylinder is equipped with a complete water-glass by which the height of water may be gauged. This method of cooling the cylinder does away with the cumbersome water tank and the circulating water and fans often employed, and the advantages gained by freedom from water pipes and connections which may freeze or be broken by the vibration of operating and hauling over rough roads, can not be too strongly emphasized.

The Foos gas and gasoline engines are designed on the well-known four-cycle principle, giving an impulse at alternate revolutions of the flywheels. Nearly all the principal working parts being assembled on one side, the operator is enabled to install the engine to the best advantage, and to have free access to the devices for starting and for regulating speed, fuel and air supply, and time of ignition.

The system of ignition, on which depends in such a large measure the steady running and effective operation of an internal-combustion motor, has been very ingeniously worked out in these engines. The Foos igniter consists of two independent electrodes, the stationary and the revolving, each carrying a steel contact-piece. The revolving blade coming in contact with the stationary spring at each revolution emits a large electric spark, while at the same time the wiping action of the two parts removes any deposit of burned carbon or scale and prevents the incrustation of the contact edges, which is often the case of so much trouble. This rubbing action of the Foos igniter keeps the points of contact brightly polished under all conditions of operation and thus ensures continuous and even ignition. The blade and spring are in frictional contact for their full width of about half an inch, and this large contact surface, together with the hardness of the special steel used, makes them very durable. Adjustment for wear is made by simply loosening a locknut and moving the stationary electrode screw one-half turn or more toward the revolving electrode, and, when necessary, the blades can be renewed quickly and at trifling cost.

The Foos governor is simple and compact, is so designed that it may be adjusted to any speed required while in operation. It is of the centrifugal type and regulates the supply of fuel by cutting out the charges beyond those required to maintain the proper speed. Plain poppet valves, having vertical motion transmitted positively to both valves, are used.

Another feature of the Foos engine is the system of counterbalancing, in which discs are bolted to the arms of the crank, thus leaving the flywheels in balance, the latter having no weights cast in their rims, and bringing the counterbalancing weights in direct line with the piston, connecting rod, crank and other parts to be balanced.

The material is carefully selected, phosphor-bronze being used in all main bearings, and steel forgings for connecting rod, crank and such parts.

The design of the Foos engine is such as to make all parts fully accessible, it being possible to remove either valve, either portion of the igniter, the cylinder head, piston and so on, without disturbing any other part of the engine, or any pipe, fittings or connections. The workmanship is of a very high grade, and the facilities of the large Foos factory, which is fully equipped with up-to-date and special tools, are most excellent.

Some Notable Allis-Chalmers Literature.

The Allis-Chalmers Company, Milwaukee, Wis., during the past year issued a number of very handsome and instructive books bearing upon its various products.

"The Book of the Four Powers" briefly sets forth the scope of the Allis-Chalmers manufactures and gives a short-range view of the application of steam, gas, water and electricity.

"The Power of the New York Subway" describes the part played by one of the Allis-Chalmers four powers in the underground rapid transit system of New York.

The Allis-Chalmers Company has become the sole licensee in North America for the manufacture and sale of the world-famous dynamos, turbines, governors and other hydraulic machinery of Escher, Wyss & Company, of Zurich, Switzerland. The book describing hydraulic turbines and governors is replete with interesting information and handsome illustrations.

Another book is catalogue No. 110, describing the style K Gates rock and ore breakers.

Any one of these books is a worthy addition to an engineering library. The Allis-Chalmers Company has spared neither expense nor effort to make them attractive, both from a typographical and mechanical standpoint.

Digitized by Google

The Westinghouse No. 92-A Railway Motor.

The Westinghouse No. 92-A railway motor is designed to perform that class of service to which the No. 49 has heretofore been applied. In general design it closely resembles the Westinghouse Nos. 93 and 101-B, and incorporates the many improvements which were first introduced in those motors.

This motor is designed for city and suburban service. In city service a double equipment of these motors is suitable for operating single or double-truck cars, not exceeding thirty feet over all, and weighing, without equipment or load, from 14,000 to 15,000 pounds. In this service, with runs from one-eighth to one-quarter mile in length, a two-motor equipment, with gear ratio of fourteen to sixty-eight, will produce schedule speeds of 10 to 13.5 miles per hour, assuming a pressure of 500 volts and a straight, level track. A four-motor equipment in the same service will operate a double-truck car not over forty feet in length and weighing 30,000 pounds, attaining practically the same schedule and maximum speeds as stated above.

The motor has a nominal rating of thirty-five horse-power for one hour, but this rating is only an approximate indication of its suitability for a given service. The curve herewith shows the performance characteristics for one-gear ratio, and the performance curves furnish the proper data for judging of the operation of the motor in a given service.

The No. 92-A motor has a continuous capacity of thirty amperes at 300 volts, or twenty-eight amperes at 400 volts. In service it will safely develop any output shown on the curves, provided the integrated heating effect does not exceed that produced by continuous operation at a load requiring either of the above currents at the corresponding voltage.

At the close of a shop run of twenty-four hours, at either of the loads stated above, the temperature rise in the windings, as measured by a thermometer, will not exceed seventy-five degrees centigrade. In actual service under a car the better ventilation will usually reduce this rise to fifty-five degrees centigrade. Heavier loads may be carried for periods of varying length, as determined by the time-temperature curves, these curves being based on a rise of twenty degrees centigrade in the interior of the motor coils.

The frame is approximately cylindrical in shape; it consists of two castings of high-grade steel, accurately milled on the common surface to secure a good joint. The side away from the axle is provided with hinges, which allow the lower frame to be swung downward. The armature may be swung down with the lower part, or may be retained in the upper frame; this arrangement gives access to every part of the motor for inspection or repair.

Ready access to the commutator and brush-holders is provided by a large opening in the upper frame, this opening is closed by a dustproof lid, held in place by a cam-locking device. Hand and peep-holes are provided for inspecting the lower field, and these are also closed by water-tight covers. Both upper and lower castings are provided with bales for handling the motor.

There are four poles projecting inward at angles of forty-five degrees with the horizontal. Each is built up of carefully annealed soft steel punchings, riveted together between end-plates of wrought iron and bolted to the frame. The retaining-studs pass well into the punchings and terminate in a special rivet. This arrangement holds the pole firmly, yet leaves the pole-face smooth and unbroken.

The field coils are wound with copper strap, insulated with asbestos and mica, and protected by several layers of tape. They are repeatedly dipped and dried, and thoroughly impregnated, the process resulting in a solid coil, thoroughly weather-proof and practically indestructible. The coils are straight and interchangeable. Flat steel springs between coils and frame prevent looseness due to shrinkage. The coils are protected by leatheroid and oiled duck washers, and are held in place by the spreading tips of the poles. The field connections are made to terminals, one being brought out at each side of the coil. The end of the coil is thoroughly bound down when the terminal is brought out.

The armature is of the slotted drum type. It is built up of circular punchings of soft steel, built up on a cast-iron spider and held between end-plates. The steel in every armature is carefully annealed by a process which gives it permanent magnetic qualities. The punchings rest on ridges on the spider, and the grooves between the ridges are open to the air at the pinion end. Air-ducts between the stampings connect with

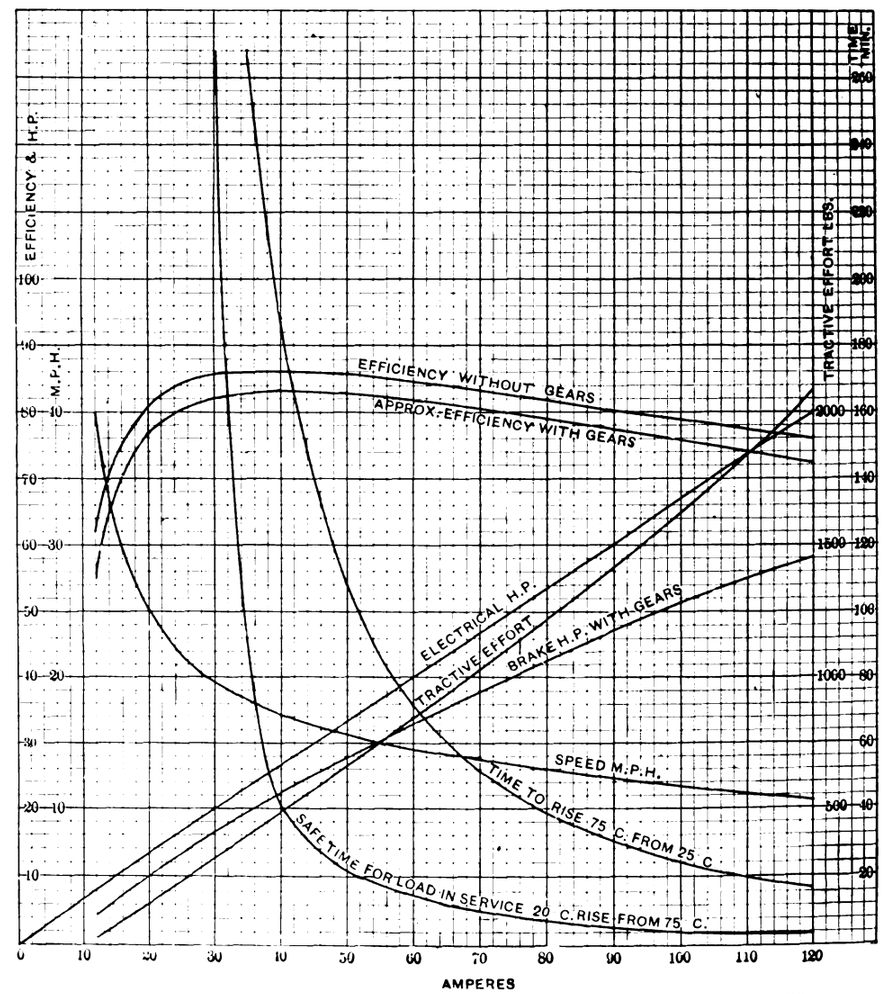


FIG. 1.—GENERAL PERFORMANCE CURVES, WESTINGHOUSE NO. 92-A RAILWAY MOTOR.

Digitized by Google

these grooves, and thus air is continually drawn in through them and forced out against the pole-pieces and field coils, producing a uniform temperature throughout.

Machine-wound armature coils are used, with insulation of a very high factor of safety, and are imbedded in rectangular slots in the armature. The coils are held in the slots both by retaining-wedges of hard fibre, driven into V-shaped grooves near the top of the slots, and by hand wires, making them doubly secure. The ends of the winding outside the armature core are covered with specially prepared canvas covers and wide bands, and rest at each end on flanges, which act as a support for them. The wide bands placed at either end of the winding, together with the fibre wedges, canvas coverings and the bell-shaped iron flange at the pinion end, form a most excellent protection against mechanical injury, as well as moisture. The diameter of the armature is thirteen inches.

The commutator is of the straight bar type, without necks, and is built up with 123 bars of hard-drawn copper, separated by segments of soft amber mica, and clamped on a bushing between V-shaped surfaces from which they are insulated by specially moulded mica. The wearing surface is nine inches in diameter and nine-sixteenths inch long. The wearing depth is fully five-eighths of an inch. The complete commutator is forced on the armature spider under pressure, and prevented from turning upon it by a steel key. Two cast-brass arms, firmly fastened to the upper frame by bolts, carry the brushes. They are well insulated by means of washers of treated fullers' board, and radial adjustment is provided to compensate for wear of the commutator. The holders are of the sliding type. Each arm carries two spiral brush springs, each of which bears upon a separate brush. The two brushes move side by side in the slot, and each extends half-way across the face of the commutator. This arrangement reduces the weight of each brush and moving element, so that it follows very closely the surface of the commutator, with an entire absence of "chattering." The shunts are of braided copper, and extend from each brush spring-tip to the arm, preventing the current from passing through the spring, the springs being so mounted as to be practically frictionless and very sensitive to movements of the commutator. The brushes are of copper-plated carbon, and each is one-half inch by one and one-half inches in section.

Leads of flexible rubber-covered cable are brought out through semi-soft rubber bushings set in the motor frame. All outside connections are made with knuckle joints.

The bearing at the commutator end is six and one-half inches long and three inches bore, and that at the pinion end seven and one-half inches long and three inches bore. Each bearing consists of a cast-iron bushing in one piece, lined with babbitt. Each bearing is carried in a housing of cast iron, the seat of which is turned to a cylindrical shape and is clamped between similar surfaces on the two halves of the frame. Each housing has a finished flange on the inner end, which fits against a finished surface on the field frame, taking the entire end thrust of the armature. The housings are held in place by tap-bolts, extending through the upper and lower frames. Each bearing is held from turning by a key.

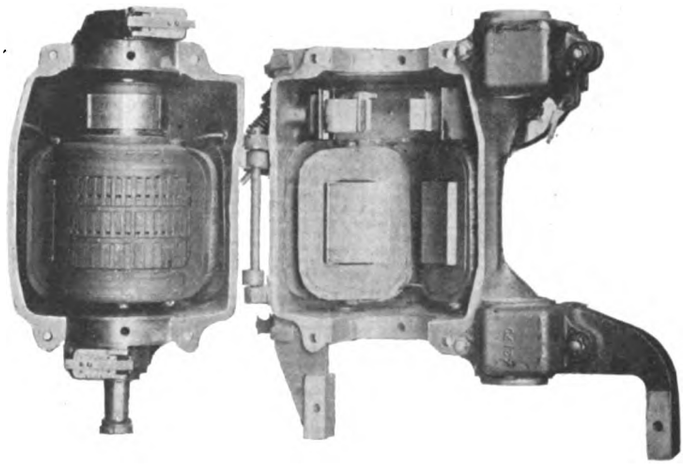


FIG. 2.—RAILWAY MOTOR, FIELD OPEN, SHOWING ARMATURE.

These housings contain oil and waste reservoirs, covered by metal caps held by springs. The reservoirs are on the low-pressure side of the bearings, and allow the saturated waste to come in contact with the armature-shaft through large openings. There is a separate space in the housing, through which the depth of oil may be readily measured, and the free oil added. The inner end of each housing is extended to include wiper rings or oil guards forced on the armature-shaft, thus preventing oil from working along to the armature, and draining the oil into a separate well in the bottom of the housing.

The axle bearings consist of cast-iron shells, divided horizontally and lined with babbitt metal. Each is eight inches long, and may be made for any diameter of axle up to five inches. The bearings are held in place by cast-steel axle caps, bolted from below to projections on the upper frame. Lubrication is obtained in a manner similar to that used for the armature bearings. Each axle cap contains an oil and waste reservoir, which registers with an opening through the top half of the frame, the oil being fed to the axle through an opening in the lower half of the bearing.

The motor is designed for cross-bar suspension. A rectangular suspension bar supported over the truck frame is bolted to special lugs on the front corners of the upper field frame.

A pinion of forged steel with machine-cut teeth is keyed to the shaft, and held on a taper seat by a nut and lock washer. The gear is made of cast steel in two parts, which are bolted together and keyed to the axle. The face is five inches. Gear ratios of 15:69, 18:66 and 22:62 are standard.

The gear case is made of malleable iron in two castings. The two parts are fastened together with lugs and bolts, and to the extension lugs on the upper frame at front and rear ends. This arrangement is particularly good, as no strains can be thrown on the gear case by vibration between upper and lower frames, the case being fastened to only one-half. The supporting lugs are especially strong and heavy, and are particularly well adapted to the use of malleable or sheet-metal cases. The whole gear case is carefully made, and will bear very hard service. The gears may be run in oil if desired.

The approximate weights of the No. 92-A motor are as follows:

Motor alone, without gears and gear case, 1,995 pounds.

Motor complete, with gears and gear case, 2,320 pounds.

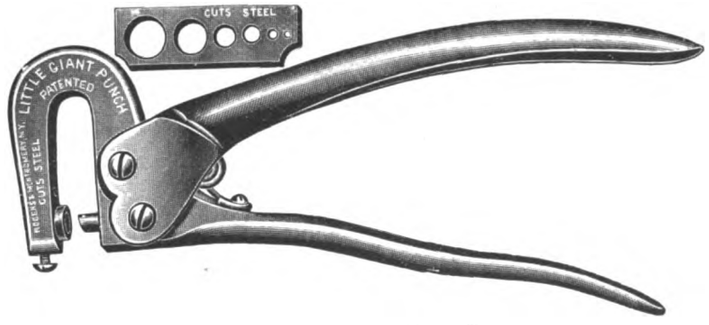
Armature complete, with commutator and windings, 475 pounds.

The approximate weight of a two-motor equipment, with two controllers and the usual details, is 5,680 pounds. A corresponding equipment of four motors, controllers, etc., will weigh approximately 10,900 pounds.

Digitized by Google

The "Little Giant" Hand Punch.

A new hand punch, shown herewith, is being placed on the market by Rogers & Montgomery, successors to the Rogers Manufacturing Company, 147 West Twenty-third street, New York city.



THE "LITTLE GIANT" HAND PUNCH.

This punch, which is called the "Little Giant" (Zacharias patent), is at present made in two sizes: No. 1 for punching holes from one-sixteenth to seven-thirty-seconds inch diameter, and No. 2 for holes of from one-quarter to one-half inch, inclusive. The No. 1 punch, which is shown in the cut, is guaranteed to easily punch a clean three-sixteenths-inch hole through 20-gauge sheet steel or galvanized iron, or 16-gauge sheet brass or copper.

In addition to punching sheet metals the punches are also especially adapted for punching leather, cloth, celluloid, slate, wood, bamboo, rubber, books or paper of any thickness up to the width of the opening between punch and die, so that the many time-saving uses to which a quick-working hand punch of this type may be put will readily suggest themselves. The design of the punch is such as to give an unusually great leverage, as a pressure of one pound exerted on the handles gives fourteen pounds at the point of the punch, and it is this great leverage, together with the high-class materials and workmanship, which enables these hand punches to do work of many kinds requiring the use of a punch press or drill press.

Both the Nos. 1 and 2 punches are seven inches over all, with the No. 2 having a slightly enlarged head to admit the larger sizes of punches and dies. Interchangeable sets of the punches and dies, of each separate one thirty-second inch diameter from one-sixteenth to seven-thirty-seconds inch, may be had for the No. 1 punch; and of each separate one-sixteenth in diameter from one-quarter to one-half inch, inclusive, for the No. 2. Any intermediate size of punch and die, different in diameter from those mentioned, may be had on special order.

The parts are drop-forged from steel, the assembling screws case-hardened, the punches and dies made from tool steel, properly tempered and hardened, the tool polished and heavily nickel-plated and fitted with coil-wire spring for expanding the handles. A sample of this punch will be sent on approval to any reliable concern making the request. If not satisfactory the punch may be returned charges collect.

New Telephone Apparatus from the Connecticut Telephone and Electric Company.

The Connecticut Telephone and Electric Company, Meriden, Ct., is placing

AUTOMATIC BRANCH EXCHANGE TELEPHONE.

on the market a new automatic branch exchange telephone and a new Bell style test telephone. The automatic system is designed for branch office exchange work, in connection with both magneto and common battery city service. With this apparatus each party makes his own connections, eliminating the services of a private line switchboard operator. When a call is to be sent from one department to another of a factory, or from the office to any part of a factory, the calling party pushes down the button corresponding to the department wanted. The pushing down of the button automatically cuts in the party and calls. When the conversation is finished and the receiver is returned to the hook, the party called is automatically cut off the line. City central can be called direct from any point in the system. This system is particularly designed for connection to common battery city service.

The No. 1 button may be designated as the exchange button throughout the system if outside service is desired. To call central it is necessary to press down the

TEST TELEPHONE.

exchange button and remove the receiver in the regular way, thus making a visual signal at central. When the conversation is finished the button is automatically reset to its former position. In this way there is established an intercommunicating system between any department or office in the building in which the exchange is installed, as well as automatic city service connection.

The connections in this instrument are made on hard rubber, and the transmitter, receiver and working parts are of the best design. The switching device is built to stand heavy use and all conditions of temperature. The trip is of case-hardened steel, and the possible chance for wear is very slight.

The Bell style test telephone is made up on the same general line as the Bell telephone test sets. The case contains a generator and polarized buzzer. The receiver is placed in a clip in a socket on the side of the case, a two-point switch

Digitized by Google

being used for cutting in the generator or receiver, as required. No batteries are required, as the receiver is used for both transmitter and receiver. The receiver in this set is of an extra large and powerful design.

The Connecticut Telephone and Electric Company is placing on the market a new style of test instrument, which has a complete telephone equipment, with its latest solid back transmitter, watch-case receiver, generator, ringer and two cells of pocket dry battery. This instrument will work over any distance, and is suitable for testing electric light, telegraph and telephone lines, cables, wiring and buildings. The instrument is also in general use in the army, and is used as a street railway telephone. Plug and weatherproof jack boxes are furnished for mounting on poles. Both of the last described instruments are made in two sizes, the largest being for heavily loaded toll lines.

Skeleton Bells.

Stanley & Patterson, 40 Cortlandt street, New York city, have placed upon the market a new form of skeleton bell

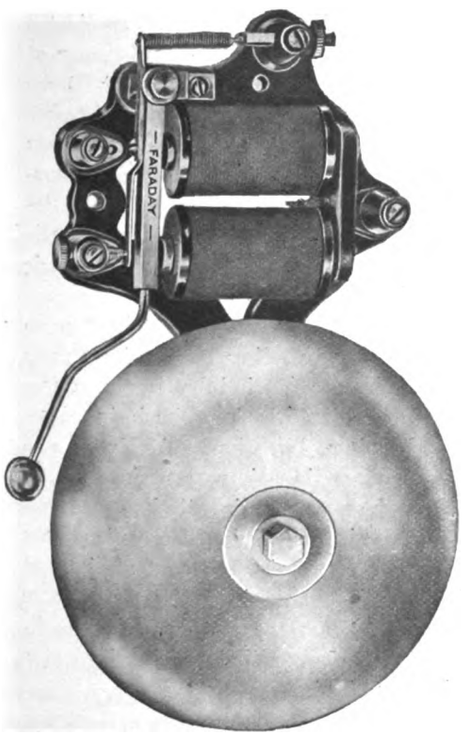


FIG. 1.—SKELETON BELL.

which is designated as the "Faraday," and for which is claimed a number of meritorious features.

Special care has been taken in the manufacture of these skeleton bells to eliminate any possibility of the loosening or moving of the trunnion frame, the turning of a contact post, or the working loose of the core from the yoke.

The trunnion frame is held in place by two screws, one of which, passing through the bell, is secured into the trunnion

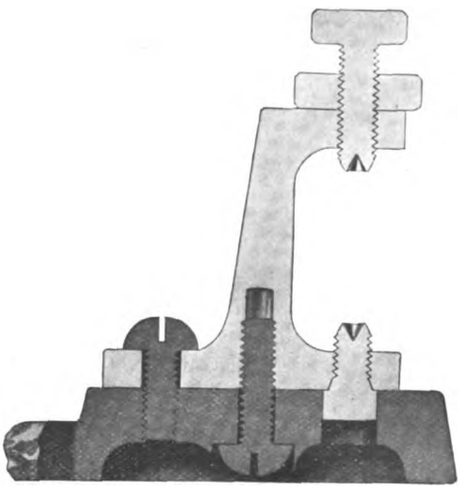


FIG. 2.—TRUNNION FOR SKELETON BELL.

frame; the other, passing through the trunnion frame, is secured into the bell frame. It would be necessary for both of these screws, forced into the casting in opposite directions, to work loose to result in a change of position of the trunnion.

The trunnion bearings in this bell are also arranged so as to eliminate the possibility of working loose. Both the upper and lower trunnion bearings are sixty-degree, tapered cones, into which are fitted the steel trunnions. The lower bearing is forced into the bronze casting of which the trunnion frame is made under such pressure as to make impossible any loosening.

The duplex side contact post is a patented feature of the "Faraday" skeleton bells. This post carries the platinum-pointed screw, and is attached to the frame of the bell so as to preclude the possibility of turning. The contact post is held in place by two screws, one of which has no wire underneath and may be driven home as hard as desired; the other screw can be tightened so as to hold the wire in place, but is independent as a necessity for holding the contact post to the frame. It, however, forms an additional safeguard to prevent the turning of the contact post.

Special attention has been given to the construction of the cores in this bell. The cores are made of cold-drawn Norway iron, thoroughly annealed after machining. The ends are formed into a tapered shoulder which is forced into a reamed hole against a counterbored surface in the back yoke. This makes a highly efficient magnetic connection. Screws are provided to securely fasten the cores to the back yoke.

The armature is milled out to receive the contact spring and adjusting spring strap. The spring strap is fastened over the contact spring with two screws. The removal of these two screws is all that is necessary to take off the contact spring should new platinum points be required.

Pure phosphor bronze is used for the tension-adjusting springs, and the same metal is used for the contact spring.

To prevent the gong from turning the gong post is provided with four ribs at right angles. These ribs fit into four incisions in the gong. The gong is held in place by a hexagonal screw milled from a solid bar.

The gong castings are made from pure bell metal.

The hammer ball is riveted on to the hammer wire, and the hammer wire is, in turn, riveted and pinned into the armature.

The frame is heavily ribbed to prevent the possible breaking of the casting when it is screwed on to an uneven wall. The frame is also provided with lugs so that the bell can be placed on a plaster wall without making indentations.

The contact points are made of pure platinum, and riveted in. The connecting wires are encased in a rubber tube protected on the outside by a braided and waterproofed reenforced covering. The

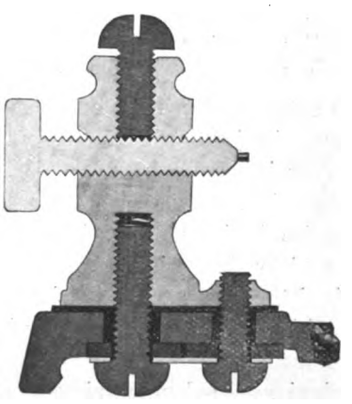


FIG. 3 —CONTACT POST FOR SKELETON BELL.

connecting screws are soldered or held in place under a non-turning washer.

All of the parts of the "Faraday" skeleton bell are made to gauge, and can be interchanged without being adjusted, fitted or filed.

Digitized by Google

Fort Wayne Electric Agents' Convention.

The Fort Wayne Electric Works, Fort Wayne, Ind., is one of the oldest concerns in this country now engaged in the manufacture of electric lighting and power apparatus. It is probably best known to the electrical interests of the United States, if not the world, as the manufacturer of the "Wood" systems of electric lighting and power which may be found in use in thousands of plants in this country. "Wood" electric lighting generators and arc lamps were among the pioneers in the industry and have always maintained the distinction of receiving a ready reception from the users of that class of apparatus.

The original company from which the present concern has been developed was formed in Fort Wayne, in 1881, to manufacture electric lighting apparatus and was called the Fort Wayne Electric Light Company. Its history has been marked by successive changes in name from the original name to Fort Wayne Electric Company in 1889, Fort Wayne Electric Corporation in 1894 and to the present name in 1899.

The part this company has taken in the development of the electrical manufacturing industry of this country has been in no small way due to the thorough and skilled designing ability of Mr. J. J. Wood, who is to-day recognized as one of the foremost inventors in the arc-lighting field of this country, in which he was a pioneer in 1879. Modern demands on electrical engineers, both in the lighting and the power applications of electricity, have been met and often anticipated by his tireless genius and strong personality showing in the products of the Fort Wayne Electric Works.

The extent of territory covered by the sales organization reaches from Boston to San Francisco and from St. Paul to Atlanta. The modern methods of a progressive business enterprise are well illustrated by the periodic conventions of the district managers of the various territories with the home office organization of this company.

Beginning Tuesday morning, January 10, 1905, and closing on Friday following, the daily business sessions of the sales forces have been relieved by evening social functions of a very enjoyable nature. Representatives from Boston, New York, Philadelphia, Syracuse, Pittsburg, Atlanta, Cincinnati, Grand Rapids, Chicago, St. Paul and St. Louis have discussed matters of common interest right on the ground of the central organization.

The social features of the convention were distributed over the period covered by the sessions, several of the Fort Wayne hosts entertaining the visitors at their homes.

The closing feature of the convention was a banquet at the Anthony Wayne Club at which over fifty of the sales force joined in disposing of a bounteous repast presided over by Judge R. S. Taylor, who has been counsel for the company ever since its infancy. Guests from the city included the local directors and others interested in local electrical organizations.

Those from the district offices attending the banquet were as follows:

J. Allan Smith, Boston, Mass.; J. C. Lott, New York, N. Y.; T. L. Sturgeon, Philadelphia, Pa.; C. A. Woolsey, Philadelphia, Pa.; E. H. Porter, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; F. S. Nicholson, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; G. B. Edgar, Cincinnati, Ohio; James O. Spear, Atlanta, Ga.; W. S. Goll, Chicago, Ill.; Frank McMaster, Chicago, Ill.; C. E. Sedgwick, Chicago, Ill.; W. C. Knight, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; A. L. Searles, Grand Rapids, Mich.

During the evening the district managers, as an expression of their appreciation and esteem for the one who is responsible for the products they handle, presented Mr. J. J. Wood with a handsome loving cup through their spokesman, Mr. W. S. Goll, manager of the Chicago office.

Mr. Wood has been with the Fort Wayne company since 1890, when he went to Fort Wayne from Brooklyn where he was manufacturing his arc lamps and dynamos when the Fort Wayne company purchased the Brooklyn plant and Mr. Wood transferred its machinery and men for making his arc-lighting apparatus to Fort Wayne. He immediately assumed charge of designing new electrical apparatus and redesigning the old apparatus and electrical devices already in production by the company.

Numerous new designs were the result of his inventive genius and electric lighting supplies were made in a more perfected form than ever before. The company advanced rapidly in the electrical manufacturing field and "Wood" systems became very widely used in electric lighting and power.

Mr. Henry S. Manning Retires from the Firm of Manning, Maxwell & Moore.

On January 9, 1905, Mr. Henry S. Manning sold to Mr. Charles A. Moore his entire interest in the firm of Manning, Maxwell & Moore, together with his interests in the various manufacturing concerns, *viz.*, the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, Hayden & Derby Manufacturing Company and the Hancock Inspirator Company. There will be no change in the name or character of the firm of Manning, Maxwell & Moore, and its business in the future will be conducted by Mr. Moore and the gentlemen who have been associated with him.

In 1873 the firm of H. S. Manning & Company was started. This company was succeeded by the firm of Manning, Maxwell & Moore in 1881. The growth of the business has been steady and constant, and the firm now has branches in Chicago, Cleveland, St. Louis, Boston, Pittsburg and Philadelphia. Various manufacturing interests have been acquired, so that to-day the firm is interested in the manufacturing industries of the Ashcroft Manufacturing Company, manufacturer of steam gauges, indicators and pipe-fitting tools; the Consolidated Safety Valve Company, manufacturer of safety specialties, the Hayden & Derby Manufacturing Company, manufacturer of "Metropolitan" injectors and ejectors; the Hancock Inspirator Company, manufacturer of Hancock separators and valves of various kinds, and the Shaw Electric Crane Company, manufacturer of electric traveling cranes.

Mr. Manning retires from the firm so that he may be relieved of business cares and problems, and indulge in the recreation to which his long business career entitles him. Mr. Charles A. Moore, who thus secures these important interests, is one of the most prominently known manufacturers in the United States, and the fact that he retains so great an interest in the firm of Manning, Maxwell & Moore guarantees that the product of this well-known company will be maintained at a high standard.

Mr. F. F. Proctor has secured for the Proctor circuit of theatres an important European specialty in the form of the "Phono-Bioscope," a combination of the motion picture machine and the phonograph, invented by a German, Herr Noggrath. This promises to create a great sensation, and is said to be the best machine of its kind ever invented.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CEBU, P. I., TO HAVE AN ELECTRIC LIGHT PLANT—It is announced that Cebu, the most important port in the Philippines next to Manila, is soon to have an electric lighting plant. A telephone system, said to be the best of any city in the Far East, is already installed.

COMPROMISE WITH NORTH AND WEST CHICAGO TRACTION COMPANIES—A compromise has been effected between Union Traction interests and the stockholders of North and West Chicago street railroad companies. Judge Grosscup has rendered a compromise verdict, authorizing the issue of $500,000 receivers' certificates, not liens on underlying companies.

NEW POWER PLANT FOR CALUMET & HECLA—A power plant for the use of the Calumet & Hecla mine is to be erected at Hubbell, Mich. The plant will supply 10,000 horse-power. Electricity will be used for all the operations in the mines, and the company anticipates a large economy in operation. About one year will be required for the completion of the plant.

BOSTON ALDERMEN VOTE FOR MUNICIPAL OWNERSHIP OF CITY LIGHTING—The new board of aldermen has passed an order authorizing the city of Boston to acquire and maintain plants for the manufacture and distribution of gas and electricity for lighting purposes. The vote was nine to three. In passing the municipal gas plant order the board followed the example of the common council, which has gone on record as heartily in favor of the plan.

CENTRAL LIGHTING PLANT PROPOSED IN WASHINGTON, D. C.—Mr. Bernard G. Green has submitted to Speaker Cannon a report recommending the construction of a power plant to supply all the government buildings in the vicinity of the White House with light and power. The plan provides for the removal of all engines and boilers from the buildings mentioned. The estimated cost of the plant is $2,000,000 and the annual expense for maintenance and operation is estimated at $200,000.

ELECTRIC LIGHT PLANT AT GUADALAJARA, MEXICO—A concession has been granted for the construction of electric tramways in the city of Guadalajara and suburbs. A company has been organized to do the work by Senor Hamon, Alcazar, of Mexico City. The company will pay to the Guadalajara city treasury the sum of $400,000 in eight yearly instalments of $50,000, which will be used by the city to construct an arch viaduct over the San de Dios river, which will be used by the tramways. The company intends to start work as soon as possible.

NEW HYDROELECTRIC PLANT STARTED UP IN CALIFORNIA—The new plant of the North Mountain Power Company, of California, was started on December 31. The power-house is located at Junction City, and the present installation consists of two 750-kilowatt, twenty-five-cycle, three-phase, alternating-current generators, direct-coupled to Pelton wheels. The effective head of water is 600 feet. The line is seventy-five miles long and runs to Eureka. The entire line and plant were built in six months. Mr. George T. Ruddack is general manager of the company.

MERGER OF ELECTRICAL COMPANIES IN CANADA—Steps have been taken to merge the different electrical and power interests operating in and around Ottawa, Quebec. The scheme contemplates uniting the Ottawa Electric Company, the Ottawa Electric Railway, the Consumers' Electric Company, the Hull Electric Company, including the street railway of that city, the Capital Power Company, of Deschene, the Hull & Ottawa Power Company, and probably the Metropolitan Electric Company. The scheme also involves the development of the water power of the Chaudiere and the details of this have been decided upon. There is an admirable power at Brittania, owned by the Metropolitan company, but it has only partially been developed. It is intended under the scheme outlined to develop this also, when necessary. The combined capital of the companies involved is about $7,000,000.

CHICAGO DIRECTORS OF THE ILLINOIS TUNNEL COMPANY—The Chicago Subway Company, which owns the stock of the Illinois Tunnel Company, the Illinois Telephone and Construction Company, and the Chicago Warehouse and Terminal Company, has announced that the following men will be in the directory of the Illinois Tunnel Company, which will operate the subway: A. J. Earling, president, Chicago, Milwaukee & St. Paul Railway; E. P. Ripley, president, Santa Fe Railway; George H. Harris, president, Chicago, Burlington & Quincy Railroad; S. M. Felton, Chicago & Alton Railway; J. Kruttschnitt, director of maintenance and ways, Southern Pacific and Union Pacific railways; B. L. Winchell, president, Rock Island Railway; C. A. Bird, vice-president, Gould lines; F. D. Underwood, president of the Erie Railroad; Benjamin Thomas, president of the Chicago & Western Indiana Railway; P. A. Valentine, vice-president of Armour & Company; Alfred B. Wheeler, president of the Illinois Tunnel Company. Among additional directors who will be announced later will be representatives of the Vanderbilt lines, the Pennsylvania Railroad and the Chicago & Southwestern Railway.

POWER PLANT IN MICHIGAN—A new company has been formed to build and operate power stations on the White river, Mich., which will make use of the power of that river for generating electric current for transmission to the cities of Whitehall, Fremont, Montague and Muskegon. The capital is said to be $1,500,000, and those interested in the enterprise are M. B. Wheeler, A. O. Wheeler, R. H. Opdyke and Wesley W. Hyde, together with several other Grand Rapids men and New York capitalists. Two dams are to be built, one of which will be located about seven miles above Whitehall, and it is proposed that sufficient water shall be backed up at this point to provide a constant supply of 4,000 horse-power throughout the year. The other dam will be located further up stream and will develop 3,000 horse-power. The work of building the first dam is to be started in the early spring, and it will be completed in the shortest time possible. The present plans contemplate furnishing electricity to one of the above-mentioned cities by January next. The dam is to have a height of sixty feet. It is estimated that the cost of the entire equipment will be in excess of $1,000,000. The flowage rights for the tract of land through which this river flows, and the property which is adjacent thereto, have been secured, and the timber will be removed during the winter. Messrs. Bates & Neilson, consulting electrical engineers, 42 Broadway, New York city, are associated with this enterprise.

NEW PUBLICATIONS.

PUBLICATIONS OF THE UNITED STATES NAVY DEPARTMENT—The United States navy department has issued the following publications: "Annual Report of the Secretary of the Navy," "Annual Report of the Chief of the Bureau of Equipment," "Annual Report of the Chief of the Bureau of Ordnance," "Annual Report of the Chief of the Bureau of Navigation," "Annual Report of the Chief of the Bureau of Steam Engineering," "Annual Report of the Chief of the Bureau of Construction and Repair," "Annual Report of the Chief of the Bureau of Yards and Docks," "Annual Report of the Surgeon-General of the United States Navy," "Annual Report of the Brigadier-General Commandant of the United States Marine Corps," and the "Annual Report of the Judge-Advocate-General to the Secretary of the Navy."

WINDMILLS IN FOREIGN COUNTRIES—The department of commerce and labor, bureau of statistics, Washington, D. C., has issued special consular reports, vol. 31, entitled "Windmills in Foreign Countries." It contains reports from consuls all over the world, and treats of the windmills in use, the climatic conditions as regards windmills, water supply, wells and pumps, irrigation and farming methods, the duty on windmills, the transportation and freight rates, and the outlook for American windmills in all of the foreign countries.

Digitized by Google

ELECTRIC LIGHTING.

LITTLE ROCK, ARK.—E. T. McConnell is making arrangements to build an electric light plant for Clarksville.

TRENTON, N. J.—The Carteret Electric Light and Power Company, of Carteret, has been granted a perpetual charter.

CEDAR FALLS, IOWA—Cedar Falls has voted to grant a franchise to the Waterloo & Cedar Falls Gas and Electric Company.

HARTFORD, KY.—J. W. Hale, of Fordsville, has contracted with the town council to install fifty lights for street lighting.

LITTLE ROCK, ARK.—A contract has been awarded to the Black Hawk Electric Company, of Davenport, Iowa, for the erection of an electric light plant at Searcy.

STRATFORD, N. J.—Extensions of the electric light system of the Clementon Township United Electric Company are being made to Stratford, Kirkwood and Lindenwold.

OSWEGO, N. Y.—The Oswego department of works has awarded the contract for lighting the city for the next five years to the People's Gas and Electric Company. The price paid will be $66 per lamp.

READING, PA.—The Keystone Electric Light, Heat and Power Company, of Kutztown, has placed an order with the General Electric Company, in Schenectady, N. Y., for an electric light dynamo double the capacity of the one in use.

LYONS, N. Y.—The Palmyra Electric Light and Power Company's plant has been purchased by William T. Morris, of Penn Yan, who is the head of a syndicate owning lighting plants in Lyons, Newark, Penn Yan, Oneida and Ithaca.

MARKSVILLE, LA.—The election on the question of levying a five-mill tax for twenty years for the purpose of installing a system of waterworks and electric lighting plant in Marksville, held recently, resulted in the tax being carried by a large majority.

SEYMOUR, CT.—The Seymour Electric Light Company has given notice of an application to the general assembly for amendment to its charter permitting an increase of capital to an amount not exceeding $100,000, providing for the issuance of bonds, etc.

ALAMEDA, CAL.—The Alameda city trustees have awarded the contract for furnishing a new engine for the municipal electric plant to the Charles C. Moore Company, of San Francisco. The same firm was also given the contract for providing the plant with a generator.

WHEELING, W. VA.—The Cameron Heat and Light Company's stockholders have elected a board of eleven directors, as follows: J. W. Dunlevy, C. E. Hutchinson, G. E. Hoffman, C. G. Fish, John Hagerman, W. M. Kincaid, W. M. Nowell, W. H. Loper, S. B. Hinerman, S. E. Leech and J. N. Howard.

NIAGARA FALLS, N. Y.—The Niagara Falls common council has granted a franchise to the Niagara Falls Gas and Electric Light Company to construct conduits in the streets, and also a franchise to the Niagara, Lockport & Ontario Power Company to erect poles and string wires within the city limits.

MINNEAPOLIS, MINN.—The Minneapolis city council has passed the lighting and power franchise of the Minnesota Power and Trolley Company. The ordinance gives a thirty-year franchise, with a graduated gross earnings tax, and limits prices for lighting to much below what have been charged.

COLUMBIA, KY.—Columbia is to have electric lights. Myers Brothers purchased the franchise, and operation on the plant will commence at an early date. One hundred lights, the required number to secure the plant, were readily disposed of, and others will be taken as the work progresses.

MADISONVILLE, KY.—There is a movement on foot to put in an electric plant at Morganfield large enough to furnish light for Morganfield, Uniontown, Sturgis, Waverly, Henshaw and a number of other towns located in a circuit of about twenty miles. Henry Oliver, of Fulton, is interested in the project.

UNION CITY, PA.—Negotiations for the purchase of the Climax Manufacturing Company's electric light plant, located in Union City, by home capitalists, have culminated in the transfer of the property to the Union City parties interested. The new company has elected a board of directors and will capitalize the plant at $25,000, with $20,000 paid in.

NAUGATUCK, CT.—The Danbury Power Company will ask the general assembly for a charter to establish a power plant on the Still river at Brookfield and New Milford, and to transmit electricity from the plant to Danbury, Bethel, Brookfield, Ridgefield and Redding. The plan is to dam the Rocky river in New Milford, just south of Jerusalem district, and the Still river at Lanesville and Brookfield.

BURLINGTON, VT.—The construction of a municipal electric light plant has been begun in Burlington. The building is already completed and several carloads of machinery have arrived. The plant complete will cost about $60,000. It will furnish about 200 arc lights, which is all the city uses, will light all of the city buildings, and will in addition leave about as much additional power for commercial uses.

CANAAN, CT.—The Berkshire Power Company, which has been organized with a capital stock of $240,000, will construct a dam and power-house on the Housatonic river at North Canaan. Preliminary work has already been commenced, and the undertaking will be pushed as rapidly as possible. Plans for the generation of a large amount of electric power to be distributed over a large area have been formulated.

SAN DIEGO, CAL.—Articles of incorporation of the United Light, Fuel and Power Company have been filed in San Diego, capitalized at half a million dollars, all subscribed, the majority of the stock being owned by John D. Spreckels, of San Francisco. The corporation is formed to construct and operate plants for making electric and gas light, fuel and power in the state of California, the principal business place being this city. There are five directors.

PORTLAND, ORE.—The Haines Electric Power Company, of Forest Grove, Ore., composed of prominent business men of Forest Grove, and of Portland, has recently been organized, and has taken over the interests of E. W. Haines and others in the electric light plant and mill at Forest Grove. The new company is capitalized for $50,000, divided into shares of $100 each. Among the stockholders are C. W. Nottingham, Ralph W. Hoyt, W. D. Haines, J. Frank Watson, John Thornburg. Headquarters of the company will be at Forest Grove.

HARRISBURG, PA.—A charter has been granted by the state department to the Commonwealth Electric Company, Philadelphia, with a capital of $100,000, to furnish light, heat and power to the city of Philadelphia. Appended to the charter application is a certificate stating that the company has renounced its original charter issued in New Jersey. The incorporators of the company are Mark Hyman, Herbert Scovill, New York; Ross A. Mackey, Brooklyn; Graham Sumner, Englewood, N. J.; E. D. Oakford, John M. Ingham and William M. Clift, Philadelphia. Mr. Hyman is president of the corporation.

HARTFORD, CT.—Lewis W. Ripley, for himself and others, has given notice that he will petition the general assembly for a charter incorporating the Glastonbury Power Company, for the purpose of making electricity and all forms of electrical force and power and of selling and distributing the same for any purpose within the limits of the towns of Glastonbury, East Hartford and Manchester, taking and using the water of Roaring brook and its tributaries in the town of Glastonbury. The charter is also to contain a provision that the corporation now existing under the name of the Glastonbury Power Company shall be merged in the chartered corporation.

KEARNEY, N. J.—The Kearney common council recently voted to erect a municipal plant to light the streets of the town. The lighting committee was authorized to engage an electrical engineer to prepare building plans and specifications for the plant. Estimates of the cost of erecting such a plant have been secured by the council, and it is believed that the total expense, including poles and wires, will be about $50,000. It is proposed to locate the plant upon the Passaic river at the foot of Johnston avenue. This action was taken after rejecting the offer of the Public Service Corporation to furnish arc lights to the city at a cost of $98 per lamp per year, which is a reduction of $2 on the price paid at present.

Digitized by Google

PERSONAL MENTION.

MR. H. P. BRUCE has been appointed manager of the Havana Electric Company, of Havana, Cuba, to succeed Mr. G. F. Greenwood, resigned.

COLONEL E. A. STEPHENS has been made manager of the Bell Telephone Company at Barnesville, Ga., and has taken charge of the business.

DR. GEORGE I. BETTS made an address on "Electricity and Its Relation to the Human Mind and Body" before the Milwaukee Literary Club at Mozart Hall, Milwaukee, Wis., on January 8.

COLONEL A. B. CHANDLER, chairman of the board, Postal Telegraph Company, was unanimously elected president of the Magnetic Club, New York, at the annual meeting held January 12, 1905.

MR. A. L. ENGLISH, of Omaha, Neb., will succeed Mr. W. P. Beyerle, who has resigned as manager of the Council Bluffs Citizens' Gas and Electric Company to accept the management of the lighting department of the Maryland Telegraph and Telephone Company.

MR. THEODORE P. BAILEY, assistant manager of the western office of the General Electric Company, left that company on January 1 to become vice-president and general manager of the L. E. Meyers Company, of Chicago. Mr. Bailey has been associated with General Electric interests for more than twenty years.

MR. C. J. PURDY has severed his connection with the Munder Electric Company as its New York sales agent to become general manager of the American Incandescent Lamp Company. He assumed his new position on January 16. The offices of the American Incandescent Lamp Company are at 26 Cortlandt street, New York.

MR. WILLIAM F. POTTER, vice-president of the Long Island Railroad, was elected president on January 13 to succeed the late William H. Baldwin, Jr. Mr. Potter has been connected with the road for eight years. He started as general superintendent, coming to that position from the Pere Marquette, where he was also general superintendent.

MR. HENRY C. MORTIMER, JR., of the General Electric Inspection Company, has joined the New York office staff of the Crocker-Wheeler Company. He will assist Mr. F. B. DeGress, manager of that office, and will succeed Mr. A. J. Thompson, who has accepted a position with the New York branch of the Bullock Electric Manufacturing Company.

MR. J. N. COX has been appointed electrical engineer by the Reading Company, with headquarters in Reading, Pa. He succeeds Mr. Ellis E. Brown, who will engage in the electrical business in Reading. Mr. Cox has been with the Reading for some years, having had charge of the electrical machinery at the Reading terminal, Philadelphia. He assumed his new position Monday, January 16.

PROFESSOR CHARLES L. HARRINGTON is giving a series of free lectures on "Electricity and Magnetism." They are delivered every Saturday night at the Museum of Natural History, Seventy-seventh street and Eighth avenue, New York city. The first lecture was given on January 7. The subjects for the lectures on the successive Saturdays beginning January 21 and ending February 25 are: "Statical Electrical Machines," "Current Electricity; Effects Within the Current," "Current Effects Without the Current," "Current Inductive Effects," "Thermoelectricity; Wireless Telegraphy" and "Rœntgen and Becquerel Rays." Besides experiments the lectures are illustrated by stereopticon views.

ELECTRICAL SECURITIES.

The slightly increasing activity in the stock market at the end of last week led many to believe that a start was to be made in the long-predicted January boom. While this hope seems hardly to be fulfilled, in even conservative quarters, the general feeling is confident and up-lifting. The continued ease in the money market, which has been a potent factor in the determination of speculative tendencies for some time past, gives rise to the belief that easy rates will prevail for some time to come. The fact that from now on considerable money will flow to financial districts from the interior of the country strengthens this opinion.

It seems quite probable that an early settlement of the Northern Securities case will result in a balancing of railway interests, while new and important alliances and deals will open the way for a great deal of new construction. This latter is anxiously awaited by a number of industries, which have been counting on such a source for their early-year prosperity.

Reports of exports for December are disappointing, in that they show a considerable decrease over exports for the same period last year in almost every staple line. There are reports of large increases in pig-iron production for December. For this month the production was larger than that of any other month in 1904, and this total compares favorably with the best record for the same period in any other year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 14.

New York:	*Closing.*
Brooklyn Rapid Transit	62⅛
Consolidated Gas	198¼
General Electric	188¾
Interborough Rapid Transit	190½
Kings County Electric	200
Manhattan Elevated	170¼
Metropolitan Street Railway	117⅛
New York & New Jersey Telephone	165
Westinghouse Manufacturing Company	187

The annual meeting of Brooklyn Rapid Transit Company stockholders will be held January 27, at 12 M. Books closed January 16, and will remain closed until the final adjournment of the meeting.

It is officially stated that the business of the Westinghouse Electric and Manufacturing Company is showing a steady increase, and the management expects that 1905 will be an excellent business year.

Boston:	*Closing.*
American Telephone and Telegraph	145½
Edison Electric Illuminating	250½
Massachusetts Electric	58
New England Telephone	139
Western Telephone and Telegraph preferred	99

The directors of the Edison Electric Illuminating Company have declared a regular quarterly dividend of 2½ per cent, payable February 1 to stock of record January 14. Books do not close.

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	10½
Philadelphia Rapid Transit	18¾
United Gas Improvement	109⅜

The directors of the Electric Company of America have declared a semi-annual dividend of 35 cents per share, a rate of 7 per cent per annum. This is an increase, the rate since 1902 having been 6 per cent per annum. This dividend is payable January 31 to stockholders of record January 20. Books will remain closed from January 20 to February 1.

Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	168
Metropolitan Elevated preferred	60
National Carbon common	40½
National Carbon preferred	113
Union Traction common	11¾
Union Traction preferred	46

The annual meeting of the South Side Elevated will be held January 26. The record of passengers carried for the year indicates that the gross receipts for 1904 will show a decrease of about $100,000. Gross receipts for 1903 were $1,678,310, and the balance added to surplus $121,943.

The annual meeting of the Northwestern Elevated will be held January 25. It is anticipated that the gross earnings for the year will be about $1,600,000, as the company carried an increase of 800,000 passengers during 1904.

It is stated that National Carbon annual earnings are about the same as last year, when $141,014 was added to the surplus.

Digitized by Google

NEW INCORPORATIONS.

ALLEGHENY, PA.—Fremont Light Company. $5,000.

McKEESPORT, PA.—Tube City Light Company. $5,000.

GRANDVIEW, TEX.—Head Telephone Company. $20,000.

WILKINSBURG, PA.—Wilkinsburg Light Company. $5,000.

NORTH LIBERTY, OHIO—Union Telephone Company. $5,000.

MONTPELIER, MISS.—Clay County Telephone Company. $1,000.

CONNELLSVILLE, PA.—Interstate Electric Company. $5,000.

QUINCY, ILL.—East St. Louis & Edwardsville Interurban. $400,000.

TROY, PA.—Troy Electric Light, Heat and Power Company. $10,500.

THREE RIVERS, MICH.—Three Rivers Telephone Company. $35,000.

MACY, IND.—Macy Telephone Company. Increased from $2,000 to $10,000.

HOPEDALE, ILL.—Farmers' Telephone Company. Increased to $20,000.

LEBANON, PA.—Lebanon County Light, Heat and Fuel Company. $25,000.

McCOMB CITY, MISS.—McComb City Electric Light and Power Company. $50,000.

WHEELING, W. VA.—Belmont Telephone Company. Increased from $75,000 to $150,000.

ROCK ISLAND, ILL.—People's Power Company. Increased from $600,000 to $1,000,000.

BRADDOCK, PA.—Colonial Light Company. $5,000. Incorporators: J. G. Splane and others.

LINCOLN, NEB.—The Central Telephone Company, Broken Bow. Increased from $35,000 to $100,000.

HARRISBURG, ILL.—The Harrisburg Water, Light and Power Company. Increased from $15,000 to $25,000.

ST. PAUL, MINN.—Shakopee Telephone Company. $50,000. Incorporators: J. B. Reis and H. P. Fischer.

CHICAGO, ILL.—Georgetown Electric Company. $15,000. Incorporators: W. F. Brugman, A. M. Searle and C. C. Travis.

LENA, ILL.—Howardsville Telephone Company. $2,500. Incorporators: George W. Davis, F. A. Howard, Edward Fisher.

ROCHESTER, N. Y.—Churchville Telephone Company. $5,000. Incorporators: William L. Ormrod, G. M. Colburn and E. A. Brower.

NEW YORK, N. Y.—Wireless Telegraph Exploitation Company. $10,000. Directors: J. R. Taylor, J. L. Lotsch, R. M. Dyer, New York.

KENOSHA, WIS.—Kenosha & Lake Geneva Railway Company. To build an electric railway from Kenosha through the lake regions. $25,000.

PETERSBURG, ILL.—The Petersburg Telephone Company. $20,000. Incorporators: John S. Hurie, R. A. Kelly and Richard Waldrich.

BELGRADE, MINN.—The Commercial Telegraph Company. $50,000. Incorporators: C. Bogerding, John F. Chisholm and A. Ridgeway.

GUTHRIE, OKLA.—Citizen's Gaslight, Heat and Power Company. $100,000. Incorporators: E. E. Hull, C. C. Roberts and J. R. Ruckles.

CADOTT, WIS.—Cadott Light and Power Company. $4,000. Incorporators: R. B. Cunningham, J. A. McGillivray, H. W. Frasl and six others.

KENOSHA, WIS.—Park City Electric Railway Company. $25,000. Incorporators: John M. Kehlor, Chester D. Barnes and Levi C. Graves.

OMAHA, NEB.—The Baxter Springs Electric Power Company. $30,000. Incorporators: E. T. McCarthy, R. W. Bailey and H. E. O'Neill, of Omaha.

NASHVILLE, TENN.—Rand Power Company. $175,000. Incorporators: H. C. Hicks, C. J. Sawyer, W. R. Hicks, S. M. Leath and R. Rutherford.

SAN FRANCISCO, CAL.—Culiacan Electric Company. $300,000. Incorporators: Isidor Gutte, Sidney Sprout, F. G. Brane, Henry Eickhoff and Henry Hacke.

ENGLISH, IND.—Crawford County Telephone Company. $2,000. Directors: John F. Zimmerman, Fred Reasor, George W. Flick, Lee King, Charles H. Denbo.

ALBANY, N. Y.—Orange County Lighting Company, Middletown. $100,000. Directors: H. N. Jackson, Percy Ingalls, Newark, N. J.; T. B. Reeve, Middletown.

LORAIN, OHIO—The West Side Street Railway. $10,000. Incorporators: W. B. Thompson, Orville Root, William Scher, R. Thew, F. W. Pierce, R. G. Nichols and W. N. Little.

CAMDEN, N. J.—Mexican-American Power Company. To generate electricity for light, power, etc. $1,500,000. Incorporators: Joel H. De Victor, G. Stewart Simons, B. Harvey Welch.

MINERAL WELLS, TEX.—Mineral Wells Electric Power and Heating Company. $50,000. Incorporators: D. G. Galbraith, of Mineral Wells; William D. Williams, of Fort Worth, Tex.

NASHVILLE, TENN.—The Paris Telephone Company. $25,000. Incorporators: John B. Thomason, C. P. Hudson, George H. Trevathan, A. L. E. Morton, F. N. Fisher, J. G. Warren and C. D. McGreer.

PORTLAND, ME.—Northwestern Power Company. To supply all kinds of power. $10,000,000. President, J. C. Rice, Boston; treasurer, C. M. Drummond, Portland; clerk, J. H. Drummond, Portland.

PEORIA, ILL.—Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company. Changed to Springfield & Northwestern Railway Company, and capital increased from $300,000 to $900,000.

SHANNOPIN, PA.—Hopewell Independent Telephone Company. $5,000. Directors: George M. McConnell, Alexander P. Morrow, John Morrow, Joseph L. Cook, New Sheffield; James Gilmore, Ethel Landing.

HAMMONTON, N. J.—Hammonton Electric Light Company, to generate and distribute electric current for light, heat and power. $50,000. Incorporators: H. B. Woodman, C. E. Starr and F. P. Reed, Hammonton, N. J.

JERSEY CITY, N. J.—Bergen County Telephone Company, to construct and operate telephone line in county of Bergen. $5,000. Incorporators: John F. Trumbull, Bound Brook, N. J.; Edward H. Hoos and Spencer Weart, Jersey City.

CHARLESTON, W. VA.—Winfield, Buffalo & Gallipolis Telephone Company. $5,000. Incorporators: E. B. Hanson, L. Quickle, S. C. Handley, Charles Harris and R. E. Black, of Buffalo, W. Va., and G. E. Stainer and M. V. Brown, of Pliny.

FORT WAYNE, IND.—Fort Wayne & Northern Traction Company. To build an electric line connecting Auburn, Waterloo, Fremont and Angola and points further north. $10,000. Directors: F. H. Cutshall, H. E. Vondermark, J. W. Wessel, Jr., F. H. Schmidt and F. C. Baade, all of Fort Wayne.

PORTLAND, ME.—Railway and Light Securities Company. Capital, $2,200,000. President, R. A. Jackson, Boston; treasurer, C. M. Drummond, Portland; directors, as above named, J. H. Drummond, Portland; J. J. Storrow and W. Endicott, Jr., Boston; Russell Robb and S. Buttrick, Concord, Mass.

INDIANAPOLIS, IND.—Central Electric Traction Company. To build a line through Miami, Fulton, Marshall and St. Joseph counties, connecting the cities of Plymouth, Peru, Rochester and South Bend. $25,000. Directors: J. O. Cole, Jerome Herff, Harry T. Masters, Albert C. Bearss and B. E. Wallace, all of Peru.

Digitized by Google

ELECTRIC RAILWAYS.

KEOKUK, IOWA—An electric railway line is projected to St. Francisville, Mo.

WHEELING, W. VA.—The city council has granted a franchise to the Pan Handle Traction Company.

CARLISLE, PA.—An electric railway will be built from Mt. Holly, Cumberland County, to Gettysburg.

CHARLESTON, S. C.—The city council of Charleston has granted a franchise to the Charleston & Summerville Electric Railway Company.

CINCINNATI, OHIO—The proposed elevated road between Cincinnati and Norwood will be operated by electricity within the corporation limits.

FORT SMITH, ARK.—The Fort Smith Electric Street Railway Company will expend about $180,000 in improvements, including a new power-house.

ONEIDA, N. Y.—It has been reported that the Oneida trolley line will be extended through Verona to connect with the Mohawk Valley line at Rome.

WEBSTER, MASS.—The Consolidated Railway Company has completed a deal for a site for a brick substation in Webster, and the structure will be erected as soon as the weather will permit.

MILWAUKEE, WIS.—Engineers are at work surveying a right of way for the Milwaukee Street Railway Company from Waukesha to Oconomowoc. Construction work on the extension will begin in the spring.

ST. JOSEPH, MO.—The county court has granted a franchise to the Union Terminal Railway Company for the construction of a line as a continuation of existing lines, from the stockyards to lake Contrary.

HUNTINGTON, IND.—The county commissioners have granted a franchise to the Interstate Interurban Company, which purposes to build between Marion, Ind., and Lima, Ohio, and to have the road completed by May 1, 1906.

NEW HARTFORD, CT.—Thomaston citizens will present a petition to the legislature for a charter for the construction of an electric railway from Thomaston to Waterville, a distance of seven miles, to connect with the Waterbury line.

OMAHA, NEB.—The county commissioners have granted a perpetual franchise to the Omaha, Lincoln & Beatrice railway to construct an electric line from Omaha to Beatrice, by way of Lincoin, and a branch line from Omaha to Fremont.

PORTLAND, ORE.—An ordinance has been introduced before the council granting a franchise to the Oregon Traction Company to lay tracks along certain streets in Portland to enable terminal facilities to be secured for an electric line to Hillsboro and Forest Grove.

SAN DIEGO, CAL.—The San Diego city council has granted an extension for one year of the franchise given to the San Diego Eastern Railway Company several years ago. A committee representing the directors is now looking after details of financing the railroad.

INDIANAPOLIS, IND.—The Dayton & Muncie Traction Company, now operating between Greenville, Ohio, and Farmland, Ind., and which proposes to run cars from Muncie to Dayton, Ohio, announces that it will have cars running into Muncie some time in February, at the latest.

SOUTH BEND, IND.—Work on an electric line between Lagrange and Shipsshewanna, Ind., progressed rapidly until the weather interfered. Work will be continued next spring. The company intends to build a spur to Lake Wawassee, to connect with Milford Junction and Syracuse, Ind.

FAIRMONT, W. VA.—A meeting of the stockholders of the Fairmont & Clarksburg Traction Company was held recently in Fairmont, when officers and directors were elected for the ensuing year. The company was bonded at $1,200,000, the bonds to be handled by Harvey Fisk & Sons, New York. An extension of several miles will be made to the lines the coming year.

OTTAWA, OHIO—The Ottawa village council has granted a franchise to the Lima Traction Company for the construction of a traction line through the town, connecting Lima and Toledo. Assurance is given that work on the new line will be begun as soon as the weather will permit.

MONTGOMERY, ALA.—Massey Wilson and his associates have been granted a franchise by the board of revenue of Montgomery County to construct, operate and maintain a street-car system on the extension of Madison avenue, recently opened by the Capitol Heights Development Company.

HIGH POINT, N. C.—The proposed interurban line connecting High Point, Greensboro and Winston-Salem appears to be a certainty, and it is thought that arrangements can be completed to have the work commence within ninety days. R. H. and R. A. Wheeler, of High Point, are interested.

HOUSTON, TEX.—A company has been formed to construct an electric railway between San Marcos and Luling, and the work of securing assistance from citizens along the line is in progress. The line will start at San Marcos and run through several towns *en route*, among them Martindale and Fentress.

ASHLAND, PA.—The Mahanoy City & Tamaqua Street Railway Company has received its charter from the state for the building and operating of a line between the two towns named. The company is headed by E. M. B. Shepp, president, and is capitalized at $60,000. Work will be commenced early in the spring.

TAMPA, FLA.—The Tampa city council has granted a franchise for the construction of another street railway, which covers the main streets in the eastern portion of the town, and then runs to Ybor City and Sulphur Springs. The projectors of the new road are T. W. Smith, C. E. Ball, W. B. Gray and George C. Warren.

MINEOLA, N. Y.—The Nassau County board of supervisors has granted an extension of time to the Glen Cove Railroad Company on its franchise to construct and operate a trolley line in Glen Cove. The company is given until June 1 next in which to begin work and must file a surety company bond as an evidence of good faith.

RENO, NEV.—The new towns of Fallen and Hazen, in Churchill County, will be connected by an electric railroad. The route has already been surveyed, and a company consisting of Nevada and San Francisco capitalists has raised $240,000 with which to build the road. The power will be supplied by an electric plant on the Truckee river.

OTTAWA, ONTARIO—The Grand Trunk Railway Company is considering the installation of electric locomotives in the Sarnia (Ontario) tunnel under the St. Clair river. The proposed change will necessitate an outlay of between $300,000 and $400,000. There will be required a power plant, storage battery system, third rail and four electric locomotives.

MISSOULA, MONT.—Preparatory work for constructing the Amador railway up Cedar creek, between Iron Mountain, on the Couer d'Alene branch of the Northern Pacific, and the Amador mining property, has been completed, and building is to begin as early as the weather permits. Ample water-power facilities already have been developed for operating the road.

SOUTH HAVEN, MICH.—A franchise for an electric railroad has been granted to C. W. Williams, of South Haven; George Bardeen, of Otsego, and S. J. Dunkley, of Kalamazoo. They must have cars running by July to hold the franchise. Extensions are proposed to Kalamazoo and Saugatuck, which will give South Haven a direct line with Detroit and Grand Rapids.

LAKE PROVIDENCE, LA.—The Lake Providence & Gouldsboro Railroad Company, Limited, a local company, has contracted with A. B. Sanders, of Shreveport, La., for the immediate construction of two miles of electric railway through the town of Lake Providence. This line will go through the business part of the town, thence through Gouldsboro, a new addition to the

Digitized by Google

town of Lake Providence. Mr. Sanders has placed his order for the material, and will build at the same time for the town a complete waterworks and electric light system.

BOSTON, MASS.—At the annual meeting of the stockholders of the Boston Elevated Railway Company the following directors were reelected: Frederick Ayer, William A. Bancroft, John J. Bright, Samuel Carr, T. Jefferson Coolidge, Jr., Francis H. Peabody, James Phillips, Jr., James M. Prendergast, Nehemiah W. Rice, Quincy A. Shaw, Jr., William S. Spaulding, Walter S. Swan and Robert Winsor.

SPRINGFIELD, MO.—A deal has been consummated whereby the control of the stock of the street railways of Springfield passes into the hands of local capitalists, and it is probable that the various lines will be merged into one system. The holdings of G. W. Parker, R. C. Kerens, S. W. Fordyce and Moses Rumsey, all of St. Louis, have been purchased by the local capitalists, the consideration being $270,000.

GRAND JUNCTION, COL.—At a regular meeting of the Grand Junction city council George Smith was granted a franchise to construct an electric railroad through the streets of Grand Junction, the work on same to commence within ninety days after the passage of the ordinance. Smith has in view an electric line to traverse the entire Grand valley, from Palisade, ten miles east of this city, to Fruita, twelve miles west.

NEW ORLEANS, LA.—Judge Lanning, of the United States Circuit Court, appointed, on January 4, E. C. Foster, of New Orleans, La., receiver for the New Orleans Railway Company, which controls all the street railway lines in New Orleans. This is the result of proceedings brought by the New York Security and Trust Company to foreclose the $2,500,000 mortgage which it holds in the property of the trolley corporation.

CHATTANOOGA, TENN.—Steps have been taken by those interested in the Cleveland-Ducktown Interurban Railway to make the preliminary survey for the proposed line from the Chickamauga Park line of the Rapid Transit Company, at the army post, to Ringgold, Ga., and thence to Catoosa Springs. The company is to be incorporated with an authorized capital stock of $300,000, which will be increased to $2,000,000.

CLARKSBURG, W. VA.—The Clarksburg & Weston Traction Company, of Clarksburg, has been chartered to construct and operate an electric railway between the city of Clarksburg and the town of Weston. The authorized capital stock is $25,000. The incoporators are Humphrey Brohard, of Flemington; Sylvester G. Monroe, of Lost Creek; Frank B. Haymaker, Charles C. Fitiro and Wyckiff M. Conaway, of Clarksburg.

BOSTON, MASS.—The Taunton & Buzzards Bay and Taunton & Pawtucket street railway companies, successor companies to the Middleboro, Wareham & Buzzards Bay and the Bristol County street railway companies, have applied to the railroad commissioners for approval of capital stock. The capital of the Taunton & Buzzards Bay Street Railway Company is fixed at $225,000, and that of the Taunton & Pawtucket Street Railway Company at $200,000.

ST. LOUIS, MO.—Articles of incorporation have been granted at Springfield, Ill., to the Granite City, St. Louis & Eastern Belt Railroad Company. The incorporators and first board of directors are F. G., H. F. and William F. Niedringhaus, of St. Louis, and W. H. Hanlon and C. F. Stelzel, of Granite City. The company proposes to construct a few switches about the National Enameling and Stamping Company's plant at Granite City for convenience in handling the products of the establishment. The principal office is to be in Granite City.

COLUMBUS, OHIO—The Columbus, New Albany & Johnstown Traction Company has filed papers in the secretary of state's office increasing its capital stock from $200,000 to $600,000, of which $200,000 is preferred stock and $400,000 common stock. This was determined upon at its recent annual meeting at which the following were selected as the board of directors: George B. Cox, of Cincinnati; Daniel J. Ryan, W. D. Brickell, H. B. Rusler, of Youngstown; L. P. Stephens and Charles E. Carter, of Columbus. The board organized by the election of these officers: president, W. D. Brickell; vice-president and general counsel, D. J. Ryan; secretary and treasurer, L. P. Stephens.

INDIANAPOLIS, IND.—A fifty-year franchise has been granted the Muncie & New Castle Traction Company by the Delaware County commissioners. The road runs from Muncie to New Castle. A feature of the franchise is the requirement that cars be stopped at every cross-road in the county at least once in every two hours, and that the company construct and maintain a new roadway wherever it uses a public highway. The new line will connect with the Union Traction Company's local street-car system at the southern extremity of the Congerville line.

CONNELLSVILLE, PA.—Right of way for the extension of the West Penn Railway Company from Leckrone to Jacob's Creek, seventeen and one-half miles, has been secured. Construction will begin in the spring. The proposed line is another step in the direction of West Virginia, where ultimately the West Penn system will connect with lines touching Morgantown, Fairmont, Clarksburg, Parkersburg and Wheeling. The route passes through all the new coal and coke towns. The road is generally known as the Pittsburg, McKeesport & Connellsville Railway Company.

PITTSBURG, PA.—Bids for the construction of fourteen miles of electric railroad between McKeesport and Irwin are to be taken so that work on the new line can be started early in the spring. The line is to be built by the Pittsburg & Westmoreland Electric Railway Company, and by its construction it will be possible for passengers to reach almost every portion of Allegheny and Westmoreland counties from Pittsburg over electric lines. The new road is to be constructed largely on private right of way, and with cement or concrete culverts, and one steel bridge at Irwin.

PORTLAND, ME.—The railroad commissioners have approved the articles of association of the Bridgton Street Railway Company in the town of Bridgton. This company proposes to run a line of railway from the landing of the Sebago Lake, Songo River and Bay of Naples Steamboat Company on Long pond to Bridgton. The incorporators are Charles L. Goodridge, N. L. Goodridge and Llewellyn Barton, of Portland, and Lyman B. Chadbourne and Fred C. Knight, of Bridgton. The proposed road would be about one and one-half miles long and the capital stock is placed at $6,000.

MEMPHIS, TENN.—Notice has been given by the Atlanta & Gulf Railroad Company that it will apply for a charter in Georgia to build a line 400 miles long from Atlanta to the gulf. The southwestern terminus has not yet been decided upon, both Pensacola and Mobile being mentioned. In Georgia the road will cross Fulton, Campbell, Douglas, Carroll and Heard counties. The application calls for the use of either steam or electric power, or both. Those interested are F. A. Kuhn, Kennon Dearing, R. B. Beedles, T. H. Goodwin, J. J. McClendon, Henderson Hallman, W. P. Powell, Hugh B. Cobb, D. P. Fleishel and J. R. Bradbury, all of Atlanta.

SPOKANE, WASH.—The Spokane Power and Transportation Company has elected its officers for the coming year, as follows: James Cleveland, president; John Condron, vice-president; George S. Richey, second vice-president; John Gray superintendent and general manager; Jesse M. Fyfe, secretary and treasurer. The directors are James Cleveland, George S. Richey, John Gray, John Condron, T. P. Reardon, W. Boyd Block and E. U. Engle. The Spokane Power and Transportation Company has plans for the construction of an electric road from Spokane to Crystal City, in the Big Bend country, and touching the small towns between those places.

READING, PA.—The lease and agreement of the Adamstown & Mohnsville Electric Railway Company to the United Traction Company has been placed on record in the recorder's office. The latter company leases the road for 999 years, beginning January 1, 1905, and ending January 1, 2904. The lessee is to pay quarterly to the lessor thirty-seven and one-half per cent of the gross receipts until the annual gross receipts shall reach $25,000, all over $25,000 to be retained by the lessee, and all taxes and interest on bonds are to be paid by the lessor. The maximum rate of fare shall be one and one-half cents per mile, except excursion rates, which shall be at the discretion of the lessee. When this lease expires the lessee shall have the right or option to purchase the road for $75,000, subject to the mortgage bonds then outstanding, not exceeding $75,000.

Digitized by Google

TELEPHONE AND TELEGRAPH.

LITTLE FALLS, N. Y.—The Bell Telephone Company is constructing a line between Little Falls and Middleville.

TROY, N. Y.—The Commercial Union Telephone Company is about to make extensive improvements to its exchange in Upper Troy.

DE SMET, S. D.—The business of the De Smet system nas grown to such an extent that it is necessary to install a much larger switchboard.

PASCO, WASH.—Material is on the ground at Pasco for a telephone line to Two Rivers, a new town building about eight miles south of the Snake river.

NEWARK, N. J.—The Chester Local Telephone Company is making preparations to extend its line through to Parker, and possibly from there to Fairmount.

GREAT FALLS, MONT.—The Cascade County Rural Telephone Company has completed a line from Great Falls to Black Butte, a distance of about twenty-five miles.

BIRMINGHAM, ALA.—Poles are being laid along the route of a new telephone system to connect Jeff, Wooley Springs, Monrovia and other rural communities with the telephone system of Huntsville. The new system will be completed at an early date.

FARGO, N. D.—The stockholders of the Red River Telephone Company have elected officers for the ensuing year, as follows: president, P. H. Lamb; vice-president, L. H. Baker; secretary and treasurer, Leslie Welter. Plans for extensions were considered.

DODGE CITY, KAN.—The Dodge City Telephone Company is extending its line to Ford City and thence to Bucklin on the Rock Island. With the line owned by the farmers in the southern part of the county this forms a network of lines covering nearly the whole of the southwest part of Kansas.

PORTLAND, ME.—At the annual meeting of the Atlantic Telegraph Company the following directors were elected: Nathan Pratt, John M. Halligan, John J. Hogan, all of Lowell, Mass.; Philip J. Deering, Howard Winslow, of Portland. John J. Hogan was elected treasurer of the company, and Howard Winslow, clerk.

WHEELING, W. VA.—The following board of directors has been elected by the stockholders of the Belmont Telephone Company: Henry Schmulbach, Dr. Andrew Heinlein, Charles J. Heinlein, J. W. Dondna, C. L. Weems, Frank M. Roberts and J. C. Dent. Plans were discussed for the general extension of the lines of the Belmont company.

SPOKANE, WASH.—George B. Bush, manager of the Pacific States Telephone and Telegraph Company, has announced that during 1905 his company expects to put in from 500 to 600 party lines within a radius of fifteen miles from Spokane. Six hundred miles of wire will be needed and forty to fifty men will be employed in construction. The cost will be $25,000.

CLIFTON SPRINGS, N. Y.—W. H. Burke, of Clifton Springs, and W. C. Ellis, of Shortsville, who have been interested in several telephone companies operating in Ontario County, have sold their interests to the Long-Distance Inter-Ocean Telephone Company, of Buffalo. The company most seriously affected by this sale will be the Clifton Springs Telephone Company, which has been operated and controlled by them.

LYNCHBURG, VA.—The Lynchburg common council has approved the proposed franchise for the Bell Telephone Company, which is intended to be operative thirty years. The company purposes to install a plant costing not less than $100,000, and to make Lynchburg a distributing centre for long-distance service between the north, west and south. The local company's plant was purchased recently by the Bell company.

OGDEN, UTAH—The Rocky Mountain Bell Telephone Company announces improvements which it is preparing to make at once to its local plant. The company now has 2,000 subscribers in Ogden. A new modern fireproof building is to be erected in the rear of the present one, twenty-eight by seventy feet, two stories and basement. In this new building will be installed a modern switchboard costing $24,000, which will more than double the capacity of the plant. The new building itself will cost in the neighborhood of $15,000.

MILWAUKEE, WIS.—A mortgage for $500,000 on the property of the Badger Telephone and Telegraph Company to the Wisconsin Fidelity Trust and Safe Deposit Company has been filed with the register of deeds. The mortgage is given in consideration of 1,000 bonds in the amount of $500 each, which will be issued by the company in the future. The rate of interest on these bonds is to be five per cent. The mortgage is signed by Frank M. Fish and John K. Fish, respectively, president and secretary of the Badger Telephone and Telegraph Company.

LOWVILLE, N. Y.—The annual meeting of the stockholders of the Black River Telephone Company was held recently, and the following board of directors was elected: Charles W. Pratt, S. C. Capron, Boonville; George R. Fuller, Fred W. Zoller, Rochester; Charles H. Poole, T. Harvey Ferris, Utica, and John J. Domser, Lowville. The board of directors elected the following officers: president, Charles W. Pratt, Boonville; vice-president, George R. Fuller, Rochester; treasurer, Charles H. Poole, Utica; secretary, S. C. Capron, Boonville; manager and assistant secretary, John J. Domser, Lowville.

ST. JOSEPH, MO.—St. Joseph and Cameron are now connected by three telephone lines. The Funston Long-Distance Telephone Company opened the third line on January 4, when its wires were connected with the central office of the Citizens' Telephone Company. The line is forty miles in length. It follows the right of way of the Burlington to Cameron. The line has also been connected with the Cameron exchange. About 1,500 subscribers, including the Cameron exchange, will be accommodated. Among the towns reached by the company are Stewartsville, Osborn, Hemple and Saxton. J. G. Funston, superintendent of the Citizens' Telephone Company, is secretary and general manager of the Funston company. E. B. Funston, of Racine, Wis., is its president.

NEW COMPANIES.

CAMDEN, N. J.—F. R. Hansell, Joseph F. Cotter and George H. B. Martin have organized the Martin & Hart Motor Company, with a capital of $200,000.

SPRINGFIELD, ILL.—The Exmoor Battery Company, organized in Arizona with a capital of $150,000, has been incorporated in Illinois with a $10,000 capital.

MILWAUKEE, WIS.—The Herman Andrae Electrical Company has been organized with a capital of $10,000, by Herman Andrae, Herman Schmidt and Jacob Tellier.

JERSEY CITY, N. J.—The Rock Island Battery Company, with a capital of $75,000, has been incorporated by Louis B. Dailey, B. Stafford Mantz and Joseph M. Mitchell.

COLUMBUS, OHIO—The Marshall Electric Company, of Cincinnati, has been incorporated by N. L. Keelen, Fred L. Hoffman, A. K. Hoffman, E. L. Langerman and K. Borman. The company is capitalized at $15,000, and will make and sell electric appliances.

INDIANAPOLIS, IND.—The Tritt Electric Company, of South Bend, Ind., has filed articles of incorporation. The object of the company, which is capitalized at $100,000, is to manufacture electric automobiles. The directors are Burleigh E. Tritt, Daniel M. Calvert, Walter B. Pershing, Edgar R. Miller and Charles M. Kreighbaum.

WILMINGTON, N. C.—The Southern Electric Company, of Wilmington, N. C., recently chartered by the secretary of state with a paid-in capital stock of $4,000, to do a general electrical business, has organized by the election of the following officers: president, J. O. Brock; secretary and treasurer, John Hall. The company will deal in mechanical and electrical supplies, doing general construction work and installing electric, gas and other lighting plants.

Digitized by Google

INDUSTRIAL ITEMS.

POWELL & COLNE, Bowling Green Building, New York city, are distributing a pamphlet describing the Tropenas converter steel process.

THE POPE MANUFACTURING COMPANY, Hartford, Ct., is distributing a catalogue describing and illustrating Pope Hartford automobiles.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is extending to the electrical field its greetings for 1905, in the form of a unique colored folder bearing a very bizarre design.

THE STUART-HOWLAND COMPANY, Boston, Mass., is furnishing its patrons with a neat calendar. This has a wide red border surrounding a photograph of the company's place of business in Boston.

THE BRISTOL COMPANY, Waterbury, Ct., has been awarded a gold medal on its exhibit of recording instruments in group 71, by the Universal Exposition, St. Louis, 1904. A medal and diploma for this award are shortly to be issued by the exposition company.

McLEOD, WARD & COMPANY, 27 Thames street, New York city, are distributing a handsome calendar for the year 1905. The illustrations on this calendar set forth about fifteen of the celebrated Kinsman specialties for stand and desk lighting of every description.

THE ELECTRODYNAMIC COMPANY, Bayonne, N. J., is distributing a number of circulars illustrating and describing the new "Interpole" variable-speed motor. Circular No. 1 deals entirely with the construction and characteristics of the motor, and circular No. 2 and circular No. 3 illustrate the application of the "Interpole" motors to machine tool driving.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36 West Jackson Boulevard, Chicago, Ill., has recently shipped an additional section of central-energy switchboard equipment to Jackson, Tenn. The Jackson exchange now has an immediate capacity for 1,260 lines, which represents a fifty per cent increase over the original installation. Several increases have been made since the board was installed a number of years ago.

THE BRUCE-MERIAM-ABBOTT COMPANY, Cleveland, Ohio, has been incorporated and will engage in the manufacture of gas and gasoline engines at Fall and Centre streets. The new company is the consolidation of the Meriam-Abbott Company, of Cleveland, builder of vertical-twin-cylinder engines and electric lighting plants, and the Bruce Company, of the same city, builder of the Bruce-Collins automatic power and marine engines. The office of the company is at 8-12 Columbus street.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., is the subject of a very interesting article in the Brookline *Chronicle* of December 31, 1904. In addition to considerable historical and descriptive matter, there are a number of well-executed half-tone plates. Among the illustrations are a portrait of Mr. Charles W. Holtzer, president, a view of the Brookline works and one of the Boston works, and group views of the executive and engineering staff and of the foremen and sub-foremen of the company.

THE F. W. BRAUN COMPANY, Los Angeles, Cal., has been awarded gold medals by the judges of the St. Louis World's Fair, covering practically its entire line of improved apparatus and appliances for assayers, metallurgists and chemists. The exhibit was arranged in three groups, and a gold medal was secured for each group. Among the medal winners were the following: Cary hydrocarbon burner, "Marvel" crude oil burner, Braun gas burner, Cary furnaces, Braun cupel machine, and a complete line of ore-crushing and pulverizing machines.

THE CLEVELAND ARMATURE WORKS, Cleveland, Ohio, is distributing an attractive catalogue calling attention to its dynamos and motors. In introducing this line of dynamos and motors the company is not attempting to bring about any radical change, either in design or mechanical or electrical construction. The company has grown during the past nine years from a small beginning to one of the largest repair works in America. The experience which it has gained through this repair work has brought it to a knowledge of the strong and weak points of all forms of electrical machinery. For its new line of electrical machinery, therefore, it claims perfect commutation, cool running, high efficiency, substantial construction and interchangeable parts, high quality of insulation, perfect balance and handsome appearance.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has placed Mr. George Magalhaes in charge of its eastern office at 136 Liberty street, New York city. Mr. Magalhaes is a graduate of Columbia University, and has been connected with the engineering department of the company for some time. He is thoroughly familiar with the company's products, chief of which are reversing controllers, solenoids, lifting magnets, magnetic switch controllers for reversing or non-reversing motors driving heavy machinery, direct-connected variable-speed motor drive for planers, etc.

MESSRS. GOLDMARK & WALLACE, 67 Cortlandt street, New York city, announce that they will represent the Eck Dynamo and Motor Works in the sale of the latter company's high-grade electrical machinery, consisting of direct-current electric motors in sizes from one-twenty-fourth to twenty horse-power, vertical motors, direct-current generators in capacities of 0.03 to fifteen kilowatts, "Hurricane" direct-current rigid and oscillating fan motors, and special motors and generators to suit the requirements of exceptional cases. Goldmark & Wallace will carry these motors in stock in sizes from one-twelfth to five horse-power.

THE CRESCENT FORGING COMPANY, Pittsburg, Pa., has been organized with a capital stock of $50,000. Its works will be located at Oakmont, a suburb of Pittsburg, and the general offices will be in the Farmers' Bank Building. For the present a forge shop 65 by 150 feet and a machine shop 60 by 100 feet will be erected of steel. A complete power plant, embracing all modern labor-saving appliances, will be installed, and all machinery will be operated electrically by individual motors. The president, Mr. Reuben Miller, Jr., states that he desires catalogues and information from manufacturers in position to furnish any part of this equipment.

JOHN A. ROEBLING'S SONS COMPANY, 117-121 Liberty street, New York city, is distributing an attractive and very practical calendar for 1905. The calendar pad is of large proportions, and the figures are of such dimensions that they may be readily seen at some distance. The illustrations are unique and present a very good idea of the various uses to which the products of the Roebling company may be put. These products include telegraph wire, trolley wire, insulated electrical wires, wire rope for ship and yacht rigging, wire rope for logging, wire rope cableways, wire rope for power transmission, wire rope for mining, elevator rope for office buildings, and suspension-bridge cablework.

THE SCHWERDTLE STAMP COMPANY, 39-41 Cannon street, Bridgeport, Ct., will receive all the assets and assume all the contracts and obligations of the Schwerdtle Stamp Company, 39 Fairfield avenue, and the Bridgeport Stamp Company, 156 Fairfield avenue. The new company has been incorporated under the laws of the state of Connecticut. It has equipped a new factory with increased facilities, including modern machinery and new type, and will be able to handle its growing business more promptly and satisfactorily than ever before. It is the intention to carry a full line of hand stamps, office and factory supplies, such as daters, numbering machines, self-inking stamps, stamp racks, type, pads, inks, steel and stencil letters, figures and metal checks.

THE ATWATER KENT MANUFACTURING WORKS, 112 North Sixth street, Philadelphia, Pa., is placing on the market a new battery switch. This switch is intended for a convenient and durable device, fashioned after larger electrical apparatus. The handle end of the lever is provided with notches to keep the lever in position. The connections are made after the switch has been mounted on the dash. When the connections have been made the switch is covered by the name-plate. This avoids bending the wires after connections are made, in order to screw the switch into place. If it becomes necessary to examine the connections this may be done by simply removing the name-plate. The switch is substantially made, the brass parts being of heavy metal; and the only two holes that are made in the device are in the insulated portion, and these are bushed with brass.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 4. NEW YORK, SATURDAY, JANUARY 28, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

CONTENTS.

EDITORIAL:
Acetylene Gas Lighting in France 139
Compounding Alternators 140
The Electrical Industry and Its Relation to the Mineral Industry 140
The Fixation of Nitrogen 141
Developments in Electric Traction 142
The Electrical Contractors' Association of Ohio 145
An Electrolytic Telephone 145
Telephone and Telegraph Statistics 146
Public Service Corporation Settles Dispute with Newark, N. J. 146
Organization of Texas Independent Telephone Association 146
The Electrical Equipment of the New York "Times" Building 147
Electric State Railway Experiments in Sweden 149
Thirteenth Annual Convention of the Northwestern Electrical Association, Milwaukee, Wis., Wednesday, Thursday and Friday, January 18, 19 and 20 150
Convention Notes 154
Mexican Substitute for Rubber 155
The Combination of Dust Destructors and Electricity Works Economically Considered, by W. P. Adams 156
Annual Convention of the South Dakota Telephone Association 161
The Independent Telephone Association of Nebraska 161
The Institute Annual Dinner 161
Death of Mr. Ernest H. Mullin 161
The Installation of a Transmission Plant 162
Kern River Power Plant Started Up 162
American Institute of Electrical Engineers 162
ELECTRICAL PATENTS 163
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 164
INDUSTRIAL SECTION:
Open Feed-Water Heaters in Connection with Steam Turbines 166
Lodge Electric Igniter for Internal-Combustion Engines 167
The Grinnell Cable-Hauling Machine 167
Wireless Telegraphy in Arctic Exploration 167
Lundell Universal Motors 168
De Cew Falls Power Station, Ontario 169
New Electrical Specialties 169
A New Form of Belt-Driven Alternator 170
Cable-Laying Engine 171
Electric Flashlights 171
Valuable Convention Souvenirs 172
Electric Power in New Zealand 172
New Battery Switch 172
CURRENT ELECTRICAL NEWS 173

MORE SUBWAY WEATHER.

At the present writing the great city of New York is being swept by a very respectable blizzard. The snow is falling rapidly, and is being whirled through the streets and piled wherever a building offers a partial barrier to the gale. Surface electric lines are struggling gallantly to keep the cars moving. The sweepers are out in full force, and they are being assisted by cars coupled behind. The cars themselves are running in twos, and are still able to maintain some sort of service. The elevated roads are perhaps suffering less, since the high wind keeps the structure fairly free from snow, but the dense clouds of flying snow interfere greatly with the view ahead, and necessarily upset the schedule.

A great contrast to these conditions on the street and overhead is the state of affairs in the subway, where the trains are running merrily along, indifferent to both wind and snow. The view along the track is as clear as on the brightest sunny day, the only difference in conditions being possibly the increased number of passengers at the stations, as many naturally wish to take the most comfortable way of getting through the city. The only fault one may find with the subway at the present time is that there is not more of it, but this, it is hoped, will be remedied as time permits. A day like the present one makes one wish that the elevated roads could be enclosed, and thus made fairly independent of storms.

ACETYLENE GAS LIGHTING IN FRANCE.

An interesting summary of the use of calcium carbide for illumination in France is given in *Engineering* (London), for January 6. When it was first shown that it was possible to produce acetylene commercially it was thought that it would supersede in many places both illuminating gas and electric lighting.

Although the production of acetylene took an important place in France in 1896, many disastrous accidents seriously checked its use. This resulted in the taking out of a large number of patents dealing with the production and utilization of acetylene, and finally the government stepped in with certain regulations aimed to diminish the risk caused by the use of this illuminant. When the receiver for the gas did not exceed in capacity 1,000 litres it could be placed in close proximity to dwelling-houses, after obtaining due authority from the municipal government; but when its capacity was greater than this, it was necessary to consider other property, and such receivers were not allowed in any place where an objection might be raised to them. These restrictions, however, were not prohibitive. It is said that there are now 40,000 installations in use in France, five-sixths of which have never been authorized. The insurance companies at first enforced stringent regulations where acetylene was used, but more recently they have modified these and charge no additional premium, provided the gas producers and the supply of carbide are not within the building.

There are 112 towns in France now lighted by acetylene. The consumption of carbide was 4,500 tons in 1898. It has since increased annually until in 1902-1903 the consumption was 14,500 tons. No later figures are available. The pipes used are generally of lead. Some early work of laying these was very unsatisfactory, as the contractors did not appreciate the conditions which should be fulfilled for an installation of this character. The towns using acetylene for street lighting are, as a general rule, small, the population not exceeding 5,000 inhabitants. Street lamps are placed from fifty to sixty metres apart, and usually contain but one burner. The price charged varies in different towns.

Recently one has heard but little about the production and use of acetylene in Europe, and from the conditions frequently

Digitized by Google

reported a year or so ago, one has been rather led to believe that it is used but little. This is probably because we heard only of those cases where a failure occurred. The successful manufacturing companies and those towns where the lighting was satisfactory attracted no attention. There is some satisfaction in knowing that this new illuminant is being used with success, and is apparently growing in popularity. It is evident that its proper field—that of illuminating small towns—is being recognized.

COMPOUNDING ALTERNATORS.

The regulation of alternators so as to maintain a steady voltage on the system is one of the most important problems in the design of these machines themselves, and in the operation of a station. There are a number of ways of doing this, which are more or less satisfactory. The oldest plan, once satisfactory for small systems, was to vary the intensity of the exciting current by means of a rheostat adjusted by hand. This arrangement has been modified by adding an automatic regulator, which adjusts the exciting current as conditions require. Some of these devices are quite simple and give excellent regulation.

Another method of compounding alternators, frequently called "compensating," consists in sending through auxiliary windings on the field the whole or a portion of the armature current previously rectified. While this arrangement takes care of changes in load, provided the power-factor does not change, it does not regulate for varying power-factors. Moreover, it increases the size and the cost of the machine. The latter objection has been avoided somewhat by compounding the exciter, and if this be done in one of several ways, compensation for a change in power-factor is secured at the same time. By modifying the method of applying the rectified current to the alternator fields themselves, it is possible to obtain a regulation for varying power-factors, and this has been done by Heyland and Latour.

All of these methods operate by changing the magnetization of the field-magnet, and hence are not instantaneous in their action, because it requires some time to effect a change in the magnetization of the fields. To avoid this, a method of compensation by means of the armature currents is described in a paper read recently by Mr. Miles Walker, before the Manchester section of the Institution of Electrical Engineers, of Great Britain. The theory of the action of this method is simple, and is said to be effective in use. Its principle lies in the splitting up of the alternator pole into two parts. One of these forms the main field-pole, and is surrounded by the main field-coil. The design is such that this pole is always saturated. Projecting from this pole is an auxiliary pole surrounded by an auxiliary coil which is placed around the two sections of the pole. This auxiliary coil may or may not be used, as conditions require. Assuming it not to be in use, the operation is as follows: the current through the main exciting coil sets up such a flux in the armature as to give the no-load voltage, and, as stated above, produces saturation of this pole. If, then, a current be drawn from the armature, its magnetizing effect tends to produce cross-magnetization of the pole. The arrangement of the two poles and the direction of the rotation are such that this cross-magnetization acts in opposition to the magnetization of the main pole, and hence tends to weaken it, while it magnetizes the auxiliary pole in the same sense as the main pole. The weakening effect on the main pole is negligible, because the latter is saturated; hence the total effect of the armature action is to produce an increased flux through the machine. With a proper proportioning of the main auxiliary poles, this increased flux would be just sufficient to maintain the voltage of the machine constant. This arrangement compensates only for change in load, since for a given current the effect is diminished by a lagging power-factor, and increased by a leading one.

The function of the auxiliary coil is to give the operator control of the compounding effect, for by producing a part of the initial magnetization in the auxiliary pole by means of its coil, the susceptibility of this pole to the armature reaction can be controlled; hence the same machine may be adjusted for flat or any degree of over-compounding. As an instance of this, the following test was given of a 150-kilowatt, three-phase generator. The voltage for no load was set at 416, the field current of the main coils remaining constant. The power-factor was practically unity. Upon throwing full load upon this machine, the voltage rose to 445, showing an over-compounding of six per cent. By diminishing the main current and bringing the voltage up to normal by the auxiliary current, it was possible to adjust the machine to hold its voltage exactly between the load and the full load.

The objection to this method of compensating is that the compounding effect decreases with a decreasing power-factor, but it is held that this objection is not serious under ordinary conditions, for, as a general thing, during the day a generator has to supply the magnetizing currents to transformers. This is chiefly inductive. As the load comes on at night, the power-factor also increases. This is a neat solution of the compensating problem, and has the advantage that its effect is instantaneous. It does, however, increase the size and complexity of the field, and hence must increase the cost. The method is pretty as it uses a disturbing influence to effect the compensation. The armature reaction instead of causing a fall in potential is made to increase it.

THE ELECTRICAL INDUSTRY AND ITS RELATION TO THE MINERAL INDUSTRY.

It is always interesting to notice how intimately electrical methods are interwoven with all our industries. One can not but be impressed with this when examining the reports of any industry, if he is at all interested in following the spread of electrical methods in other industries, and in seeing how the needs of the electrical industry give rise to new industries. For instance, one at first thought would be of the opinion that a report upon the mineral resources of the United States would have but little to attract the attention of electrical men. On the other hand, a great deal of interest may be found in the report which the United States Geological Survey, Department of the

Digitized by Google

Interior, Washington, D. C., has recently issued upon the mineral resources of the United States, covering the calendar year 1903. When examining this report one realizes how intimately the mining industries, the metallurgical industries and others are related to the electrical industry.

Among the minerals important in the electrical industry are, primarily, copper and coal. On the other hand, copper producers are dependent chiefly upon electrical consumers for their output. This is shown significantly by the rapid increase in the production of copper as the telephone, electric light, electric traction and, finally, electric transmission of power were introduced. Previous to the introduction of the telephone, the telegraph was the only electrical application, and this consumed but little copper, since the wires used for transmitting messages were chiefly iron. In fact, for a number of years after the telephone was introduced iron wires were universally used. The copper employed in these industries was chiefly in the manufacture of instruments. When electric lighting came in, the demand for copper caused a marked increase in its production to take place. Thus, the total output of the country in 1876 was about 19,000 long tons. In 1879 it was 23,000 long tons. In 1881 it was 32,000 tons. As electric lighting spread the consumption of copper increased until in 1887 it was 81,000 tons. In the following year it jumped to 101,000 tons. This is the date usually given as the beginning of electric railroading. During the nineties the increase in the output of copper was rapid, and in 1903 it had reached 311,627 tons.

Coal, being necessarily our chief reliance for power production, is vitally important electrically, but, taken as a whole, the consumption of coal in electric power stations is comparatively small. The total consumption of coal for the year 1903 was approximately 1,000,000 short tons per day. As the latest statistics for water power developed in this country show that this was only 438,472 horse-power (this being for the year 1902), it is apparent that while hydraulic development is of vital importance in the production of cheap electric power, this development will not have much effect upon the consumption of coal in this country. It should be borne in mind here that this enormous consumption of coal does not by any means represent the total fuel used in the country, for there were produced during the year in addition over 100,000,000 barrels of petroleum, and nearly 6,000,000 tons of natural gas. Assuming that all this fuel had been used for the production of power, and estimating the average consumption of six pounds per horse-power-hour and the average time of the running, fourteen hours per day, the power produced would have been 26,000,000 horse-power. This may be compared with the 438,472 horse-power made available, but not all used, by water-power stations.

Another metal particularly of interest to the electrician is aluminum, because this is produced entirely by electrical means and is nearly all used in the electrical trades.

Other metals more or less used for electrical purposes are zinc, which finds a small use in batteries and a large use in the manufacture of alloys which are indispensable for the manufacture of electrical apparatus of all kinds; lead, used as a protection for electrical conductors and in the manufacture of storage batteries; nickel, and antimony. Among the minerals are manganese, manganese ores, monazite and zircon, which are the sources of the rare earth oxides used in the manufacture of the Nernst lamp glowers.

Under the heading of clay-working industries we find that about ninety-four per cent of their value for the year represented porcelain electrical supplies, these amounting to nearly $1,500,000. This, it will be remembered, does not include glass insulators.

Carborundum production is another of the new industries depending entirely upon electricity. The production of this material for the year was not much less than that of the natural material, corundum. The latter abrasive is now made in the electric furnace, but none of the artificial corundum was on the market in 1903.

These do not represent all of the mineral industries which are at all related to the electrical industries, but the more important ones have been mentioned. This brief summary of this interesting and valuable report indicates how widely the new power is being used both as a means of producing these materials and as a consumer. In almost all of the industries covered in the report we could find some electrical interest—sometimes commercially; at other times merely of scientific value. Is this not an excellent object lesson of the widespreading electrical influence? Who twenty-five years ago could have imagined such unforeseen development of what was at that time mainly of scientific interest, with but one exception—the telegraph.

THE FIXATION OF NITROGEN.

An improved method of fixing atmospheric nitrogen has been announced by the Siemens & Halske Company, of Berlin. This process is the result of work with the so-called cyanamide process, but it seems to be a distinct advance over the latter. The cyanamide process is one in which the nitrogen in the air is fixed by passing air over calcium carbide. It is said that the resulting compound, which is calcium cyanamide, may be used directly as a fertilizer, and moreover, it contains lime as well as nitrogen. It has been used, experimentally at least, with considerable success at certain agricultural experiment stations.

The new process differs from the other by eliminating one step. Instead of making calcium carbide and then passing over this a stream of air, the air is passed over the mixture of lime and carbon itself, while the latter is being heated in an electric furnace. The process is thus a direct one, and not secondary. There are now several processes by which atmospheric nitrogen may be fixed, and as soon as the cost of doing this has been reduced sufficiently we may expect to see artificial fertilizer take an important position as an article of commerce. A large item in the production is the electric power necessary for carrying on the processes which have so far been devised.

Digitized by Google

DEVELOPMENTS IN ELECTRIC TRACTION.

NEW YORK RAILROAD CLUB DISCUSSES AN IMPORTANT PAPER.

At a meeting of the New York Railroad Club, held January 20, 1905, Mr. W. B. Potter presented a paper entitled, "Developments in Electric Traction." An abstract of the paper is as follows:

The recent advances made in electric traction have made it possible to deal with many classes of traffic which would not have been considered a few years ago; and, although we recognize that there are still many long-distance lines handling a certain description of traffic which is unfavorable to electric haulage, these cases are being reduced each year by the progress of invention, and also by the changes which are taking place in traffic conditions. By this is meant that the passenger service on many lines which was of a concentrated nature a few years back is now becoming more distributed, and is, therefore, favorable to the installation of an electric system.

Electric traction is peculiarly adapted to suburban and interurban railways and the general increase in this class of traffic has been enormous since the inauguration of electric service. The ultimate profits to be derived from any new traction scheme, whether steam or electric, must of necessity depend upon the resulting effect on traffic. This is, in many cases, a more or less unknown quantity when the proposition of electrification is first considered; but both history and experience have proved that in the past the amount of traffic has increased approximately in proportion to the facilities given the public and that it is quite possible to create a new traffic, as well as to provide for that already existing.

For this reason, in considering the electrification of a steam system as a whole, or the electrification of its branch or suburban lines, it is not sufficient to obtain figures showing the likely profits to be derived from such an undertaking merely by compiling data showing the cost of installation and the traffic receipts based upon the number of passengers traveling at that time. A margin may be allowed in favor of electrification due to the extra traffic that the increased facilities are practically sure to induce. The most profitable method of handling a distributed passenger service is by running many short or long trains, as the case may be, at frequent intervals, whereas with steam locomotives it is the general practice to deal with the traffic with only long trains capable of conveying a very large number of people at one time. I draw your attention to this fact, as it shows very forcibly that in a great number of instances where the traffic is of a concentrated nature at the present time, and, therefore, considered as unfitted for being handled electrically, were an electric system installed the traffic would naturally change from the concentrated to the distributed form.

Electricity has been considered for traction in many different ways; but broadly speaking, these may be divided under two main headings—direct-current and alternating-current systems. It has become common practice to style a system as either direct current or alternating current, according to the type of motors used on the car.

The direct-current system, with a central station feeding numerous rotary converters through the medium of three-phase high-tension transmission lines, which in turn supply an overhead trolley network with direct current at a pressure of from 550 to 600 volts, is without doubt the most highly developed and best known system in this country.

The alternating-current system may either employ single or three-phase generators and transformers. Both the generators and transformers will be three-phase where three-phase induction motors are used on the cars; and in such cases the line is equipped with two overhead trolley lines and the track rails serve as the third conductor. When single-phase motors are used on the cars, either three-phase or single-phase generators and transformers may be used, the choice being dependent on local conditions.

Three-phase systems have been extensively used in Europe, especially in Switzerland, Italy and Germany. The three-phase induction motor is particularly well adapted for service in which it is desired to control the speed of the car by means of the motors on down grades, either for the purpose of returning energy to the line or as a measure of safety.

The single-phase alternating-current system possesses two features which recommend its use: economy of trolley copper, due to the higher trolley voltages, and the elimination of the rotary converter. The chief advantage gained by these features is a saving in the initial cost of equipment: factors which increase in importance in proportion to the amount of power required by each car or train and with the length of the trolley line. The relative cost of any alternating-current or direct-current system will be materially affected by the number of cars employed. The saving in power resulting from the elimination of the rotaries is about offset by the greater weight and slightly lower efficiency of the alternating-current motor.

The efficiency of the alternating-current control, during acceleration, will, generally speaking, be somewhat higher than that of the direct-current system with series parallel control. With the alternating-current system fractional voltages can be obtained from the transformer on the car. Each step of the alternating-current controller gives a running position which corresponds with the series and parallel positions in a direct-current controller.

The potential of the transmission lines from the power station may be selected, as in the case of the direct-current system, without reference to the trolley or secondary voltage. The trolley voltage must, however, be considered from a different basis than that of the direct-current systems for the reason that in addition to the ohmic resistance of the trolley and track circuit there is an apparent increase in resistance, due to the alternating current. This increase in apparent resistance for twenty-five-cycle alternating current, as compared to direct current, is about fifty per cent in the trolley wire and between six and seven times greater in the rail return. The rails being steel, the increase in apparent resistance is relatively much greater than in the trolley wire. As the resistance of the track return with large steel rails is proportionately much less than that of the trolley wire, the apparent increase in resistance for the latter and the track taken together will be, roughly, from one-half to twice that for direct current. An alternating current at 1,000 volts is, therefore, about equivalent to 600 volts direct current so far as affecting the amount of trolley copper, and to secure the advantages of the alternating-current system to a reasonable degree at least 3,000 volts or, for heavier service, perhaps 5,000 volts must be employed.

The design of an alternating-current motor as regards length of air-gap and armature speed is affected by the lower average flux density. For this reason an alternating-current motor is larger and heavier than a direct-current unit of the same output.

The equipment of heavy locomotives with alternating-current motors for high-speed passenger service is a possibility, but owing to the limitations imposed by the space available for the motors, it

Digitized by Google

seems probable that two locomotives, each with four motors, would be required for service which could be performed by a single direct-current locomotive with four gearless motors. For locomotives in slow-speed work—such as freight or shifting—a double-gear reduction will, in many cases, be required, owing to the difficulty of winding an alternating-current motor of large size for slow speeds.

It is admitted that the first cost of equipping a railroad electrically is higher than the initial outlay for equipping the same road with steam locomotives; but it is well-nigh impossible to make a general comparative statement as to the relative first cost. This will depend on the number of locomotives required to handle the traffic in the one case and in the other upon the density of the traffic, and it is the latter factor upon which the size of the generating station and transmission lines are dependent.

For example, assume a suburban train of four cars hauled by a steam locomotive, and a similar train operated by electric motors under the cars:

Tests on a steam locomotive in this class of service have shown, approximately, 0.07 indicated horse-power-hour per ton-mile and a coal consumption of 6.86 pounds per indicated horse-power-hour. Assuming coal at $2.50 per ton, the cost of coal per train-mile is 14.5 cents.

The cost of electric power per kilowatt-hour is well established by records from many power stations. As the cost of coal and labor is a variable quantity we will assume $0.006 as a basis. The labor and maintenance of substations may be taken as ten per cent additional, making a total cost per kilowatt-hour of $0.0066. The efficiency of transmission and substations may be taken as seventy-eight per cent. The cost of power for the electric train per train-mile would be 10.3 cents.

The wages per day for a train crew in steam service may be taken as twelve dollars. The crew for the electric train will be the same, omitting the fireman. In steam service this crew will make a train-mileage of, approximately, 100 miles per day. In an electric service, due to its greater flexibility, it is a reasonable assumption that the crew will make a mileage of 150 miles per day.

Under this assumption the wages per train-mile will be: steam, twelve cents; electric, 6.7 cents.

The maintenance of steam locomotives varies, but in this class of service 6.5 cents per locomotive-mile seems a fair basis from the records available. The maintenance of the electrical equipment per car-mile on the Manhattan is $0.025, and as these equipments are larger, we will assume one cent per car or four cents per train-mile.

A summary of the comparative cost per train-mile is as follows: steam, 34 cents; electric, 21.2 cents.

Assuming a yearly mileage of 50,000 miles, which is a reasonable assumption for the electric train, the yearly difference in cost of operation, in favor of electricity, would amount to $6,400, representing an interest on the total investment per train which would be more than sufficient for that usually required for the car equipment and the proportionate part of the power station and transmission. Furthermore, to this capitalized investment should be credited the cost of a steam locomotive equipment capable of making 50,000 miles per year.

The statistics covering the steam and electric operation of the Manhattan Elevated[1] shows an increase in traffic and a lower cost of operation per car-mile, resulting from electrical equipment. The probable increase in traffic was not sufficiently recognized, prior to the electrical equipment, as to be reckoned an important factor in the earnings of the road, but its influence to this end will be better appreciated when it is remembered that during the latter period of steam service the number of passengers carried decreased each year.

Careful calculations should be made, on each individual road considering electrification, as actual results will vary with every new set of conditions. The point at issue is whether the traffic is, or is likely to be, of such a character that the saving in operation or increased receipts will show a proper return upon the required capital.

In considering the application of electric power to freight service, the subject may be considered more strictly from the standpoint of existing traffic, as the reasons which influence the growth of passenger traffic will apply only in so far as the movement of freight may be facilitated and cheapened. Electric power in a single unit, such as locomotive, is best suited for general freight, although there may be special cases where it will be advantageous to equip several or all of the cars in a train and control from the leading car.

As with the steam locomotive, the design of the electric locomotive is influenced by the service for which it is to be used.

[1] See ELECTRICAL REVIEW, November 26, 1904.

The bogie truck type following the precedent of the motor-car was the first to come into general use and it has become a well-established type for general service in high-speed haulage, or for yard shifting where there are many curves. The articulated type is well represented by the locomotives originally supplied to the Baltimore & Ohio Railroad for the Baltimore tunnel. This type is much the same as two coupled locomotives with the disadvantage of not being two independent units, either of which can be operated or repaired independently of the other. The rigid frame type is one in which all axles are held square with the frame and parallel to one another. The mechanical design is strong and simple and well adapted for heavy slow-speed haulage. The additional equipments for the Baltimore & Ohio Railroad tunnel are of this type.

The requirements of high-speed passenger service are especially severe, demanding a locomotive of large power and consequently of heavy weight, as well as one possessing a reasonably flexible wheel-base.

The locomotive recently designed and built by the General Electric Company and the American Locomotive Company for the New York Central Railroad is the result of a careful study of many different types. This electric locomotive differs from any that have previously been built, in having a rigid frame for the drivers and pony trucks at each end for guiding.

The method of conveying electric power to a car or train is influenced by the size of equipment and conditions under which it operates. The simple trolley and wheel in general use has been surprisingly satisfactory in service much more severe than that for which the trolley-wheel was originally considered. The limitation of its capacity is rather in the life of the wheel than from any particular difficulty in collecting the current. With cars of medium size, at moderate speed, an upward pressure of fifteen or twenty pounds against the trolley wire is sufficient and the life of the wheel is frequently 10,000 miles or over. At car speeds of fifty to sixty miles an hour an upward pressure of thirty-five to forty pounds appears necessary to ensure the wheel maintaining close contact with the wire over the irregularities of the suspension. This greater pressure, coupled with the larger amount of current commonly taken at such speeds, results in the rapid wearing of the trolley wheels.

Considerable attention is being given to the development of a collector for heavy

Digitized by Google

service which will cost less to maintain than the present trolley-wheel. The bow form of trolley, in which a sliding bar of copper or aluminum at right angles to the trolley wire replaces the trolley-wheel, has been used to some extent abroad and seems to have met with considerable favor. The cars on which the bow trolley has generally been used are of comparatively slow speed and power, and such tests as have been made indicate that in the equivalent of our suburban service the maintenance of the bow trolley would considerably exceed that of the trolley-wheel. A modification of the bow trolley in which a roller replaces the sliding bar has been used in a number of cases, with excellent results. Where the trolley wire is maintained within a foot or two of uniform height, a reversible trolley contact with a pantagraph mechanism, carrying a roller for contact with the wire, can readily be applied. Where the variation in height of the trolley wire is considerable, on different parts of the same line, the pantagraph construction must necessarily be of considerable size. It is customary to install two pantagraph trolleys, each collecting its share of the current and where necessary to collect a larger amount, as might be the case in locomotive work, additional trolley contacts may be installed to any extent required. A pantagraph type of trolley, provided with a shoe instead of a roller, is well adapted for use in connection with third-rail operation, where it is desired to make contact through special track work or road crossings where the third rail can not be conveniently installed.

The ordinary methods of trolley-wire suspension and insulation are not well adapted for high-potential alternating trolley lines, and what is known as a catenary suspension of the trolley wire will probably be more generally used. In the catenary suspension the supporting cable or catenary is carried over the top of high-potential insulators at the point of support and the trolley wire is attached by clips and hangers directly to the catenary without intervening insulation. The catenary thus serves as a supplemental conductor to the trolley wire and it may be of either steel or copper. As the trolley wire is supported at frequent intervals, the poles for the catenary can be spaced at longer distances than common with the ordinary type of trolley construction.

The third rail, although used to a considerable extent in place of the trolley, has been criticised, particularly from the standpoint of danger and trouble from sleet. The unprotected rail is open to both these objections, but with a suitable protection against accidental contact and from sleet, these objections are to a great extent overcome. A protection providing these features is in use on the Wilkesbarre & Hazleton Railway, New York subway and the one under construction for the New York Central.

The location of the third rail, with reference to the track, would seem to be a simple question, but owing to local conditions, nearly every installation has been different. Between clearing the low-pressure cylinders of compound locomotives, the hoppers on the large steel coal cars and keeping within the bridge abutments and tunnels, the location is generally a case of compromise. It will be advantageous to facilitate the interchange of equipments by establishing a uniform location of the third rail and the importance of such a standard and difficulty of finally determining it will increase with every new installation.

The subdivision of the third rail into sections which will be normally disconnected from the supply circuit and automatically connected when in the immediate vicinity of the car, has many times been proposed. Such an arrangement appears to have little or no advantage, as, apart from the complication introduced, the sectional third rail should be protected by a covering to the same degree as an ordinary third rail. Unless the sections are very short, the rail will be energized for some distance beyond the car, and persons getting on or off, or working about the car, would be likely to receive shocks, and more especially so as the rail would ordinarily be considered harmless. Another important reason for protecting the rail is that the cover will form a shield from sleet, which is much more troublesome on a sectional third rail than on the ordinary third rail.

The third-rail contact shoe, which has been quite generally used, depends on gravity for its contact with the rail; therefore, at high speeds with any unevenness on surface of the third rail this type of shoe shows a disposition to jump and arc excessively. A better form of shoe is one in which the contact is held against the third rail by a spring.

The initial expense of electrical equipment, more especially that due to the cost of power station and trolley line, has deterred many steam railroads from electrifying branch lines in sparsely populated districts. Such lines could be served more profitably by independent cars than by steam trains, as the possibility of economically operating single cars on frequent headway, by providing a better service, would have an important influence upon the development of the traffic.

To meet the requirements of this class of service, a self-propelled car, independent of any feeder system, seems particularly well suited. With this end in view there have been numerous schemes suggested and tried, some employing steam and others compressed air as a motive power; and again, storage batteries and gasoline engines have been used. Without discussing the relative merits of these different methods, it may be briefly stated that the gasoline engine seems to have the advantage of possessing the greatest power for a given weight, and is also able to cover considerable distances—owing to the concentrated nature of the fuel and the high efficiency of the engine in relatively small sizes.

The paper was illustrated by lantern slides. At its close President Vreeland announced that the meeting was open for discussion, and called on Mr. W. J. Wilgus, fifth vice-president of the New York Central & Hudson River Railroad.

Mr. Wilgus stated that the cost of equipment in electrifying a steam road is not the principal part of the expense. On the New York Central the cost of the equipment was about one-quarter of the total cost of electrification. Slow-speed traffic must be separated from high-speed. Grade crossings must be eliminated, and stations and platforms must all be rebuilt. The terminal must also be reconstructed. The increase of business due to the electrification and the consequent better service is looked upon to remunerate the company for the outlay. A steam road uses only part of the property rights. It does not utilize either the overhead or the underground rights, and can only expand sidewise, while an electric road can be used both overhead and in tunnels. With electric traction a great amount of switching is done away with, as multiple-unit cars can each switch themselves. Another item of expense on the New York Central which will be done away with by electric traction is the frequent cleaning of the Park avenue tunnel. This tunnel is now cleaned thoroughly every two weeks. The gases and noise from locomotives are an additional annoyance.

Mr. Frank J. Sprague said that the largest question in the electrification of steam roads is, will trunk lines be operated electrically, and will alternating current or direct current be used; also, will high

Digitized by Google

tension or low tension be used? He stated that it is possible to run trunk lines electrically with low voltage if the traffic is dense. The load on a substation is proportional to the distance between them, and increases as the distance between them increases, irrespective of the density of the traffic.

Mr. B. G. Lamme spoke of the increase in the size of motors being attended with an increase in voltage in stationary work. He called attention to the fact that there had been almost no increase in voltage in railway work. He does not believe that the third rail is suitable for freight service, and that the trolley must be placed either overhead or underground. If the voltage used on railway motors is increased, the overhead trolley can be retained. If direct current is used with low voltage and heavy service, 3,000 or 4,000 amperes would be necessary on the line, and this would be objectionable with overhead work. He thinks that the remedy will be to use high-tension alternating current with a small current, and considers that the single-phase system is the best; or a motor-generator might be used on the car with polyphase motors. He stated that a 15,000-volt trolley apparatus is now planned with a speed of ten miles per hour for freight service. Catenary suspension will be used for the trolley wire. He considers that motor-generator systems are not flexible enough for universal use on railways, but that the pure single-phase system is perfectly flexible and can be adapted to any service. High voltage can be used outside of the yards or on grades with alternating current, and it can be varied to suit conditions of speed. This can not be done with direct current. With alternating currents the voltage can be varied without opening the circuit, thus doing away with the complications incident to direct-current control.

Mr. B. J. Arnold stated that he was glad to hear Mr. Potter say that alternating-current railway motors were a success. He early thought that the direct-current system would not be able to put the steam locomotive out of business. He said there were three possible ways of using alternating current, namely: the series single-phase motor, the motor-generator used on the Ward Leonard system, and three-phase motors on the axles. The two latter systems were handicapped by requiring an excessive weight of locomotive. The single-phase series motor has been developed and seems to be the solution of the problem of electrifying steam lines. He believes that the elimination of grade crossings is absolutely essential, but is opposed to the use of the third rail. He discussed the reasons for the adoption of direct current on the New York Central, and stated that alternating-current motors for railway work were not sufficiently developed at the time the decision was made to warrant their adoption. Local conditions also required direct current. He agrees with Mr. Sprague that the density of traffic affects the application of electricity to trunk lines, and thinks it would not pay one road in a thousand in the United States to equip its system with direct current, but that it would pay nearly all to equip with alternating current. Roads will electrify their systems for passenger service, which will grow rapidly, and freight service will eventually be operated electrically, as it will be the smallest part of the business, and it will not pay to use two systems.

Mr. George Gibbs spoke of the difficulties of finding a form of rail or transmission to suit all classes of service. He is opposed to the building of cars which encroach more on the permanent way than do those in use at present, and spoke of the difficulty of installing a third rail so as to clear steel hopper cars and compound locomotives. On the later freight cars the truss rods are too close to the rails, so that no room is left for the third rail. He hopes that a thorough discussion of the proper position of the third rail will soon take place.

Mr. J. G. White favors putting the advantages and disadvantages of electrification of steam lines in separate columns, translating them into dollars and cents, and then adding up and finding which is the better. He spoke of the increase of traffic on electric lines, and the decrease of traffic on steam lines in the West. He favors the third rail, and described the difficulties experienced with the bow trolley in Holland. He stated that on the line recently constructed by his company there the cars were equipped with the bow trolley, and that at one time, while fifteen per cent of the equipment was in use on the line, every trolley was disabled.

Mr. Potter, in closing the discussion, stated that the third rail will do its work perfectly with proper protection from sleet and accidental contact, and that it will be quite permanent. He thinks that the Manhattan Elevated Railroad could be operated with a trolley, if necessary, at 600 volts, if two pantagraphic trolleys were placed on each car.

The Electrical Contractors' Association of Ohio.

The Electrical Contractors' Association of Ohio met in regular semi-annual session at Cleveland, Ohio, January 11, 1905. The occasion was a notable one on account of the number of representatives present from all parts of the state, together with the presence of large numbers of supply dealers and manufacturers, making the meeting by far the largest and most important of any hitherto attempted in the history of electrical work in Ohio.

The pleasure of the occasion was enhanced by the presence of the Buckeye Club, which is composed of the electrical supply dealers in Ohio, Indiana, and cities bordering thereon. The contractors' association after transacting its business entertained as guests the members of this coterie at an elaborate banquet

The report of the state secretary showed considerable growth for the contractors' association since its last meeting, there being some fifty delegates present on this occasion. National Secretary W. H. Morton, of Utica, N. Y., was present and made a statement showing a wonderful growth on the part of the national association generally, in point of membership, finances and trade conditions.

The delegates were guests of the local Cleveland association. Mr. F. C. Werk, as state president, welcomed the members in a few well chosen remarks. The meeting together with the banquet was held in the well-known assembly room of the Hollenden Hotel.

Delegates were present from Cincinnati, Cleveland, Columbus, Toledo, Canton, Dayton, Springfield, and other points. Mr. E. M. Lawton, of Cincinnati, and Mr. J. C. McMaster, of Columbus, were elected state directors and representatives to the national meeting in Boston in July.

The convention adjourned to meet in Toledo the second Wednesday in August. All present were enthusiastic because of the growth of the association, and the advantages it offered to members.

An Electrolytic Telephone.

A novel electrolytic telephone has been invented by Herr E. Ruhmer, of selenium cell fame. This apparatus consists mainly of an electrolytic cell, with electrodes of unequal size. When the electrodes are traversed by microphone currents the cell reproduces the words spoken into the microphone, to which it is connected. The apparatus was recently exhibited at the jubilee exhibition of the German Electrical Society in Berlin.

Digitized by Google

Telephone and Telegraph Statistics.

Bulletin No. 17, of the Bureau of the Census, Department of Commerce and Labor, Washington, D. C., contains the most complete statistics of the telephone and telegraph industries that have ever been compiled for this country. The figures given in these statistics are for the year ending December 31, 1902.

The magnitude of these two industries and their relative importance are indicated by the following figures: there were in operation at that time 4,151 telephone systems and twenty-five telegraph systems. The former had 4,850,486 miles of wire; the latter, 1,318,350 miles, not including 16,667 nautical miles of submarine cable operated by submarine cable companies. The capital stock and bonds outstanding were for the telephone systems, $348,031,058; for the telegraph systems, $162,946,525. The total revenue of the telephone systems for the year was $86,825,556, and for the telegraph systems, $40,930,038. The total assets of the telephone systems were $452,172,546; for the telegraph they were $195,503,775. Of this, the value of the construction and equipment was $366,561,694 for the telephone; $156,911,448 for the telegraph. These totals do not include the rural telephone lines having no exchanges, nor the telephone and telegraph lines operated by railroads. Figures from the latter are given separately.

Taking up first the telephone, it is shown that the 4,151 systems had 2,178,366 subscribers, and had in use 2,315,297 telephones. Over these systems there were conducted 5,070,554,553 conversations. These companies employed 14,124 salaried officers, to whom were paid $9,985,886. There were 64,628 wage-earners, who earned $26,369,735. Their operating expenses and fixed charges, not including interest on bonds, were $61,652,823. The gross receipts from operation were $81,599,769.

The average number of messages sent during the year per telephone was 2,190. The average gross income for the year was $37.50 per telephone. The operating expenses were $24.56. The fixed charges were $3.58, leaving an average net income per telephone per year of $9.36. During the year the amount added for new construction was $51,903,021. There were 10,361 public exchanges. This represents the entire number of offices in which intercommunication is made between subscribers. There were 4,985 independent rural lines reported which do not operate exchanges. There were 7,783 private branch exchanges reported for the year.

Of the total 4,151 telephone companies, 44 were Bell and 4,107 independent companies. The Bell companies were operating 3,387,294 miles of wire; the independent companies, 1,462,562 miles. The Bell companies had 1,222,327 subscribers; the independent companies, 956,039. The former companies had in service 1,317,178 telephones; the latter, 998,119. There were in operation fifty-four companies using an automatic system, one of these being a Bell system, and the other fifty-three independent.

Of the 2,271 incorporated telephone companies, forty-four were Bell companies, and 2,227 independent companies. The par value of the capital stock and bonds outstanding for the Bell companies was $233,270,936; for the independent companies this was $114,760,122.

Of the twenty-five telegraph systems in operation, twenty-one were incorporated. The par value of the stocks and bonds outstanding was $162,146,525. There were 1,307,046 miles of wire. Of this, 816,593 miles were operated by the single Morse system; 185,048 by means of the duplex system; 294,910 by the quadruplex system, and 10,495 by machine or automatic systems. Of the total miles of wire in use, 21,658 were underground; 679 miles were in submarine cables, and 1,265,368 were overhead.

The commercial telegraph systems employed 829 salaried officers, who received $1,162,632, and 26,798 wage-earners, who received $13,877,041.

Six hundred and eighty-four railway companies reported the operation of telegraph and telephone lines in connection with their transportation business. The total miles of wire in these systems were 1,127,186. There were 17,606 telephones in use, and 85,753 telegraph instruments. The number of telegraph messages sent during the year for railway business alone was 201,743,756, and there were, in addition, 4,474,593 commercial messages sent over these lines.

Public Service Corporation Settles Dispute with Newark, N. J.

The city of Newark, N. J., has settled its dispute with the Public Service Corporation over the payment of five per cent of the gross receipts to the city by the company on all the trolley lines in the territory annexed to the city of Newark. An agreement has been draughted by City Councilor Coult, and has been approved by the officials of the Public Service Corporation. The agreement describes the territory affected, and stipulates that five per cent shall be paid on annual gross receipts within the city limits, whether the territory over which the tracks are laid was a part of the city prior to the agreement which originally instituted the five per cent payment, or has been annexed since, or may be annexed in the future. In the agreement the limits of the five-cent fare are also determined. The company is willing to carry passengers from one city boundary to any other city boundary, providing that it be not required to carry them over the Orange mountains, if the city should ever extend that far.

The agreement is the result of action taken by the city council of Newark, rescinding the permission given by the city as a property-owner to the Public Service Corporation to build a loop around the new city hall, and of a resolution passed by the city council requesting the Board of Public Works to show no favors to the Public Service Corporation until it had complied with the city's demand regarding the payment of five per cent of its gross receipts on all lines in the territory which had been annexed to Newark since the original agreement between the city and the corporation.

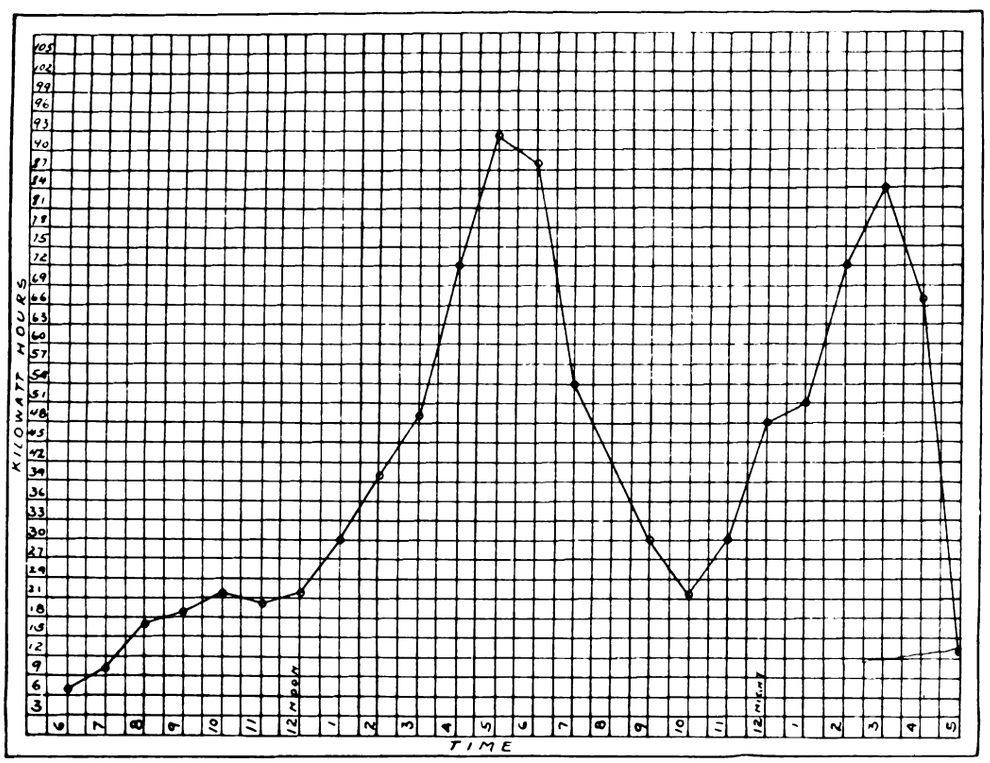
Organization of Texas Independent Telephone Association.

The Texas Independent Telephone Association organized in Dallas, Tex., January 5, 1905, with the following membership: E. M. Chamberlain, Greenville; C. A. Shock, Sherman; W. J. Johnson, Wills Point; R. T. Riddle, Weatherford; C. W. Roberts, Abilene; E. R. Webber, Orange; W. P. Johnson, Corsicana; F. B. McElroy, Dallas; E. W. Dunaway, Paris; H. C. Schumacker, La Grange; J. B. Earle, Waco; Charles W. Emmer, Beaumont. The association elected the following officers: E. W. Dunaway, Paris, president; vice-presidents, E. R. Webber, C. W. Roberts, W. P. Johnson; secretary and treasurer, J. B. Earle. The members present represented 12,580 telephones in actual use in Texas, and 4,250 miles of long-distance toll lines. This does not include any independent telephones or independent telephone lines, except such as were personally represented at the meeting. The association determined to confine its membership to bona-fide stockholders in or managers of independent telephone companies. Persons interested in the manufacture or sale of supplies for independent telephone companies are entitled to honorary membership. A paper was read indicating the policy of the owners of the independent telephone companies of Texas.

Digitized by Google

The Electrical Equipment of the New York "Times" Building.

THE new building of the New York *Times* is unique among large office buildings in New York in that it has no independent power plant. All the current used in the building is supplied by the New York Edison Company. A number of reasons influenced the choice of the outside service in preference to the independent plant. One of the most important was the fact that for a large part of the year there would be no fire in the basement, and the high heat which would attend the operation of a high-pressure steam plant in the summer months would thereby be avoided. This would also eliminate the necessity of providing a large and expensive ventilating system. Other reasons were the saving in space, the saving in first cost, and the saving in annual cost of operation. Furthermore, as the Edison company can furnish current from a number of different stations, the liability of a breakdown in the service is greatly diminished.



LOAD DIAGRAM AT "TIMES" BUILDING.

The Times Building has two load peaks —one between 5 and 6 P. M., due to the lighting of the offices and heavy service on the elevators about that time. The second peak is due to the operation of the presses in the early hours of the morning. To overcome these peaks it would be necessary to provide a large reserve equipment or an expensive storage battery plant. The load curve is shown in Fig. 1.

Current is brought into the building from three different Edison services—from Broadway, from Forty-second street, and from Seventh avenue, and is distributed by the three-wire system. A meter-board, shown in Fig. 2, is located at the point where each of these services enters the building. From each of these meter-boards ten cables of 800,000 circular mils carry the current to the main switchboard, which is shown in Fig. 3. The main switchboard is composed of three panels, each of which represents a separate service. Each panel is six feet long and seven feet ten inches high. The board is made of gray Tennessee marble two inches thick. The diagram of the switchboard is shown in Fig. 4. The upper part of each panel is devoted to the lighting circuits, and carries laminated, three-pole, double-coil combination switch and circuit-breakers. There are twenty-six of these circuit-breakers in all. They are so arranged that the neutral and one outside leg may be thrown out together, the remaining leg being independent. The power circuits are taken from the bottom of the board, and there are no circuit-breakers on this part of the system. It was not desirable that the presses should be stopped by any sudden rush of current, due to a small temporary overload, but the motors are amply protected by fuses. The centre portion of each panel of the switchboard is occupied by two 500-ampere recording ammeters and a special three-throw kiss switch which is shown in Fig. 5. This switch is designed so that each of the main panels may receive current from any one of the three Edison services. The lower portion of each panel, in addition to the power switches, carries a 2,000-ampere recording ammeter. A recording voltmeter is placed on the upper part of the centre panel.

In addition to the Edison service, subway current is used in the basement and first floor of the building on some of the lighting circuits. A transformer in the Times Square station of the subway transforms 11,000-volt current from the primary subway circuit to 220 volts. From this transformer a single-phase current is brought into the building and used in Nernst lamps and about 1,100 incandescent lamps.

Three wires are taken from the main switchboard to each of the lighting panels on the different floors. Current is distributed from the lighting panels to the various lamps by two-wire circuits. In the various offices incandescent lamps are used, there being a chandelier and wall lights in each room. In the two arcades on the ground floor and in the basement Nernst lamps are employed as well as incandescent. The pressroom and composing room are lighted by Cooper Hewitt mercury vapor lamps, there being twenty-two in the pressroom and ten in the composing room. In addition to the mercury vapor lamps in the pressroom, twenty-eight incandescent lamps are installed in the press pits—seven in each pit, including one portable lamp. The Cooper Hewitt tubes are twenty inches long and one inch in diameter, and are arranged two lamps in parallel. Each tube is 300 candle-power, and three and one-half amperes are required for each pair of lamps. In addition to the other lamps in the building, fifteen arc lamps are used in various places, and also a Moore vacuum tube, which is on the alternating-current circuit. This tube is installed in the basement, near the ceiling, and conforms to the shape of the room lighted. A large searchlight is mounted on the top of the tower. The total number of incandescent lamps in the building is 6,205. All of them operate at 110 volts, except those on

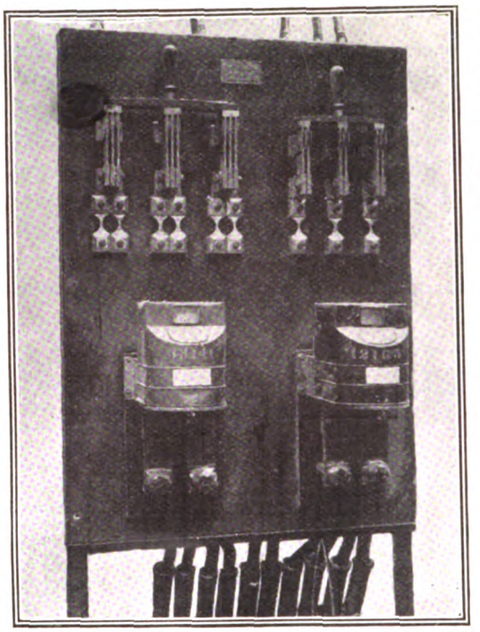
Digitized by Google

the 220-volt, alternating-current circuit. One hundred and eight motors are used in the building, with a total of 1,175 horse-power. The four presses in the basement each has a seventy-five-horse-power motor, which operates the press at full load. The presses are controlled by the Kohler system. Two motors, one of fifteen and one of ten horse-power, are used in this system to start and control the presses and bring them up to speed. Until the presses are running at full speed, the seventy-five-horse-power motor is disconnected. After the press is at full speed the two smaller motors are thrown out, and the seventy-five-horse-power motor carries the load alone. A number of other motors are installed in the pressroom. There are two twenty-horse-power motors on the auto-plate machines, and eight twenty-four-horse-power motors on the paper hoists. The motors on the auto-plate machines are controlled by an adaptation of the Kohler system. A paper-conveyer, running from the pressroom to the ground floor, is operated by a ten-horse-power motor.

The linotype machines on the sixteenth floor are operated by thirty-eight special slow-speed, one-quarter-horse-power motors, which run at 650 revolutions per minute.

There are a large number of smaller motors, ranging from one-half to three horse-power, used on various machines in the press and composing rooms. These motors operate blowers, shavers, jig saw, trimmers, grindstone, proof-presses, job-presses, etc.

There are four high-speed passenger elevators, which are controlled by the

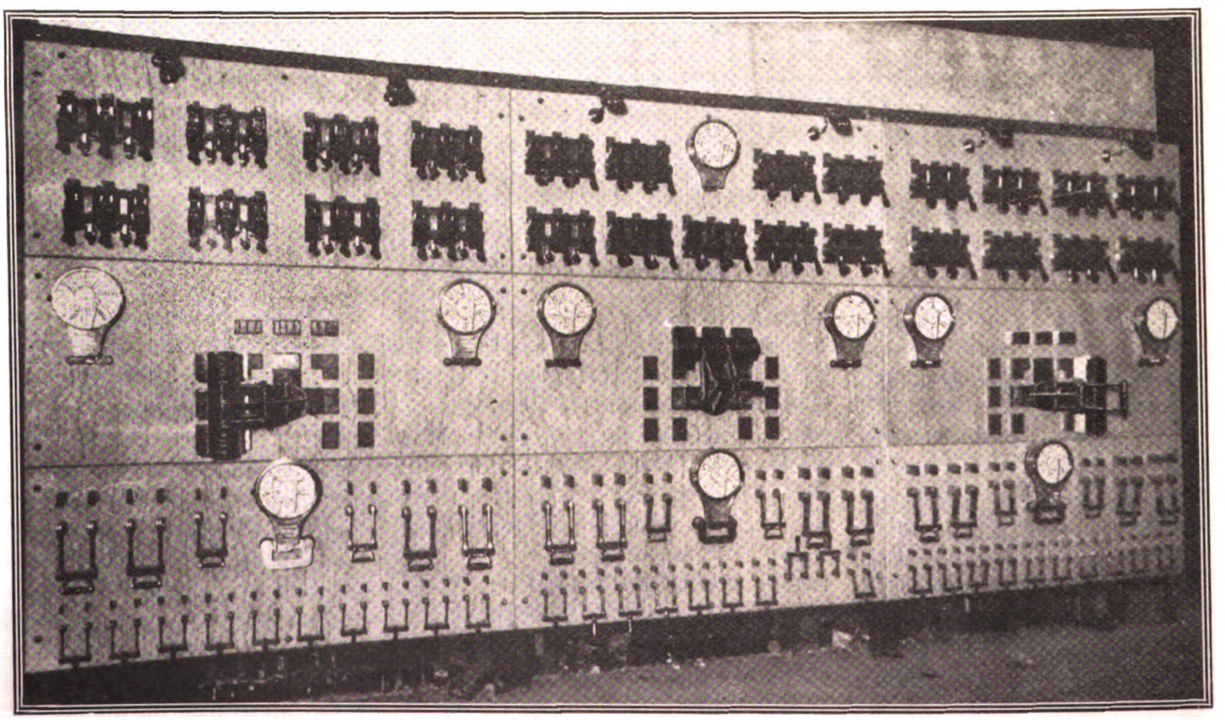


Edison Meter-Board, "Times" Building.

Ward Leonard positive control system. One of these elevators has an ascent of 326 feet, one and one-quarter inches. Two of them have a rise of 217 feet, three and three-quarters inches, and one a rise of 201 feet, three-quarters of an inch. The elevators run at 350 feet per minute, with a maximum load of 3,000 pounds. Each elevator is run by a forty-horse-power motor. Three other motors, of twenty-five, seventeen and one-half and ten horse-power, respectively, operate tower and sidewalk elevators. An elevator which runs from the gallery in the composing room to the main floor of the composing room, is used for transferring the forms. The latter elevator is operated by a five-horse-power motor.

The water in the building is supplied by two Gould triplex power pumps, each of which is operated by a thirty-five-horse-power motor. These motors are connected to the pumps by means of Morse silent chain drives. In addition to the house pumps there are three sewage pumps, each operated by a ten-horse-power motor. These motors are connected to a float, so that they will automatically start when the water in the sewage manhole reaches a certain level, and stop when it has all been pumped out.

A complete system of pneumatic tubes is installed in the building for transferring matter from the different departments of the paper. Compressed air is furnished this system by means of an air-compressor which is operated by a two-horse-power motor. This motor starts automatically at any decrease of pressure in the system and stops when the normal working pressure is restored.

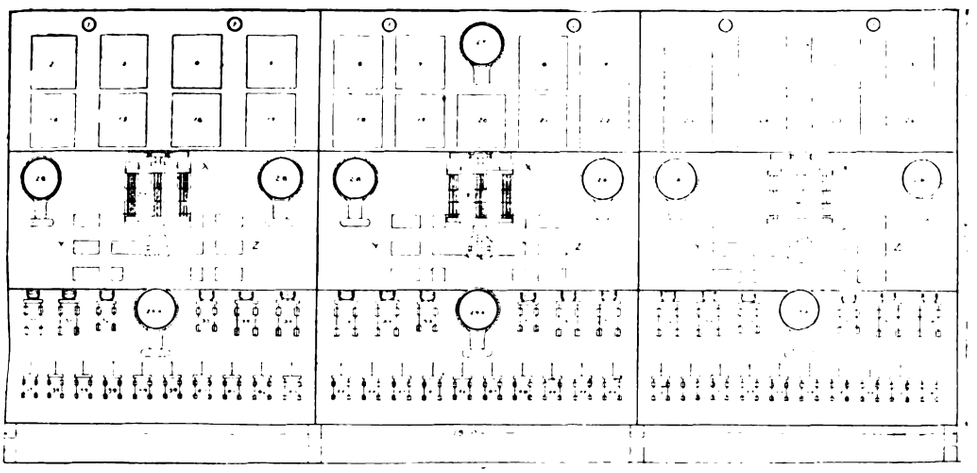


Main Switchboard, "Times" Building.

All the motors in the building operate at 220 volts, with the exception of a few small motors of under one-half horse-power, which operate at 110 volts, and which are connected to the lighting cir-

Digitized by Google

cuits. For furnishing current for the messenger call, time clock, telephone service, etc., a motor-generator is installed in the basement. This furnishes a low-voltage current for operating the above devices. The motor-generator is connected to a storage battery system, which is used when the motor-generator is shut down. This motor-generator and storage battery system are controlled through a special switchboard in the basement.



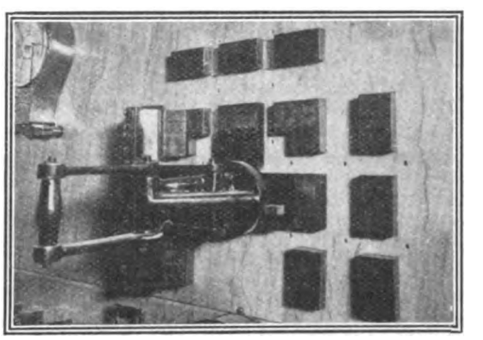
SWITCHBOARD DIAGRAM, "TIMES" BUILDING.

1—Two light brackets. Twenty-six circuit-breakers for service noted. 2—First floor. 3—20th, 21st, 22d floors. 4—17th, 18th, 19th floors. 5—16th floor. 6—13th, 14th floors. 7—11th, 12th floors. 8—9th, 10th floors. 9—7th, 8th floors. 10—5th, 6th floors. 11—3d, 4th floors. 12—2d floor display. 13—Second subbasement (A). 14—Spec. halls, 17th to 24th floors, inclusive. 15—15th floor. 16—23d, 24th floors. 17—Spare. 18—Spare. 19—Second subbasement (B). 20—Reg. halls, 17th to 24th floors, inclusive. 21—Reg. halls, 2d to 16th floor, inclusive. 22—Spare. 23—2d floor. 24—Basement. 25—Subbasement. 26—Spec. halls, 2d to 16th floor, inclusive. 27—Recording voltmeter. 28—Recording ammeters. 500-amperes. 29—2,000-ampere circuit-breakers; service No. 1. 29a—2,000-ampere recording ammeters. 30—Press switch. 31—Press switch. 32—15th floor power switch. 33—Spare switch. 34—Press switches. 35—Elevator switches. 36—House pump switches. 37—Heating apparatus switches. 38—Searchlight switch. 39—Six switches for two hoists each. 40—Vent fan switch. 41 Switch for vent motor at roof. 42—Switch for exhaust fan. 43—Switch for air-compressor. 44—Switch for paper dumbwaiter. 45—Switches for auto-plate machines. 46—Switches for plate shaver. 47—Switches for tail cutter. 48—Switches for machine shop. 49—Switches for elevators. 50—Switches for motor-generator (Bells). 51—Switch for Kenney vacuum sweeping system. 52—Switch for matrix heater. 53—Switch for moulding machine and steam tables. 54—Spare switches. X—Edison service No. 1. Y—Edison service No. 2. Z—Edison service No. 3.

Two hundred and fifty-seven telephone outlets are provided in the building, and four telephones can be supplied at each outlet. Eight hundred wires leave the building and connect with a cable of the New York Telephone Company under Broadway. Fifty-one telephones can be used at one time within the building. One hundred of these wires are used by the newspaper. One hundred and sixty-two wires are laid in cables from the Western Union and Postal Telegraph lines. Eighteen loops for instruments are arranged in the newspaper telegraph room, and provision is made for twenty-two more. The Western Union company's cable contains 100 wires. Fifty of these are led to the newspaper's telegraph room. The Postal Telegraph company has sixty-two wires running into the building, of which thirty are used by the newspaper.

In addition to the uses of electricity heretofore mentioned, it is also employed for the plate-warmers, coffee urns, teakettles, etc., in the restaurant; for heating soldering-irons, and for heating the stereotyping paste pot; also for heating hair curlers and tailors' irons. In dental work in the building it is used to operate a mallet, a gold annealer, a sterilizer, dental engine, mouth lamp, porcelain baking furnace, X-ray apparatus and cautery.

All the wires used in the building are rubber-covered. The insulation was tested up to 5,000 volts before installation. Twenty-one miles of conduit and seventy-five miles of wire are used in the building, running from the main switchboard to the various appliances and lights. All wiring is done on the Edison three-wire system, with a voltage of 220 between the two outside wires, and 110 between either outside and the neutral wire. In all cases



THREE-THROW KISS-SWITCH AT "TIMES" BUILDING.

the neutral wire has twice the cross-section of either of the outside wires, the sizes of most of the sets being No. 2, No. 00, and No. 2, respectively. All cables in the building run in iron pipe to the panel-boards and motors. The panel-boards are all of marbleized slate, and are arranged with the bus-bars exposed on the surface. The wiring has been so designed that the load can be increased about thirty-eight per cent without any change being made.

All the cables are carried from the main switchboard in the basement to the upper floors in shafts which are located at the north and south of the elevator shafts, and which run from the bottom to the top of the building. In order to take the strain incident to the great length from the upper end of the cables at the top of the wire shafts, special pull boxes were arranged at the seventh and fifteenth floors. These pull boxes consist of a box containing an iron rod, on which are strung porcelain insulators. The cables are looped around these insulators and fastened. The north shaft supplies all floors below the seventeenth, the tower of the building being supplied by wires in the south shaft. The north shaft contains, at the ground floor, twenty-five conduits, in addition to space for the telephone service. The south shaft contains ten conduits, which are used for the lighting service only.

The wiring plans were furnished by Clark & MacMullen, and the wiring was done by Peet, McAnerney & Powers, of New York city.

Electric State Railway Experiments in Sweden.

United States Consul S. S. Bergh, at Gothenburg, Sweden, gives some additional information with regard to the electric railway tests which are to be carried out on the Sweden state railways. Some time last spring the railway board petitioned the government for permission to erect electric transmitting apparatus on land belonging to the state, between Tomteboda and Värtan, in order to carry out the experiments with electric traction, for which a grant of $134,000 had been made by the Riksdag. At Tomteboda station double wires will be used, and at Värtan the contact system will be employed for transmitting the current from the power station to the electric locomotive or motor-car. The rails will serve for the return current. For these experiments a high-tension, single-phase, alternating current will be used. The tension and frequency will be varied as desired.

These experiments are of much importance to the entire country, and the board of trade has recommended that the request of the railway board be granted, provided the permission to erect and use the apparatus be limited to a certain period, say, five years, and that private rights be protected.

Digitized by Google

Thirteenth Annual Convention of the Northwestern Electrical Association, Milwaukee, Wis., Wednesday, Thursday and Friday, January 18, 19 and 20, 1905.

WEDNESDAY MORNING SESSION.

THE thirteenth annual convention of the Northwestern Electrical Association was called to order on Wednesday, January 18, 1905, at 11.45 A. M., in the clubroom of the Hotel Pfister, Milwaukee, Wis., by the president, Mr. T. F. Grover.

After the usual routine of calling for and approving the minutes of the last meeting was dispensed with the president delivered his annual address, an abstract of which follows:

"The past year, I believe, has been a successful one to the great majority of the central stations as well as to the street and interurban railway interests. Electricity is constantly reaching out and finding new industries to conquer. The last year will go down in history as an eventful one in electrical industries. One of the more important achievements being the opening of the great New York subway, which would not have been possible without the aid of electricity. The perfecting of the single-phase railway motor has done much for the interurban railway, as it permits the transmission of electrical energy for greater distances, and by the use of transformers does away with expensive substations and opens the way for the speedy conversion of steam railways to electric.

"But little has been heard of 'municipal ownership' in the territory covered by this association during the past year. Municipal plants now in operation have failed to show the large profits predicted, and it is easily to be seen by all fair-minded business men that a corporation, properly managed, operating commercial lighting, power and railway plants, can and does furnish better and cheaper street lighting than can be furnished independently by any political body."

The secretary's report was then rendered and approved, and a recess taken until 1.30 P. M.

WEDNESDAY AFTERNOON SESSION.

After calling the convention to order the president appointed as a nominating committee, J. H. Harding, O. M. Rau and R. M. Kimball.

Membership committee: S. B. Livermore, P. H. Korst and W. B. Jackson.

The report of the legislative committee was then presented.

LA CROSSE, WIS., Jan. 17, 1905.

NORTHWESTERN ELECTRICAL ASSOCIATION,
Milwaukee, Wis.

Gentlemen—I beg to submit the following report on legislation in the several states covered by this association. So far as the subcommittees have reported there has been nothing of much moment to the electrical business enacted or proposed since our last meeting.

The committee from Iowa reports an act covering malicious mischief and trespass which I append here to be read in full.

The committee from Illinois reports no bills passed detrimental to electrical interests.

The committee from Indiana reports a bill for an act concerning municipal corporations pending before the state legislature of Indiana, and expects to have a copy of same to read to convention.

The committee from Michigan does not reply to my request for a report.

The committee from Wisconsin also makes no report, although ample time has been given it to reply to my request for a report. In relation to Wisconsin, I append the heading of Governor La Follette's new bill on taxation of electric and gas properties, street railways, and life insurance companies, which bill the Wisconsin members can procure from their representatives for reading.

The committee from Minnesota reports no meeting of legislature last winter, and so far as can be learned nothing important nas been introduced this term.

This covers the states except Michigan, and there has been almost nothing done to change the existing laws governing our business. Your general chairman has changed his residence from Minnesota to Wisconsin, and is no longer eligible to serve on Minnesota's subcommittee.

Respectfully submitted,
S. B. LIVERMORE,
Chairman committee on legislation.

CEDAR RAPIDS, IOWA, Jan. 12, 1905.

The following laws were passed by the thirtieth General Assembly of the State of Iowa affecting electrical interests:

Chapter 130.

MALICIOUS MISCHIEF AND TRESPASS.

H. F. 381.

An act to repeal section four thousand eight hundred and seven (4807) of the code and of the supplement to the code, and to enact a substitute therefor, relating to malicious mischief and trespass.

Be it enacted by the General Assembly of the State of Iowa:

Section 1. Repealed—Malicious injury to highways, bridges, railways, telegraph lines, etc. That section four thousand eight hundred and seven (4807) of the code, as the same appears in the code and the supplement to the code, be, and the same is, hereby repealed and reenacted; and when reenacted, the same shall read as follows:

"If any person maliciously injure, remove or destroy any electric railway or apparatus thereto belonging, or any bridge, rail or plank road; or place, or cause to be placed, any obstruction on any electric railway, or on any such bridge, rail or plank road; or wilfully obstruct or injure any public road or highway; or maliciously cut, burn, or in any way break down, injure or destroy any post or pole used in connection with any system of electric lighting, electric railway or telephone or telegraph system; or break down and destroy or injure and deface any electric light, telegraph or telephone instrument; or in any way cut, break or injure the wires of any apparatus thereto belonging; or shall wilfully tap, cut, injure, break, disconnect, connect, to make any connection with or destroy any of the wires, mains, pipes, conduits, meters or other apparatus belonging to, or attached to, the power plant or distributing system of any electric light plant, electric motor, gas plant or water plant; or shall aid or abet any other person in so doing, he shall be imprisoned in the penitentiary not more than five years, or be fined not exceeding five hundred dollars, or imprisoned in the county jail not more than one year, or by both such fine and imprisonment at the discretion of the court."

Approved March 30, A. D. 1904.

Chapter 132.

THE WILFUL TAKING OF ANY ELECTRIC CURRENT, GAS OR WATER FROM THE WIRES, METERS OR PIPES.

H. F. 382.

An act prohibiting the wilful taking of any electric current, gas or water from the wires, meters, pipes or any apparatus of any electric light, electric motor, gas or water plant with intent to defraud.

(Additional to chapter five (5) title twenty-four (xxiv) of the code.)

Be it enacted by the General Assembly of the State of Iowa:

Section 1. Larceny—If any person wilfully and with intent to defraud, in any manner take from the wires, pipes, meters or any other apparatus of any electric motor, electric light, water or gas plant or works, any electric current, water or gas, he shall be guilty and shall be punished accordingly.

Approved March 30, A. D. 1904.

Respectfully submitted,
W. J. GREENE,
Chairman subcommittee.

DIXON, ILL., Jan. 7, 1905.

In reply to yours of the 7th will say that the Illinois Electrical Association has looked after legislation in this state. There was no bill passed detrimental to the business.

ED. P. MAXWELL,
Chairman Illinois state committee.

LA PORTE, IND., Jan. 7, 1905.

Answering your letter of the 6th, we beg to report that the legislature does not meet until the 9th of January. We were at Indianapolis yesterday looking up this matter, and are happy to report, that so far there are no bills reported that are hostile to us. Should there be any introduced later on we will so report.

J. H. HARDING.

LA PORTE, IND., Jan. 14, 1905.

We beg to report that there is a bill for an act concerning municipal corporations pending before the state legislature of Indiana; so far we have been unable to get hold of a copy of the bill, but hope to be able to bring one to the convention.

J. H. HARDING,
Chairman Indiana legislative committee.

The committee on uniformity of advertising matter made a report, which

Digitized by Google

was accepted, and the committee was ordered continued during the ensuing year.

The following applications for membership were received, and the secretary instructed to cast one ballot:

ACTIVE—John Powers, Sterling, Ill.; George P. Dravo, Milwaukee, Wis.; J. Carson, Duluth, Minn.; J. B. Hirst, Kenosha, Wis.; John Wright, Antigo, Wis.; W. E. Haseltine, Ripon, Wis.; Mt. Morris Electric Light and Power Company, Mt. Morris, Ill.; Oak Park Yaryan Company, Oak Park, Ill.; La Crosse City Railway Company, La Crosse, Wis.; H. B. McMeal, Chicago, Ill.; C. J. Schram, Lake Geneva, Wis.

ASSOCIATE—Jewell Belting Company, Chicago, Ill.; Kaukauna Electric Light Company, per A. R. Coates, president and manager; Allis-Chalmers Company, by B. H. Warren, president, Milwaukee, Wis.; Western Display Company, per T. R. Willmerscheid, president, St. Paul, Minn.; Nernst Lamp Company, Pittsburg, Pa.; Burton C. Dinius, Zion City, Ill.; Bullock Electrical Manufacturing Company, Cincinnati, Ohio; W. D. Keuz, Marinette, Wis.

A paper by Mr. W. B. Jackson, Madison, Wis., was read on the subject of the "Successful Joint Utilization of Several Small Water Powers by the Janesville Electric Company," an abstract of which follows:

I have in mind a city of about 17,000 inhabitants, which has no less than three separate hydroelectric plants, two of these being provided with steam auxiliaries. This is the system of the Janesville Electric Company, of which one of our past presidents, Mr. P. H. Korst, is the manager, and in the details of which he takes an intimate interest.

This plant, like numerous others in our western cities, started many years ago, when the town was young. Its growth was continuous with the town until it was operating about 130 horse-power of water-wheels and had an engine capacity of 350 horse-power, located in the centre of the city.

About this time it had the opportunity to add to its available power, under favorable conditions, the Fulton hydroelectric plant, at a distance of about twelve miles from the central plant. In this transmission three-phase, alternating current, at sixty cycles and 6,000 volts, is generated from the power of the Yahara river.

It was not long before further power was required by the company, and it was again enabled to add to its resources another hydroelectric plant. This is its present Monterey plant, located about three miles south of the city, upon the Rock river. Here 350 horse-power of water-wheels and a 350-horse-power engine have been changed from driving a cotton mill (their original sphere of action) to driving a 275-kilowatt, alternating-current generator, which furnishes three-phase current at sixty cycles and 2,300 volts pressure.

Thus the electric company had acquired, step by step, a system comprising:

A centrally located hydroelectric plant with steam auxiliary together with the requisite distributing circuits and translating devices.

A hydroelectric plant transmitting three-phase, 6,000-volt alternating current twelve miles to the central plant; and a second hydroelectric plant with steam auxiliary, transmitting three-phase, 2,200-volt electric current three miles to the central plant.

The distributing system comprises a three-wire, 125-volt direct-current service furnishing the lighting and power for the central section of the city; a 500-volt street-railway circuit for operating the street railway of the city; three-phase alternating-current distributing circuits for furnishing light and power to the outlying districts of the city; and alternating-current series arc-lighting circuits.

As the central station had outgrown its quarters, and conditions made it undesirable to remain in its old location, it was decided to build a new plant at a point where a much better hydroelectric development could be accomplished, but still affording a centrally located plant for general distribution throughout the city.

The question then confronted the company of determining the best arrangement for the new plant so as to bring together in one united whole the several plants under its control, in order that it might give the most efficient and most satisfactory results in all of the several classes of service to be supplied by its system.

All of the apparatus in the old station was in excellent condition, but it was in small units. Nevertheless, it was decided to utilize practically all of it in the new plant, adding thereto only what was required to take care of the increasing load.

There are not infrequent cases when old apparatus is thrown aside in the reorganization of electric plants to be replaced by more modern and possibly slightly more efficient apparatus, when the actual added net returns from such a change are far less than the added fixed charges, and which, had the old apparatus been suitably continued in service, would have given thoroughly reliable and satisfactory results for many years to come at a positive net saving to the company.

Some of the details of the Janesville system should be of considerable interest to those concerned with the generation and utilization of electric current.

There are installed in the new central plant referred to 780 horse-power of water-wheels driving a single shaft extending through the building. This shaft is appropriately subdivided to permit operating portions of the plant while the others are at rest or undergoing repairs.

Belted to the shaft upon one side are the driving elements, comprising a 350-horse-power Corliss engine and two synchronous motors, one for 6,000 volts, the other for 2,200 volts. All of the driven elements, comprising two 125-volt and three 250-volt, seventy-five-kilowatt, direct-current dynamos and one 110-kilowatt 500-volt dynamo, can be belted to the shaft from the other side.

Thus suitable space is obtained for all of the driving and driven machinery and at the same time the belt-drive of each unit can be arranged to possess the advantages of having the lower belt upon the pulling side.

Although the usual work of the synchronous motors is to receive power from the other plants and assist the water-wheels in driving the main shaft of the central plant, yet when desirable they are driven and used to supply the alternating current required for that portion of the lighting and power system.

By the use of transformers located between the 6,000-volt section and the 2,200-volt section of the switchboards, the 6,000-volt apparatus may be operated in connection with the 2,200-volt apparatus with practically the same facility as though everything was at one pressure.

The arrangement of the switchboard is simple, but affords the possibility of operating any one of the plants singly or in any combination with the other plants that the stage of the water may make desirable.

By the arrangement above noted a thoroughly practicable and efficient combination is obtained whereby all of the power for supplying the entire service of the electric system may be drawn from any one of the three plants, and two of the plants are equipped so that the power may be furnished either by water or steam, as conditions warrant. An efficient combination of the several plants is thus accomplished and the company is remarkably well fortified against possible interruptions of service. Only a very unusual coincidence can simultaneously disable all of the sources of supply.

Mr. C. M. Rau, of Milwaukee, read a paper entitled "Direct-Current *versus* Alternating-Current Distribution." Mr. Rau said, in part:

There has been considerable controversy as to the stability of a sixty-cycle rotary compared to that of a twenty-five-cycle rotary. This argument had considerable weight before the advent of the turbine, but by having a rotating instead of a reciprocating engine for the prime source of power, the stability of a sixty-cycle rotary is equally as reliable as that of a twenty-five-cycle rotary, and therefore the sixty-cycle current becomes just as suitable for direct-current railway systems as the twenty-five-cycle, and naturally is directly applicable for lighting and power service, and becomes readily convertible by static transformers for the various distributing systems required by a lighting installation. Particularly is this favorable for the central or business districts of a city, as the installation of static transformer substations is inexpensive compared with the large investment of copper or the frequent location of rotary stations with their attendant losses in efficiency and expense of maintenance.

The usual practice in operating a direct-current system from a high-tension alternating power plant requires the installation of frequent substations equipped

Digitized by Google

with standard apparatus, consisting of necessary transformers, regulators and rotary converters. From this the current is distributed through the usual low-tension switchboard, feeders, mains, etc., to the customer's premises.

For an alternating-current system the current would be taken directly to static transformers, which would be placed at such locations as the concentration of load would indicate, and would be located at more frequent intervals than rotary substations, thereby avoiding the extensive system of feeders, as the current would be taken directly from the low-tension side of the transformers to the mains.

In comparing the efficiencies of an alternating-current and direct-current system the calculations were based on the assumption that the static transformers were to be located at the same points as rotary substations and in units equivalent to the direct-current rotary converters and cut in and out of use similarly to rotary apparatus as the load increased or diminished, using the usual system of feeders as employed on a direct-current system to distribute the load to the mains.

The next important question is the comparative cost of the installation. The calculations were based on a station having a capacity of 15,000-kilowatt full-load output. This showed a saving on the cost of apparatus and buildings for substations alone of $130,000, which is entirely due to the smaller space required for static transformers, and the difference in cost between the necessary converting apparatus from alternating to direct current as compared with the cost of static transformers for the alternating system.

We, therefore, have as an increased economy up to the customers' premises on the alternating-current system the saving due to the difference in losses, the savings on interest due to the smaller investment and the saving on depreciation due to simpler installations, which amounted, on the installation above referred to, to somewhat more than $75,000 per year, the output of the previous year being used on which to calculate the value of the losses.

So far the investigation from a financial point of view leaves no question as to which system of distribution to adopt.

The next question to receive consideration is the relative commercial value of the two currents, and it is on this question that the difficulty is encountered of persuading the interests controlling the large direct-current systems to change to alternating-current systems.

After a most exhaustive investigation of this part of the question there was found, in a city of some 600,000 inhabitants, no installation which is now served by a direct-current system, which could not be served equally as well, if not better, by an alternating-current system.

As to purely electric lighting service, the alternating current is more suitable than the direct current, giving a greater variety of uses, as well as a more effective means of distributing light. The incandescent lamp is equally effective on both systems, so also the arc lamp, while the Nernst lamp adds materially to the advantages of alternating-current lighting, and the ability to do decorative lighting by means of low-voltage lamps through the introduction of transformers opens a field of economy in this class of work which could not be attempted with direct current.

For ordinary power work the alternating-current motor is superior to the direct-current motor, as the abolishing of brushes is a decided advantage where a large number of small motors is in use. In looking up the trouble calls from power customers it was found that fully seventy-five per cent were due to brush or commutator trouble.

The greatest difficulty to overcome is the variable-speed motor customer, but as this class of service is limited to the larger users of power, they could be readily accommodated by the installation of motor-generator sets for each individual case.

The operation of elevators is also difficult to take care of with the alternating-current motor, but with the development of the single-phase railway motor a suitable elevator motor can not be far off, and all that is needed is the creation of a demand for apparatus of this class, when, no doubt, our associate members will be ready to supply the demand.

In conclusion it might be stated that on the favorable showing made by this investigation, a change has been made from a direct-current, three-wire Edison system to an alternating-current, sixty-cycle, single-phase system in the city of Racine, Wis., which is an active manufacturing town and has a population of 30,000 inhabitants, and where every practical class of service was met that could be covered by a central station system.

In the discussion which followed the reading of this paper Mr. Colles said he thought this question was about the most important that is now before the electrical world, especially important to large towns.

The one great disadvantage under which the alternating-current labors in distribution is the lack of a suitable variable-speed and variable-load induction motor. All other problems are practically solved he said, so far as the alternating-current distribution is concerned. We have just as good lights and lighting service in the alternating service as in the direct, and for constant motor work, in machine shops or any other shop, the induction motor is practically just as good, so far as the efficiency is concerned, and in many other respects a great deal better than the direct-current motor; but for any place where a variable load is needed, it is far from being what it ought to be, and he thought that this was the sticking point of almost all of those who consider the question of installing that system.

Mr. Ament said the question of transformer capacity for consumers in smaller places where the load is irregular is a serious one; and while Mr. Rau's plan from a central station standpoint is excellent, and we all hope to get it, yet some better proposition in most communities for disposing of apparatus exchanged must be made.

Mr. Kimball asked Mr. Rau whether he has limited the size of single-phase motors installed in Racine.

Mr. Rau replied that this had not been done, although in the total installation in Racine there was not anything larger than five horse-power. That is one of the advantages in going through a customer's installations on an occasion of this kind. They are usually made irrespective of engineering principles. He cited an instance where a manufacturing plant using sewing-machines had a five-horse-power motor running half a dozen machines. There were only two months in the year when the manufacturer ran to the full capacity of five horse-power. A proposition was made by which two motors were installed, one of one horse-power and one of three horse-power respectively; the first year's business will pay the entire cost of a change of motors.

Following the discussion a communication was read from the National Electric Company, of Milwaukee, extending an invitation to the delegates to visit the company's works.

The secretary read a paper on the subject of "The Rating of Arc Lamps," by Professor George D. Shepardson, of Minnesota University. Professor Shepardson's paper dealt mainly with the methods of making up lighting contracts so that the best interests of both supplying company and consumer might be considered. He said:

It is a difficult matter to word a contract for street lighting so as to be fair to the city and to the company, so that each party knows exactly what is both the intended and the actual meaning of the terms, and so that either party can determine fairly whether the contract is being properly carried out. The city wishes to obtain illumination of the streets and landscape, together with a certain amount of what is sometimes called illumination appearance. Where simply illumination is desired, the people are satisfied with any sources of light that will illumine the roadway so that one can see to walk or drive with a fairly good vision of the path. In addition to this there is a general desire to have the streets appear to be lighted; in other words, to have the sources of light conspicuous. For the latter purpose, nothing can compare with the open arc with its intense brilliancy

Digitized by Google

and its deep shadows, although a Nernst lamp with clear globe approximates it. The modern enclosed arc light loses much of the illumination appearance characteristic of the older open arc and also gives out less total light, but it has less pronounced shadows and it throws nearly as much light to distant points.

Since light is what is desired, or rather illumination, it would seem that the most rational basis for a contract for street lighting would be an illumination of the street surface, which should have certain average values on main streets, certain lower averages on others, and whose minimum values should not fall below certain specified values according to the importance of the streets. To avoid uncertainties in measuring, care should be taken to specify whether the illumination is to be measured on the horizontal or vertical plane, the latter favoring widely scattered light sources, such as arc lights.

Lighting contracts based upon the illumination produced would put all sorts of light upon nearly the same basis, and would render it comparatively easy for city or company employés to make fairly reliable tests whenever desirable.

In cases where companies do not care to sell illumination as such, it would be some improvement over present contracts based upon nominal candle-power to charge by the kilowatt-hour. Contracts for lighting streets by gas are frequently based upon a fixed charge per thousand cubic feet estimated from hours of burning and periodical tests of consumption by various burners taken at random and tested under working pressure. In this case the city requires periodical cleaning of the globes and assumes that the street illumination is satisfactory. Such tests are difficult in the case of mantle burners, and unless provision is made for renewal of mantles when broken and after a definite period of service, there is apt to be much poor illumination.

It would not be difficult to provide for similar sort of testing for electric lights. The circuits might be run into testing stations established in fire department houses or police stations where instruments could be plugged in at will to measure the current. Occasional tests on the line with voltmeters would check the adjustment of individual lamps with sufficient accuracy. In the case of alternating-current lamps, an occasional wattmeter test is not a difficult matter.

One of the most satisfactory methods would be to have integrating wattmeters at the power-house, so as to measure the entire energy delivered to the street circuits for both arc and incandescent lighting. While this method would measure the energy lost on the line and in translating devices other than the lamps, suitable allowance could be made in the contract.

The main objection to contracting for street lights on the basis of energy consumption is that there is no definite relation between kilowatts and candle-power. In the case of incandescent lamps, the size, initial candle-power, age and method of manufacture all enter into the amount of light per watt, and the street fixture exerts an influence more or less. In the case of the arc lamp, the light is affected by the globes and coatings, by the size and quality of the carbons, by the length of the arc and perhaps by the power-factor.

Mr. R. N. Kimball, of the Kenosha (Wis.) Gas and Electric Company, said he had a 2,000-candle-power so-called contract, and was using what he called a 450-watt lamp. Recently where his company put in wattmeters on the board it was able to show the city council at any time the daily readings. There is now no controversy as to whether they are getting the light or not, and that is a very satisfactory way to close up a discussion.

Mr. H. Almert, of the Cicero Light, Heat and Power Company, Oak Park, Ind., said his company started to use wattmeters for its own protection, in trying to determine the amount of current lost or stolen, and found the plan satisfactory. It adopted it also when it wanted to check up the street lighting system, to see what it actually did get on a kilowatt-hour basis for current.

Mr. C. H. Williams, of Madison, Wis., read a paper entitled "Distribution and Dollars."

Mr. Williams considers that every problem which arises in electrical engineering may be reduced to a dollar and cents basis, and that the engineer of the present day is called upon not only to reach a certain clearly defined result, but to accomplish it with due regard to the investment and expenses entailed. Engineers, he thinks, are gauged by the results which they obtain, and in this particular line the gauge is most likely to be graduated to dollars or dividends, and the dividends will not be long forthcoming unless good service is rendered, while good service can not be secured without following sound engineering principles. The paper dealt with the factors regulating the size and number of feeders to be installed, the choice of size of transformers and secondary feeders, regulation as affecting renewals, the necessity of keeping accurate distribution records, means for obtaining satisfactory regulation, transformer losses affecting distribution costs, heating effects in transformers, regulation of transformers, records of transformer tests, lost and unaccounted-for current, transformer losses, resistance losses, card systems for keeping records of connected loads, meter-shunt loss, selection of incandescent lamps, and cost of lamps.

After a brief discussion, Mr. J. W. Pogue, manager of the Milwaukee (Wis.) branch of the Sheldon School of Salesmanship, was introduced. Mr. Pogue made a lengthy address on the method of modern salesmanship and the special training which was now undertaken to fit the men for this service.

Mr. E. C. Eastman, of Marinette, Wis., was introduced, making a few brief remarks, after which recess was taken until Thursday.

THURSDAY MORNING SESSION.

Discussion was reopened on Mr. C. H. Williams's paper entitled, "Distribution and Dollars." Mr. H. Almert thought the question of standardizing the sizes of transformers was an ideal one. He doubted very much whether the same result could be accomplished in any of the properties with which he was connected. In the outlying districts, which are not necessarily very distant in small towns, the work becomes scattered, and feeder capacity and secondary distribution become a very serious question very early, and it is not very far from the station or substation before individual transformers are necessary.

Following the discussion on Mr. Williams's paper, a discussion ensued relative to the presentation of advance copies of papers read before the convention. It was moved and adopted that the president be empowered to delegate two members to lead in the discussion on any particular paper, these members to be notified in time to prepare for such discussion.

Discussion was then reopened on Mr. O. M. Rau's paper entitled, "Alternating-Current *versus* Direct-Current Distribution."

Mr. I. M. S. Waring said that during the discussion of Mr. Rau's paper at yesterday's meeting, some statements had been made relative to storage batteries which may have created an impression that was entirely foreign to Mr. Rau's intention. The principal applications of batteries, the systems of Edison distribution, are first, batteries at the rotary substations; second, substations of batteries only installed at heavy distributing centres on the low-tension system. Illustrations of both of these types may be found in practically all of the large cities, notably New York, Chicago, Brooklyn, Philadelphia, Washington, St. Louis, etc. In each of these cases the cost of the battery is almost, if not entirely, offset by the additional investment in boilers, engines, generators, rotaries and static

Digitized by Google

transformers that would be unnecessary without batteries.

In the second case, *i. e.*, battery substations at distributing centres in the low-tension system, besides the saving in power-house and central station apparatus, a saving in copper is effected which makes the comparison decidedly in favor of batteries. Without this class of battery sufficient copper is necessary to transmit the maximum current demand from the rotaries to the distributing centres, while with the battery this transmission is materially reduced. In each case the batteries are discharged at the time of maximum demand and charged at a period of light load. The load-factor of the entire system is increased with a resulting increase in efficiency of all apparatus from the boiler room to the low-tension distributing centres.

The paper by Mr. E. P. Warner, on the subject of "Series Alternating Arc Lamps," was read and discussed.

Mr. Warner summed up in his paper the mechanical and electrical characteristics of the two systems. His conclusion was that the results which had been achieved in series alternating arc lighting during the past three years were of a character to give confidence to the central station engineer that the system had come to stay and was one which might be safely adopted.

The nominating committee of the association submitted the following names for the officers and directors for the next year, which were unanimously adopted and the gentlemen declared elected:

President, C. H. Williams, Madison, Wis.

First vice-president, Roger N. Kimball, Kenosha, Wis.

Second vice-president, H. Almert, Oak Park, Ill.

Secretary and treasurer, Thomas R. Mercein, Milwaukee, Wis.

Directors, P. H. Korst, Janesville, Wis.; Ernest Gonzenbach, Sheboygan, Wis.; H. J. Gille, St. Paul, Minn.

Mr. Williams thanked the association for the honor it had conferred upon him. He felt that it had placed a great responsibility upon somewhat inexperienced shoulders, but with the help of all he would try to make up in activity what he lacked in experience.

THURSDAY AFTERNOON SESSION.

The session was called to order by the president at 2 P. M. Discussion on Mr. E. P. Warner's paper, entitled "Series Alternating Arc Lighting," was opened by request by Mr. A. A. Morton, of Pittsfield, Mass. There is one thing he thought ought to be brought out very prominently in this arc-light question, and that is, that it is impossible to get together and say that the series alternating system is the thing for everybody to put in. He had done a good deal of traveling through this part of the country, and while he felt that the series alternating system is what we are all coming to, and have got to put in eventually, it did not seem to him that one can take up every plant and say that now is the time to put in the series alternating apparatus.

The next paper was by Mr. W. T. Goddard, on "High-Tension Practice." This consisted largely of lantern slides, described by the speaker.

A paper by Mr. Clarence Renshaw, of Pittsburg, was read on "Single-Phase Railways and Their Possibilities." This paper was illustrated by stereopticon slides, and detailed the characteristics of the single-phase system in its application to railways. This paper was discussed briefly after which the convention took up the paper by Mr. Norman McCarty, entitled "Economy and Working of the Diesel Engines."

Mr. McCarty's paper was discussed at length, the performance of this type of engine attracting considerable attention and producing a marked impression in favor of the internal combustion machine. A vote of thanks was extended to Mr. McCarty.

The paper by J. W. Shuster, of the University of Wisconsin, was read. This paper discussed "Motor Adaptability." This paper rehearsed the principal features of the various commercial forms of motors, and their bearing on central station practice.

After a brief discussion the convention adjourned until ten o'clock Friday morning, at which time, there being no further business, adjournment was taken *sine die*.

Convention Notes.

A LARGE delegation from Chicago to the thirteenth annual convention of the Northwestern Electrical Association arrived in Milwaukee about eleven o'clock Wednesday morning, over the Chicago, Milwaukee & St. Paul Railroad. A parlor car had been chartered by the H. T. Paiste Company, of Philadelphia, and placed at the disposal of the delegates. Mr. James Wolff, western manager of this company, acted as host. Refreshments were served, and every attention given to the delegates, who enjoyed the greatest possible comfort.

Milwaukee, being the home of the National Electric Company, this company made elaborate arrangements for the reception and entertainment of the delegates to the convention. The company exhibited at the Hotel Pfister—the headquarters of the association—some of its specialties. Several bromide enlargements were hung on the walls, giving an excellent idea of a few of the larger electrical machines made by the National company. A reproduction of particular interest was that of the 1,000-kilowatt rotary converters recently supplied to the Milwaukee Electric Railway and Light Company, and another was that of two 1,000-kilowatt units, comprising a motor-generator set, supplied to the Union Electric Light and Power Company, of St. Louis, Mo. This latter set is one of eighteen 1,000-kilowatt units which are being supplied to the city of St. Louis, to be employed as motor-generators and frequency changers. This is an order of which the northwestern engineers are justly proud. The new Lundell universal motors attracted special attention. The radical feature of construction is a magnetic circuit entirely composed of laminations, thus giving a homogeneous field. Other features of novelty which are comprised in this motor are an improved brush-holder and an improved design of the commutator. The motor is especially suitable for variable-speed work, and a standard ratio of three to one is advocated by the National company. Bulletin No. 400, describing this motor, was distributed at the convention. A new publication, entitled "The National Electrical Catechism," was presented to each visitor.

The trade-mark adopted by the company consists of two half-sections of generators, placed one above the other—the lower part representing the alternating-current, and the upper half the direct-current machine—the two portions being joined by a scroll bearing the word "National." As a souvenir of the convention, a handsome watch fob was given away, bearing as a charm a bas-relief representation of the company's trade-mark. The company also issued passes over the street

Digitized by Google

railway system, and tendered a reception to the delegates at its works.

Among the representatives of the company present were the following: S. W. Watkins, president; B. T. Becker, assistant general manager; Robert Lundell; C. G. Burton, sales agent; W. L. Waters, chief engineer; W. J. Richards, assistant engineer; A. P. Peck, sales agent; J. H. Denton, general superintendent; R. P. Tell, secretary and treasurer; Robert T. Lozier, general manager electrical sales; H. M. Klingenfeld, advertising manager.

The Allis-Chalmers Company and the Bullock Electric Manufacturing Company had an elaborate exhibit of apparatus at the Hotel Pfister. The company distributed to the delegates a watch fob bearing the trade-mark of the Allis-Chalmers Company on one side, and the trade-mark of the Bullock company on the other. These souvenirs were greatly appreciated and very much in evidence.

Among the representatives of the Allis-Chalmers and Bullock companies were Arthur Warren, manager of the department of publicity; George B. Foster, Chicago sales agent; H. S. Mallalieu, department of publicity; L. F. Raines, department of publicity; E. N. Dickson, purchasing agent; Harry Byrne, sales department.

Among other exhibitors and representatives in attendance were the following:

Westinghouse Electric and Manufacturing Company—Walter McDonald, sales department; A. L. Millard, sales department; C. A. Ross, sales department; H. B. Griffin, detail and supply department; Clarence Renshaw, engineering department. The Westinghouse Electric and Manufacturing Company distributed valuable memorandum books as souvenirs.

General Electric Company—J. B. Tingley, sales department; J. Scribner, manager lighting department; E. P. Edwards, sales department; S. F. Dibble, manager small motor department; F. N. Boyer, manager supply department; F. W. Hild, assistant engineer. The General Electric Company distributed as souvenirs miniature incandescent lamp scarf pins.

Fort Wayne Electric Works—C. E. Sedgwick, sales department; C. E. Searle, sales department; Walter S. Goll, manager Chicago office.

Duncan Electric Manufacturing Company—Thomas Duncan, vice-president and general manager; William H. Sinks, sales department.

Nernst Lamp Company—A. C. Wales, A. E. Fleming.

Holophane Glass Company—C. A. Howe, sales manager; H. E. Watson, sales department.

Reynolds-Dull Flasher Company—E. R. Dull.

Benjamin Electric Manufacturing Company—Syles R. Fralick, sales department.

Federal Electric Company—R. B. Francis, sales department.

Locke Insulator Manufacturing Company—J. S. Lapp, sales manager; W. T. Goddard, sales department.

Electric Storage Battery Company—G. H. Atkin.

Wagner Electric and Manufacturing Company—A. H. Timmerman, superintendent; E. K. Seymour, sales department; George R. Foster, district manager.

Andres & Sons Company—J. C. Schmidtbauer.

Daggett Trolley Company—W. F. Daggett, president.

C. F. Hamacek.

Northern Electrical Manufacturing pany, Madison, Wis.—T. F. Whitfield, Milwaukee manager.

Dearborn Electric Company, Chicago—Charles Messer.

Porter & Berg, Chicago—P. E. Davenport and Leon Bly.

Monarch Electric and Wire Company, Chicago—Samuel Markowitz.

National Conduit and Cable Company, New York—W. H. Pearl.

Macomber & Whythe Rope Company, Chicago—George S. Whythe.

Electrical Appliance Company, Chicago—William Low, president, and W. P. Upham.

Pass & Seymour, Solvay, N. Y.—Julian S. Jackson, sales agent.

Adams-Bagnall Electric Company, Cleveland—J. G. Pomeroy, western sales agent.

Laporte Electric Company, Laporte, Ind.—J. H. Harding, treasurer and superintendent.

Waclark Wire Company, Chicago—J. B. Wallace.

General Incandescent Arc Light Company, New York—Francis Raymond, western sales agent.

American Steel and Wire Company, Chicago—W. A. Garns, sales department.

American Circular Loom Company, Chelsea, Mass.—H. B. Kirkland, western manager.

H. T. Paiste Company, Philadelphia—James Wolff, western manager.

Stanley Electric Manufacturing Company Pittsfield, Mass.—Locke Etheridge, M. E. Edwin, L. Barr, western sales manager, and A. A. Morton.

Thomas G. Grier Company, Chicago—George A. Gray.

Spranley & Reed, New Orleans—W. T. Spranley.

American Diesel Engine Company, New York—Norman McCarty, general sales manager.

George Cutler Company, Chicago—George Cutler, president.

New York Insulated Wire Company, New York—James Wolff, western manager.

Standard Underground Cable Company, Chicago—E. J. Pietzcker.

M. B. Austin & Company, Chicago—Arnold H. Friend, sales agent.

Cutler Hammer Manufacturing Company, Milwaukee—A. W. Berresford, secretary; F. L. Pierce, treasurer; F. S. Wilhoyt, engineering department; C. L. Knight, engineering department; N. S. Hopkins, purchasing agent; J. T. Hawkins, advertising manager.

Central Construction Company, Oshkosh, Wis.—George F. Rohu, Milwaukee; L. E. Wolf.

Chicago Insulated Wire Company, Chicago—William M. Smith, secretary and treasurer.

Standard Underground Cable Company—J. R. Wiley, manager western sales department.

Henry Newgard & Company, Chicago—C. E. Browne, secretary.

On Thursday evening a supper and vaudeville smoker was given under the auspices of the association. It was largely attended and every one had a jolly good time. The affair took place at Mozart Hall.

Mexican Substitute for Rubber.

James A. Leroy, United States consul at Durango, Mexico, reports that a shrub called the guayule, which grows on the arid northern plateau of Mexico, renders an extract possessing the appearance and qualities of rubber. Nothing worthy of mention has hitherto been done with this plant, probably because sufficient attention has not been drawn to it, or because of failure to find a satisfactory process of extraction. Within the past two years, however, New York rubber manufacturers have developed a process for the utilization of the plant. Under the name of the Anglo-American Company they have obtained a concession from the state of Coahuila, and are about to build a factory for the extraction of rubber from the guayule at Torreon.

Digitized by Google

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED—III.[1]

BY W. P. ADAMS.

(*Concluded.*)

As the refuse is delivered it is tipped on to a platform above the cells and burned steadily throughout the twenty-four hours, no attempt being made to burn extra refuse during the peak. The delivery of refuse begins on Monday generally about 9 A. M., and ceases about midday Saturday. The destructor is generally entirely shut down from 11 P. M. on Saturday until the early hours of Monday morning; before the new refuse begins to come in, the cells are started on such refuse as was left over from Saturday. It has been the practice since the works started to weigh carefully the coal used on each shift, so the values of the refuse are readily obtainable on each shift. It will be seen from the diagram (Fig. 8) for Monday, December 15, 1902, that the day load is small, the early morning load large comparatively, and, of course, the peak shift the heaviest. On this day the cells were started at 1 A. M., and the greater part of the load was run on coal during the first shift; on the second shift no value appears to have been obtained from the refuse, as the coal works out at about nine pounds per unit generated; ten hundredweight of the coal, however, was used for

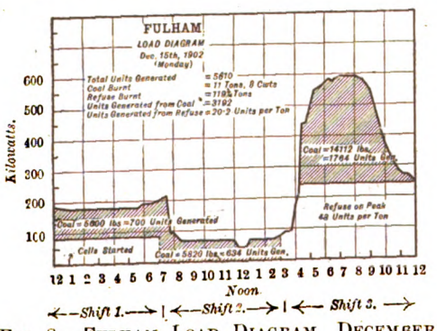


FIG. 8.—FULHAM LOAD DIAGRAM, DECEMBER 15, 1902.

banking, and no account is taken of steam supplied to the disinfector from 9.30 to 4.45. In all the curves no allowance is made for steam supplied to the disinfector, brick-making plant, etc., and the coal is worked out at eight pounds per unit throughout. On Mondays a poor value is obtained for the refuse, as the whole of the cells and flues have to be heated up from cold, and on Tuesdays full value does not usually seem to be obtained, although (Fig. 9) December 16, 1902, shows an almost record value. Bearing in mind the maximum of fifty-five units per ton obtained by Mr. Russell at Shoreditch on test, this figure of 91.5 units per ton is not a little remarkable, as it was obtained under ordinary working conditions, and until I drew out the curve such a result was not even suspected. I may say that most of the curves from Fulham were selected almost at random from the log-books, and had never been plotted before with the coal and refuse values filled in.

A second series of curves taken a year

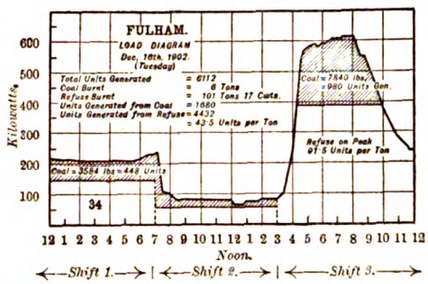


FIG. 9.—FULHAM LOAD DIAGRAM, DECEMBER 16, 1902.

later showed very similar results, but the highest value obtained on the peak is seventy-eight units per ton; the average value, however, is some five units per ton higher, notwithstanding the addition of the Bellis fan engine and of the brick-making and clinker plant. On both first and second shifts the load has largely increased, and a better value is obtained in consequence.

To bring the diagrams up to date I have prepared a series in January this year, and in these were found the best results; the average obtained for over three days—50.4 units per ton—is good, but the record value on the peak load of January 9 (Fig. 10) of ninety-four units per ton is very fine, and in view of the small day load an average for the day of 52.3 units is highly satisfactory. After studying these curves the first question that will be asked is, why, if such splendid results are obtained on the peak, are not better figures recorded on the two first shifts? Air leakages, I am given to understand, are largely responsible for this; troublesome cracks have been developed in the flues through the shrinkage of the soil upon which they are built, and, notwithstanding the care taken to make the destructor boiler fronts tight, considerable quantities of air pass into the flues, thus cooling the destructor gases. When the boilers are coal-fired this air is utilized in combustion in the usual way, and thus, the larger the load—*i. e.*, the more coal burned, the better the value obtained from the refuse. The air leakages are without doubt serious, and are engaging the attention of Mr. Fuller. In addition to this, a fairly large proportion of the coal is used for banking spare boilers; this would appear to be a necessity in an alternating station where a convenient battery is not available in case of necessity. In course of time, with a larger day and early morning load, I can see no reason why the fine values obtained on the peak load should not be maintained throughout the day, and, if it were at all possible to avoid shutting down on Sundays for cleaning purposes, throughout the week. Under existing conditions, but with a large day load, I consider that some seventy to eighty units per ton ought eventually to be obtained in winter and some fifty to sixty units in summer. In deference to Mr. Fuller's wishes, I have given in table B fifty-two units per ton as the ultimate all the year round average. As I have nothing at stake in the matter except perhaps my reputation as a prophet, I should have put the figures some twenty-five per cent higher; the average value obtained on the peak on the ten curves I have plotted is seventy-five, and this at the present high-water consumption.

During the year 1902-3 the clinker obtained was some fifty per cent of the refuse burned. Mr. Fuller tells me he has now reduced this to about one-third,

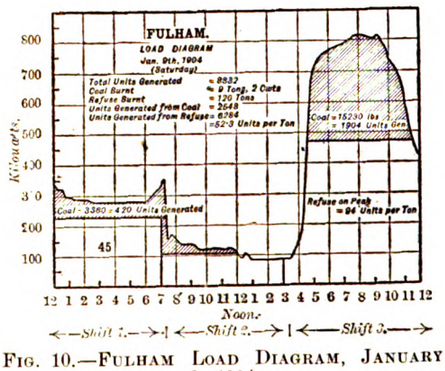


FIG. 10.—FULHAM LOAD DIAGRAM, JANUARY 9, 1904.

and sometimes he gets as little as twenty-eight per cent. This clinker is now being sold at a profit, so that on the present year's returns the rather heavy item for cost of disposal will disappear. The credit for electricity is about twenty per cent less than the ascertained coal value. The costs, after deducting revenue, amount to 26.3 pence per ton; this deficiency is met by a credit from the health department. The ultimate value of the steam based on the present coal costs amounts to about £5,000; it is probable that the cost of repairs will increase, but after making

[1] Abstract of a paper read before the Institution of Electrical Engineers, London, England, December 15, 1904. The former portion of the paper appeared in the ELECTRICAL REVIEW, January 7 and 21.

Digitized by Google

a reasonable allowance in this connection the figures would seem to justify one in concluding that when the full heat value of the refuse is utilized the Fulham destructor should earn a profit of approximately £1,000 a year after all costs of destruction have been paid. Such profit as results from the sale of clinker should be added. Fulham at present holds the record for lowest total costs of destruction in the London combined works.

Hackney—As already stated, I have taken great pains to ascertain the actual coal consumed per unit generated at Fulham, but as no regular record is kept of the water consumption, it may perhaps be suggested that I have taken too high a figure in basing my calculations on eight pounds. I am quite satisfied as to the correctness of this figure, but owing to the element of uncertainty, I turn with the greater pleasure to the Hackney records, for here the water is metered and the coal consumption is ascertained. In addition to this, the figures of the water and coal consumption are quite exceptionable.

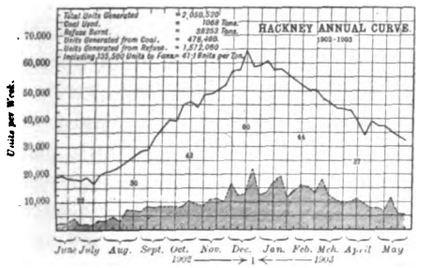


FIG. 11.—HACKNEY ANNUAL CURVE.

The electrical plant at Hackney consists of high-speed engines and direct-current generators, and an interesting feature is the 1,200-unit Tudor battery. The plant is run condensing, and thirty pounds of water are used per unit generated. The average coal consumption is about five pounds per unit generated. The Hughes & Stirling destructor consists of three four-cell groups, with a combustion chamber between each two pairs of cells. The combustion chambers lead direct to three Babcock boilers placed immediately behind the cells. The refuse is tipped into hoppers, from whence it is raised by elevators into three large bins above the cells; from these bins it is drawn as required and fed into the cells. The blast is provided by electrically driven fans, and is not heated.

The annual curve (Fig. 11) is not dissimilar from the Fulham; a better value, however, is obtained in the summer, and the Fulham record of fifty-three units per ton throughout the week is beaten by the Hackney sixty units per ton. The units per ton throughout the year amount to 41.1, as against the Fulham 27.8. It should be observed that the curves cover the same period—namely, from June, 1902, to May, 1903. The coal in this and all the Hackney curves is plotted in at five pounds per unit generated.

The chief interest lies in the Hackney day-load diagrams, for at present the day load is small and the peak value almost beyond belief. The method of burning the refuse differs slightly from that in use at Fulham, in that a varying number of cells is used when occasion requires. The refuse is, however, burned uniformly, without any attempt to force the cells during the hours of the heavy load. The rate of burning per cell-hour varies very little. The cells are shut down early on Sunday morning, when the refuse which has been collected during the week is exhausted, and started again on Monday morning as soon as the new supply of refuse begins to come in. On November 6, 1902—a Thursday, which is closing day at Hackney—the whole output was carried on refuse steam (Fig. 12). The highest value on the peak lasting about two hours amounted to no less than 104.3 units per ton. The rate of burning is shown at the base of the diagram. Eight cells were burning from 12 to 8 A. M., twelve cells onward to 10 P. M., and from ten to twelve eight cells. Although the refuse was being burned steadily, the generating plant was shut down from 6 A. M. to 1 P. M. The

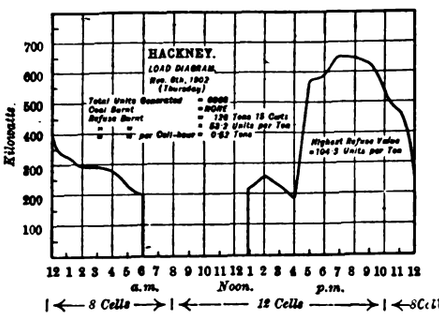


FIG. 12.—HACKNEY LOAD DIAGRAM, NOVEMBER 6, 1902.

three diagrams for December 16, 17 and 18, 1902, showed that the high value of 104 units per ton is not altogether exceptional, the average for the three days amounting to 102.1 units per ton. On each of these days the refuse was burned uniformly throughout in ten cells, and the generating plant was entirely shut down for four or five hours. The value obtained on December 17 of 105.8 units per ton on the peak load is the highest record which has come to my notice. I desire to repeat that these figures were obtained under ordinary working conditions, and without any one being aware that such fine results were being realized until the curves had been drawn out. Given a sufficiently large load such as that obtained at Shoreditch, there really seems to be no reason why 100 units per ton should not be reached throughout the day.

After observing the splendid value obtained on one of the Fulham curves, I

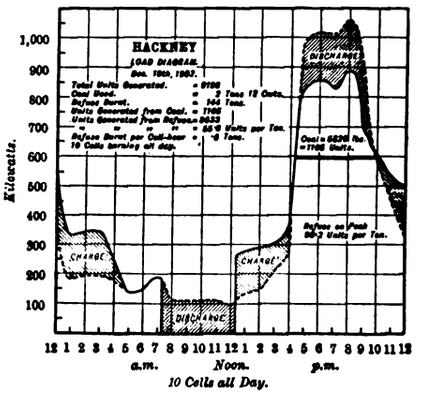


FIG. 13.—HACKNEY LOAD DIAGRAM, DECEMBER 18, 1902.

naturally anticipated better results would be found at Hackney, and, comparing the relative water consumption, if ninety units per ton is obtained at Fulham, 120 or even more ought not to be an impossible figure at Hackney. Air leakages are, I believe, not unknown at these works, and may, perhaps, account for reduced efficiency.

I have thought that a diagram showing the value of the large battery at Hackney might be useful. The diagram of December 18, 1902 (Fig. 13), gives the total load on the station, including feeder output. The solid line gives units generated, and the dotted line the station output. The battery charge and discharge are indicated by the shaded portions, on the top of the peak the average load taken is about 160 kilowatts and the maximum 220 kilowatts; roughly, the discharge on the top of the peak represents 600 units; about half the nominal capacity of the battery. Had the full capacity of the battery been utilized the load carried on the peak would have been 250 kilowatts, and a very small quantity of coal would have been required. As it is the diagram shows that about forty per cent of the coal which would be necessary without the battery has been saved.

A reference to table B will show that for the year ending March, 1903, some thirty-seven units per ton of refuse were generated after deducting the electricity used in the fan motors. As the average of steam-raising value is put at eleven pounds per pound all the year round, and the water evaporated during the last financial

Digitized by Google

year was only 0.54 pound per pound, it seems fairly safe to assume that an average figure of sixty-four units per ton will be obtained ultimately. Personally, I shall be surprised if in the course of a few years this figure is not considerably exceeded. In this connection it is not a little interesting to note that a value of 105 units per ton at thirty pounds of water per unit means an evaporation of 1.4 pounds of water per pound of refuse.

The destructor costs for the last financial year are high; the wages correspond curiously with those at Fulham, the clinker disposal formed a considerable item of expense, and as the destructor was running only eleven months during the year, the capital charges per ton were heavier than will be the case in future. The credit to the destructor for electricity is based on the coal cost, and is therefore absolutely fair. As in the case of Fulham, the difference between the destructor revenue and total costs—namely, 35.4 pence per ton destroyed, is met by a credit from the health department. Owing to the Hackney destructor having a less favorable market for its steam, it does not seem likely it will earn a profit as will probably be the case at Fulham.

Bermondsey—The smallest of the London combined stations has successfully completed a year of working. The returns, however, have not yet been published, and at the time of writing are not available. Mr. Vincent has, however, kindly placed at my disposal information which will prove of interest. The plant consists of high-speed vertical engines with direct-current generators; no use is made of the exhaust steam. The battery is small, being of only 240 units capacity. The Hughes & Stirling destructor consists of three pairs of cells with three Babcock boilers. A combustion chamber is provided between each pair, which leads into a flue at the back of the cells and so to the boilers. This arrangement is not quite so favorable as that at Hackney. The blast is provided by electrically driven fans, which only take six per cent of the total quantity of electricity generated. In addition to supplying steam to the electric generators a supply is given to the adjoining baths and washhouses. The coal bill at the baths before the erection of the destructor was between £400 and £500 per annum; two stokers were also employed whose wages amounted to about £150 a year. The coal burned at the electricity works was only 400 tons for the year; thus, altogether apart from the electricity works, a saving of about £600 less £380—the value of the coal—has been effected by the introduction of the destructor. It will thus be seen that the whole of the electricity generated may be credited to the refuse. After deducting the units used by fan motors, the very creditable figure of 29.8 units has been obtained per ton of refuse, a figure second only to Hackney. On the official test the fine value of 1.65 pounds of water was obtained per pound of refuse, and, in view of the high calorific value of the Bermondsey refuse, Mr. Vincent anticipates that some eighty-six units per ton is the ultimate value of the refuse. The credit given to the destructor of one penny per unit generated, or 1.09 pence per unit sold, is undoubtedly high, but the works are unfavorably situated, the price of coal is high and condensing is impossible. Compared, therefore, with the average for the six uncombined London undertakings of 0.93 penny, the figure is not so extravagant as would appear at first sight. In view of the high coal value, the Bermondsey destructor should earn a substantial profit when the full heat value of the refuse is utilized.

Woolwich—The combined electricity and destructor works here have so recently been added to the list of metropolitan undertakings that returns for a year of working are not available. I am able, however, to give the result of an excellent test taken early this year. With a water consumption of forty pounds per unit generated, the fine figure of 100 units per ton was generated for two hours continuously. With the same economical plant as at Hackney this figure would have been 133 units per ton. If Mr. Mitchell can bring his water consumption down he may yet beat all records. The destructor is a Meldrum Brothers "Simplex."

PROVINCIAL UNDERTAKINGS.

Wimbledon—From the figures given to me by Mr. Tomlinson Lee it is plain that these works should not be included in the list of combined undertakings. The joint works adjoins the sewage works, and the whole of the steam available from the refuse is used for sewage pumping and heating the hospital some 600 yards away from the works. The coal saved to the sewage works amounts to £900 a year, and Mr. Lee states that beyond what the destructor can do he provides coal-generated steam to the value of about £5 per annum in addition; this being so, the value of the steam in terms of possible units of electricity generated can only be estimated. On the basis of the present coal cost—namely, 0.9 penny per unit sold—the units generated would amount to 300,000. From another source I understand that it has been estimated at forty-five units per ton. Taking the former figure, thirty-three units per ton is a highly creditable performance, seeing that the refuse is burned with pressed sewage sludge in the proportion of one ton of sludge to two tons of refuse. The large percentage of moisture and the very small percentage of combustible matter in sludge are well known. The furnaces are of the Beaman & Deas type, with Babcock boilers.

Grays—Through the courtesy of Mr. Long and Mr. Arthur Preece I have been provided with very full information regarding these works, and although the quantity of refuse burned is exceedingly small compared with the large works we have been considering, the results obtained are valuable. The generating plant is of the usual type, vertical high-speed engines with direct-current generators. The battery is double-pole of 160 units capacity. The plant is run non-condensing. The destructor is a two-cell Meldrum "Simplex," with a Lancashire boiler which is usually short. An economizer is in use, and also a regenerator in conjunction with steam blast. During 1902 the coal consumption per unit generated as ascertained by Mr. Long when the destructor has not been at work was nine pounds in the winter and ten pounds in the summer. The average for the year works out at 9.5 pounds. The total coal used during the year was 348 tons, a large proportion of which was used in getting up steam to assist the destructor for a short time every day. The resulting fifteen units per ton of refuse is poor, but it is clear that as the load increases a better value will be obtained. Returns for the year ending March, 1903, have reached me, and a substantial improvement is already manifest. Allowing for the reduced consumption of nine pounds of coal per unit, the average units per ton of refuse is increased to twenty-one. The ultimate value with the plant working under more favorable conditions should reach thirty units per ton. In a small plant of this description burning between 2,000 and 3,000 tons per annum, the economical utilization of the refuse becomes quite a special study, and the burning of coke breeze or coal in the destructor furnace to assist in the event of a shortage of refuse would probably prove more economical than getting up steam in an independent boiler. It is not possible to mix good fuel with the refuse, but with a little trouble a portion of the grate can be separately utilized. It is, I understand, now Mr. Long's practice to burn

Digitized by Google

coke breeze in the furnace in this manner.

Gloucester—The type of destructor in use in this town is that constructed by Messrs. Heenan & Froude. The plant is a comparatively small one, consisting of two cells only, with one Babcock boiler. An economizer is used, and also a regenerator in conjunction with the fan-blast, the fan being driven by electric motors. The engines are vertical, high-speed condensing, the generators direct current, and an E. P. S. battery of 440 units capacity is in use. In recording the returns for the year 1902-3, I have had difficulty in apportioning the units generated between coal and refuse; Mr. Bache, the engineer, informs me that the usual rate of burning is one ton per hour, but on the peak the rate is increased to from twenty-five hundredweight to twenty-eight hundredweight. He states that 100 kilowatts to 120 kilowatts was maintained for one hour. From twenty-five to forty units per ton are obtained in summer and from sixty to eighty in winter. When all the refuse is burned usefully, it is expected that an average of eighty-six units per ton will be obtained; at present the day load is small. In dividing the units generated for the year between the coal and refuse, I have had to assume that fifteen pounds of coal were burned per unit generated. The refuse-generated units on this basis work out at one-third of the estimated total possible. Messrs. Heenan & Froude inform me that at present one-third of the refuse is burned usefully.

Christchurch, N. Z.—One other plant I must mention briefly, as it has the distinction of being the only combined works outside the United Kingdom. The installation at Christchurch, New Zealand, has just completed its first year of working, and when the returns are published shortly, excellent results are promised. The electrical equipment is the usual high-speed, direct-current type, but the battery is large, being half the size of that at Hackney—namely, 600 units. As an advocate of large batteries in combined works, I look forward with special interest to the publication of particulars, for the total capacity of the generators installed is only 200 kilowatts. The destructor is of the Beaman & Deas type, consisting of two pairs of cells and two Babcock boilers, erected by Messrs. Meldrum Brothers in 1902. Twenty-five tons of refuse are destroyed between the hours of 8 A. M. and 10 P. M., giving ample steam for supplying the load during these hours and for charging the battery; the generators are shut down the rest of the day. The average evaporation is given at 2,000 pounds of steam per ton of refuse.

Enough has already been said to show that under statisfactory conditions excellent results may be obtained from the combination of refuse destructors with electricity works. The installations at St. Helens and Shipley have been described by Mr. Highfield and Mr. Schofield, respectively, and between thirty and forty units per ton are obtained on the average. In a recent letter, Mr. Schofield informed me that he anticipates that some fifty units per ton will eventually be realized. At Partick, 29.6 units per ton were realized during last year, and it is anticipated that thirty-seven units will ultimately be obtained. Although I have not obtained much data from Garston, the figures supplied show that some fifty to sixty units per ton are frequently obtained, and particulars of a test lasting eighteen hours with the generating plant run non-condensing show an average of sixty-two units per ton, the water consumption being fifty pounds per unit generated.

In endeavoring to secure good steam-raising results, it is desirable to maintain the temperature of the flues as uniformly as possible, and any device therefor which will render the shutting down of the plant for cleaning purposes unnecessary will be valuable. Particularly is this so in small plants, and the apparatus devised by Mr. Sillery, of Wrexham, is a step in the right direction. By means of this apparatus the dust destructor at Wrexham has been kept running for a whole year without a break. The maintenance of the temperature in the flues is important, not only from a steam-raising point of view, but also is desirable as tending to reduce the expenditure on repairs. The constant expansion and contraction of the brickwork owing to alternate heating and cooling is destructive.

As points deserving of careful attention, I have already referred to air leakages and the method of producing the blast. Both of these may be sources of large percentages of waste. Another point to which I have referred, and which it may be well to emphasize, is the possible loss of efficiency due to long and badly arranged flues. Mr. Price F. White, of Bangor, has been most kind in providing me with information concerning his plant, and in explanation of the poor results obtained calls my attention to the construction of the main flue. It is important to note that the destructor was added after the electricity works had been put down, and the main flue from the destructor to the boiler house is long and built at a low level. The result is that the flue is very damp, and the greater part of the evaporation due to the destructor gases takes place outside the boiler. At times, Mr. White informs me, the flue is so full of water that the destructor has to be shut down.

A large proportion of total costs is often caused in disposing of the clinker. This matter is one requiring serious consideration, as if a satisfactory sale for this destructor by-product can be secured, a heavy annual cost will be turned into a substantial profit. As an illustration of this I may point to the fact that at Fulham the cost of disposal of clinker amounted to £479. Mr. Fuller is making special efforts to dispose of his clinker profitably, and this year the loss will have disappeared and a profit has been secured instead. At Hackney, Mr. Robinson is not quite so successful, but he is now disposing of the clinker without cost. This will result in a saving of £750—no mean proportion of the total costs of destruction last year.

So long ago as 1892, Professor George Forbes stated in a lecture before the Society of Arts that if the refuse then collected in Paddington were properly burned and used in the most economical way, it should provide enough electricity to light one eight-candle-power lamp for two hours every night of the year per head of the population, which is the estimated amount of light demanded by the exigencies of modern civilization. It is a great pleasure to me to take upon myself the vindication of Professor Forbes as a prophet, for by the exercise of a small amount of scientific license, I am able to demonstrate that in at least two metropolitan boroughs this result will certainly be achieved within a few years. A thirty-watt carbon lamp burning two hours per night throughout the year would absorb twenty-two units. A Nernst lamp giving the same light would burn, say, eleven units. The population of Fulham is 150,000, thus 1,650,000 units would be required; the ultimate value is estimated at 1,870,000 units. The population of Hackney is 230,000, the units required would amount to 2,530,000; the ultimate value of the Hackney refuse as estimated by Mr. Robinson is 2,436,000 units.

I will ask you to bear with me while I make a modest little calculation on my own responsibility. The annual collection of refuse in London amounts to approximately 1,250,000 tons; taking so low an average as forty units per ton as

Digitized by Google

its potential capacity for generating electricity, no less a sum than £200,000 per annum—taking the average coal cost of all the London undertakings—is being tipped on dust heaps, resolved into vapor and deliberately barged out to sea at a heavy cost.

Conclusions—As I am addressing engineers, I need summarize my conclusions but briefly.

1. The remarkable figures obtained in some undertakings as demonstrated in the series of curves I have had the privilege of laying before you, are evidence that great advances have been made in the problem of utilizing waste heat from burning refuse in destructors since the pioneer works were started.

2. That these results still leave room for substantial improvement—(*a*) By closer attention to the details of construction of furnaces and flues and the general arrangement of the plant; (*b*) by improving the methods of handling and burning the refuse; (*c*) by careful utilization of the steam generated and the adoption of an economical form of blast.

3. That, given suitable conditions, there is without doubt a substantial gain to be effected by the combination of electricity and destructor works; but owing to the variation in the calorific value of refuse in different localities, and to other special local considerations, every proposed case of combination needs to be considered on its merits by persons qualified to make an independent and intelligent enquiry.

4. That the various and in some cases crude methods in vogue of adjusting accounts between the two works need to be systematized, and that it is highly desirable that the results obtained be separated and recorded with accuracy, so as to give, so far as possible, a true record of the financial position of both works.

Mineral Resources of the United States.

The United States Geological Survey, Department of the Interior, Washington, D. C., issued two bulletins recently. One deals with the stone industry, and contains nothing of interest to electrical industries. The other, however, is of considerable interest to these industries. This is a statistical examination of the production of minerals in the United States during 1903, and compares the business of this year with preceding years.

After giving a brief general summary of the year's business, the iron production is taken up, but there is no attempt to show what bearing the electrical industries have upon this trade.

Copper, however, stands in an important relation to the electrical trades, and it is interesting to notice how the production of this metal has increased since the introduction of the telephone, electric lighting, the electric railway and power transmission, growing from an annual production of 19,000 long tons in 1876—the year when the invention of the telephone was announced—to 311,627 tons for the year covered by the report. Of this total production, twenty-seven and one-half per cent is from the Lake Superior mines, twenty-eight and nine-tenths per cent from Montana, and twenty-one and one-tenth per cent from Arizona.

Lead is another metal which is very useful to the electrical engineer, but the report gives no means of determining how much this material was used in the manufacture of accumulators and sheathing of cables during 1903. The total production was 280,000 short tons.

The production of aluminum is of particular interest, since not only is this entirely produced electrically, but the chief use is for electrical conductors, and the report states in this it is still expanding in this country. It is said that during the year, among many others, two contracts were reported, one for 500,000 pounds, and one for 298,245 pounds of aluminum wire. Drawn wire seems to be more susceptible to corrosion by atmospheric action than rods, and to counteract this disadvantage, manufacturers are now putting on the market a so-called weather-proof wire, which is coated with a preparation that forms a thorough protection for the metal. To overcome the difficulty encountered in soldering aluminum conducting wire, a patent was taken out in 1903 by Nicholson, by which a compound ingot of copper and aluminum is drawn into a wire having a copper core and an aluminum cover. The core of copper may be readily soldered without raising the resistance of the joint.

The production of aluminum in this country became important only after the electric furnace was put to commercial use. For instance, in 1883 the total quantity produced was only eighty-two pounds. In 1886 it jumped to 3,000 pounds, and then increased rapidly to 61,281 pounds in 1890. The following year the output was 150,000 pounds, and since then it has increased rapidly until the last few years, when it has remained fairly steady, the estimated output for 1903 being 7,500,000 pounds.

Steel-hardening metals are not of much interest to us, except possibly tungsten, which is used in the production of permanent magnets for checking instruments, because of the high retentivity which it confers upon the steel. Some of the other metals of this group have a secondary interest, since the study of them has had an important bearing upon electrical science. Among these is uranium.

The coal industry touches the electrical industry in two ways, because it is our main reliance for the production of electrical power, and for the important part which electrical apparatus is taking in the mining of this commodity. The total production of coal in 1903 was 357,-356,116 short tons—a little less than 1,000,000 tons per day, and practically all of this was consumed in this country. Of this total consumption, that used in electrical generating stations was but a few per cent. It is interesting to compare the production of this country with that of the entire world, which was 967,857,406 short tons, this country producing thirty-seven per cent of the total. The countries coming next are Great Britain and Germany. Of the total production of coal, 77,974,894 short tons, or 21.8 per cent, was machine-mined.

The production of petroleum for 1903 was 100,461,337 barrels of forty-two gallons each, an increase of over eleven per cent over the previous year. The total production for the world was 165,773,361 barrels. During the year there were produced, in addition, 238,769,067,000 cubic feet of natural gas at atmospheric pressure. This represents approximately 5,968,000 tons.

Under the heading of abrasive materials we find carborundum listed, the production for the year being 4,759,890 pounds, an increase of over twenty-one per cent over the previous year. The output of artificial graphite for the year was 2,620,000 pounds—the largest quantity produced in any year, and an increase of ten per cent over that of the previous year. The production of natural graphite was 4,538,155 pounds. These two, however, supplied but a part of the total market, as there were over 16,000 long tons of graphite imported during the year.

Among the rarer minerals mined are monazite and zircon, which are valued for the rare earth oxides which they contain. These oxides are used in the manufacture of mantles for incandescent gas lamps and for glowers for the Nernst lamps. The demand for monazite is increasing, although there is not a large increase in

Digitized by Google

the yearly production. The demand for zircon is small. The value of monazite is due to the presence of a small percentage of thoria. The commercial mineral contains from three to nine per cent of this oxide, with small amounts of other valuable oxides, which are used to a limited extent in other industries. The commercial deposits of these minerals lie in North Carolina and South Carolina, where mining is carried on on a very small scale—frequently by children. Monazite is not obtained from the original rocks, but in the gravel deposits of present and former streams which have resulted from a disintegration and erosion of the crystalline rocks containing monazite. These gravels are worked over by means of sluice boxes, and the value of a deposit depends greatly upon the available supply of water. After the gravel has been worked over once it can be reworked, since by that time it has accumulated a sufficient quantity of fresh deposit to make it pay.

Under the heading of clay-working industries, we find that the value of the pottery products for the year was over $16,000,000. Of this total, $1,464,980 represents the value of the porcelain electrical supplies. The production of glassware is shown, but no reference is made to its use in the electrical trades.

The production of mica for the year was valued at a little over $59,000—a little less than half the value of the production for the previous year.

Annual Convention of the South Dakota Telephone Association.

The annual convention of the South Dakota Telephone Association was held at Sioux Falls, S. D., January 11 and 12, 1905. Fifty towns were represented by delegates, and the convention was very successful. A number of papers was read, among them being two which were presented by H. J. Minhennick, of Sioux City, and by I. J. Kusel, of Chicago. The papers were entitled, respectively, "Cable Construction and Electrical Engineering as Applied to Telephony," and "Automatic Apparatus and Its Relation to the Manual, and Vice Versa." The convention was closed by a banquet at the Cataract Hotel.

The Wagner Electric Manufacturing Company.

The directors of the Wagner Electric Manufacturing Company, St. Louis, Mo., met on the evening of January 23, and elected the following officers: S. M. Dodd, president; J. W. Bell, vice-president; A. Blair, secretary; W. A. Layman, treasurer and general manager.

The directors voted a quarterly dividend of one and three-fourths per cent. It is expected that the business for 1905 will show a large increase over that secured in 1904.

The Independent Telephone Association of Nebraska.

Representatives of the principal independent telephone systems of the state of Nebraska met on the afternoons of January 18 and 19, at Lincoln, Neb., and discussed plans for the formation of a state organization and the improving of service throughout the state. A committee of five members was appointed to consider plans for a clearing-house for the purpose of distributing to each system its share of money received for long-distance tolls. This committee consisted of J. C. Killarney, Auburn; F. E. Ebersole, Lincoln; G. T. Everett, Columbus; W. C. Bell, York; T. H. Pollock, Plattsmouth.

Considerable discussion was indulged in concerning the best methods of standardization. It was the general sentiment that some standard should be adopted for the construction and operation of lines, particularly those systems which were intercommunicating. A committee was appointed to take this matter into consideration. This committee included F. E. Ebersole, O. M. Thorpe, of Wahoo; W. C. Bell, A. N. Munn, of Nebraska City, and T. H. Pollock.

A communication was read from the National Telephone Association, suggesting affiliation with that body. This matter was taken under discussion, and will be reported upon at the next meeting.

On Thursday, January 19, the chief topic of the morning's discussion was the eligibility of certain members of the association. It was decided to restrict the membership of the association exclusively to those persons who are engaged only in the independent telephone business.

Following this discussion, the nominating committee reported the following selections for officers for the ensuing year: president, W. C. Bell, York; vice-president, C. J. Garlow, Columbus; secretary-treasurer, G. T. Everett, Columbus.

The committee appointed to consider the matter of a clearing-house reported favorably, and was continued so that a fuller report might be made some time in March.

The committee appointed to consider the matter of standardization requested more time, and will submit a full report to the executive board.

The state association is strongly in favor of affiliating with the national organization of independent telephone companies. The constitution of the Pennsylvania Independent Telephone Association was read and referred to a committee composed of Messrs. Ebersole, Clark and Hansen, to report with recommendations as to changes that would benefit the Nebraska association.

Among the exhibitors at this convention were the following: Automatic Electric Company, Chicago; Frank B. Cook, Chicago; Kellogg Switchboard and Supply Company, Chicago; Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.; American Electric Telephone Company, Chicago; Chicago Telephone Supply Company, Chicago; Kusel & Kusel, Chicago; Western Electric Company, Chicago; Monarch Telephone Manufacturing Company, Chicago; John A. Roebling's Sons Company, New York; Standard Underground Cable Company, New York; Swedish-American Telephone Company, Chicago; American Electric Fuse Company, Chicago; Wesco Supply Company, St. Louis, Mo.; Vought-Berger Electric Company, La Crosse, Wis.; National Conduit and Cable Company, New York; Nebraska Electrical Company, Lincoln, Neb.

The Institute Annual Dinner.

The annual dinner of the American Institute of Electrical Engineers will be given in the ballroom of the Waldorf-Astoria, New York city, February 8, 1905. This promises to be a most interesting occasion. The committee has decided to devote this dinner to emphasizing the triumphs of electric traction. An original menu has been arranged, and some novel features will be introduced. A number of pioneers in electric traction and present-day leaders will be among the speakers. The dinner will be served for $5 per cover, without wine or cigars.

The following special committee has been appointed to make arrangements for this annual dinner: T. C. Martin, chairman; F. C. Bates, H. W. Blake, P. G. Gossler, W. C. Gotshall, E. B. Katte, F. B. H. Paine, Charles W. Price, Calvin W. Rice, L. B. Stillwell, H. G. Stott and Arthur Williams.

Death of Mr. Ernest H. Mullin.

Mr. Ernest H. Mullin, manager of the advertising department of the General Electric Company, with offices at 44 Broad street, New York city, died on January 25, of heart disease. The news of Mr. Mullin's death will be received with great sorrow. He was one of the most widely known men in the electrical fraternity. He was a member of many electrical organizations and an indefatigable worker for the upbuilding of the American Institute of Electrical Engineers, of which organization he was, at the time of his death, a manager. Funeral services will be held at his home, Milburn, N. J., on Saturday, January 28.

Digitized by Google

The Installation of a Transmission Plant.

In the *Electric Club Journal* for January, 1905, an interesting article entitled "The Installation of a Transmission Plant," by "A Road Engineer," presents an amusing and instructive account of some early installation troubles. Among other trials which the engineer endured were those of bringing into working shape a pair of balky rotary converters. The following is an abstract from this article:

"This particular plant was laid out for three 750-kilowatt generators, but only two were to be installed. They were sixty-cycle three-bearing machines arranged to have an impact water-wheel mounted on the shaft just where a pulley would be placed if the machine were to be used with a belt-drive. Two exciters were furnished, each mounted with a water-wheel similarly to the generators. A switchboard, two banks of two-phase three-phase transformers for stepping up to 15,000 volts, some high-tension bayonet switches and type R lightning arresters completed the power-house equipment. The transmission was thirteen miles and at the receiving end were two 400-kilowatt, 550-volt, eighteen-pole, rotary converters. These converters were the largest that had yet been built for sixty cycles.

"The rotary converter, on account of the type, naturally required considerable attention and some experimentation to get into satisfactory service. One of the characteristics of these machines, which occasioned special treatment, was the high commutator speed, which greatly increased the influence of surface roughness upon the commutator. The combination of high speed and roughness caused the brushes to vibrate, which resulted in rather poor contact between them and the commutator. Of course sparking took place. If the commutator was neglected, the sparking would accentuate the roughness of the commutator and this increased roughness would further aggravate the sparking, so that the sparking would increase at an accelerating rate until the machine would finally buck. This with a uniform load, while all other conditions were good. The cause was not fully understood at the time and it was thought to be chiefly in the setting of the brushes. After a short experience with this machine it was discovered that a smoothness sufficient for slow-speed commutation might not be sufficient at a high surface velocity. Although the commutator might feel smooth to the finger, if the end of a lead pencil was pressed against the back of a brush, a good deal of vibration might be felt. In overcoming this, it was found quite advantageous to support a piece of a grindstone on a properly constructed rest and crowd it against the commutator, while running with the starting motor. This was persisted in until a fresh surface was obtained. After following this up with a very fine sandpaper, a surface was got which caused no perceptible vibration of the brushes.

"A further aid to smooth running was obtained by saturating the brushes with cylinder oil. Two sets of brushes were fitted to each machine, and while one set was in operation the other was immersed in oil. After receiving the above treatment, a machine would commutate perfectly for a very considerable period of time. After this a few hours' work would be required to put it in shape again.

"When first put into commission these rotary converters pumped quite badly and no adjustments of their fields would materially improve them in this respect. After some correspondence with the manufacturing company instructions were sent out to me to bore out the fields for a larger air-gap and bevel the pole corners. The boring out of the fields was somewhat of a puzzler at first as the machines were too large to be handled by any machine shop in that territory. After a time a boring bar was located that had been used to bore out the cylinder of a medium-sized Corliss engine. This bar was mounted in the bearings of a rotary converter after having been reconstructed to bore a sufficiently large diameter. It was belted to the end of the shaft of the other rotary converter which was carrying the railway load. This belt was necessarily small and ran at such a slow speed that it would not transmit power enough to pull the cutting tool through more than a very fine cut, but by taking a large number of cuts the bore was increased to the required amount. While this was being done the manufacturing company sent out two sets of copper dampers to be tried on the pole-pieces. One of these sets consisted of sheets of copper bent to the curvature of the pole-face and each made to completely cover one pole-face. The edges of each sheet were bent up an inch or so all the way around to secure it to the side of the pole-piece.

"As soon as the above changes had been made on one machine it was brought up to speed by the starting motor and the field was built up. Before, however, the field attained full strength, the machine commenced to make an ominous noise and slowed down. On investigation it was found that the copper facings on the poles had bulged out against the armature and were actually acting as brakes on the armature core. The armature being of the open-slot type, its teeth caused the magnetic flux in the air-gap to gather in tufts, and as these tufts followed the teeth across the pole-faces, they generated such excessive currents in the copper plates that the latter were discolored by heat and pulled out of position by the magnetic action of the induced currents. This difficulty was so great that these dampers could not be used at all. Their action is now well understood and with partially closed slots they make an effective damper. The other set of dampers was made of rectangular bars of copper surrounding the pole-pieces near the tips. Their use and the change in air-gap and beveling of the pole corners, resulted in decreasing the pumping to an unobjectionable amount."

Kern River Power Plant Started Up.

The power plant of the Kern River Power Company was started on December 30, 1904. The plant is located about 120 miles from Los Angeles, Cal., and has just been completed at a cost of about $2,000,000. It will furnish about 15,000 horse-power.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED AT DIRECTORS' MEETING, NEW YORK, FRIDAY, DECEMBER 23, 1904.

Charles V. Allen, Orange, N. J.
Robert Jamieson Browne, Calcutta, India.
John Shepherd Cowgill, Three Rivers, Mich.
Orville Hiram Ensign, Los Angeles, Cal.
William Craig Forsythe, Tallahassee, Fla.
Francis Perry Foster, Corning, N. Y.
Charles S. Hamner, Schenectady, N. Y.
John Steele Henderson, Wilkinsburg, Pa.
James Heywood, Philadelphia, Pa.
James Kent, Boston, Mass.
Fred Hutton Kroger, Boulder, Col.
Homer McCullough, Sheridan, Mont.
Domingo L. Monjo, Elizabeth, N. J.
Augustus Julius Pahl, San Francisco, Cal.
Henry Waterman Peck, Pittsburg, Pa.
William G. T. Pope, Lisbon, Portugal.
Henry Albert Pressey, Washington, D. C.
Norman Rowe, Guanajuato, Mexico.
Pierre V. C. See, Chicago, Ill.
Adolph Shane, Ames, Iowa.
Hans Christian Specht, East Pittsburg, Pa.
Alexander S. Spiegel, Chicago, Ill.
Frederick Starr Stitt, New York city.
William Maurice Talbot, Havana, Cuba.
John Rutledge Williams, Birmingham, Ala.
Roscoe Woltz, Lynn, Mass.
Walter Wood, Philadelphia, Pa.

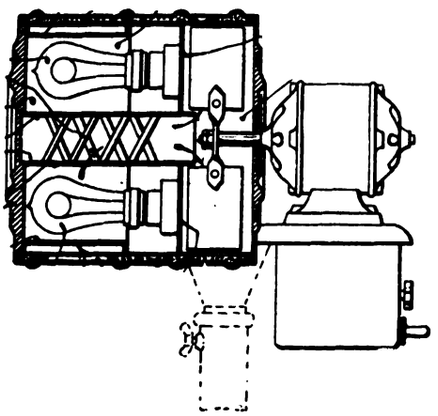
TRANSFERRED FROM ASSOCIATE TO MEMBER.

Sidney R. Sheldon, Moscow, Ida.

Digitized by Google

Electrical Patents.

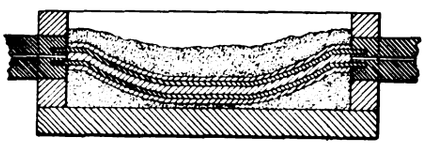
The hair driers now generally used for drying damp hair are mostly so constructed that the air heated by gas, spirits or otherwise is conveyed to the hair by means of fans or ventilators, and the very hot air rapidly produces a dry and undulated hair. These heating devices have in addition to others the drawback that the gas and spirit cause an unpleasant smell and make the air too dry, and further, that the heating can not be sufficiently regulated. Moreover, gas can not be used in places where there are no gasworks, but, as is frequently the case nowadays, electric light plants. A hair-drying apparatus patented (778,888, January 3, 1905) in this country by Otto Peter and Herbert von Kempski Ràcoszyn, of Osnabrück, Germany, obviates the above noted objections by providing an air warmer, which by means of electric lamps heats the air so rapidly and strongly that the hair drier is at once ready for use. This air warmer is easy to handle, causes no unpleasant



HAIR-DRYING APPARATUS.

smell, dries the hair thoroughly, and may be used with absolute safety. The invention consists of two concentric cylinders each provided with an orifice, a cover closing both of these cylinders at one end. A ring-shaped cover closes the space between the two cylinders at the other end, and in the ring-shaped space between the cylinders is arranged a plurality of glow lamps. A ventilator is at the open end of the inner cylinder, and means are employed for driving this cylinder whereby cold air is drawn into the outer cylinder, is heated by the lamps, and is drawn through the inner cylinder. Means are also provided for applying this heated air to the hair.

An improvement in the manipulation of refractory material is the subject matter of a patent (778,286, December 27, 1904) recently granted to Elihu Thomson, of Swampscott, Mass., and assigned to the General Electric Company. The invention relates to the formation of articles such as tubes, plates, or more complex forms, out of refractory material such as fused silica. In carrying out the invention a refractory conductor is provided, such as carbon, arranged to be traversed by a heavy electric current and adapted

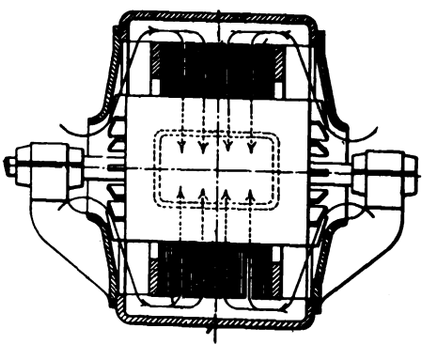


MANIPULATION OF REFRACTORY MATERIAL.

to be embedded in or surrounded by quartz granules or silica in comminuted form. Upon the passage of very strong heating currents through the carbon conductor, the quartz or other refractory material in the immediate vicinity of the conductor is melted, so that upon the cooling of the conductor a body of fused quartz following the contour of the conductor is formed. By choosing the size and shape of the conductor, it is possible to produce articles of fused quartz in a large variety of configurations.

Charles J. Reed, of Philadelphia, Pa., has assigned to Security Investment Company, of Pennsylvania, a patent (778,894, January 3, 1905) recently granted to him on a process of making spongy lead for secondary battery electrodes. The object of the invention is to provide an easily practised and inexpensive process for making finely divided lead, without electrolytic action, and therefore one which will consume a comparatively small amount of time and in which scrap or waste materials may be advantageously utilized. In practising the invention, one or more compounds of lead are mixed in a powdered condition, such, for instance, as oxide chloride, or sulphate of lead, with finely divided metallic zinc or zinc dust in chemically equivalent proportions. This powder when thoroughly mixed is subjected to a liquid of such composition as will decompose the lead compound into metallic lead and oxygen, chlorine, or sulphuric acid, according to the particular lead compound employed. The oxygen, chlorine or sulphuric acid unites with the zinc to form a zinc salt that is easily washed out by means of water, leaving pure metallic lead in a spongy form. Among the materials which may be utilized in practising the process are red lead and zinc dust in chemically equivalent proportions and a solution of zinc chloride. The mixture of powdered materials may be treated with the solution while in loose form to produce the finely divided lead for subsequent application to a suitable electrode plate or frame, or the mixture of powdered materals may be slightly dampened and applied to the plate or frame as a solid coherent mass, then dried out sufficiently to make it suitably absorbent, then subjected to the reducing liquid until the composition has been completely converted into metallic lead and a zinc salt, and finally subjected to a water bath for a sufficient length of time to remove the zinc salt. The plate thus formed is ready for use in a secondary battery.

An improvement in means for ventilating electrical machines has been patented (778,834, January 3, 1905) in this country by Albert Aichele, of Baden, Switzerland, who has assigned his patent



MEANS FOR VENTILATING ELECTRICAL MACHINE.

to the firm of Actiengesellschaft Brown, Boveri & Company of the same place. The invention relates to dynamo-electric machines, and more particularly to means for cooling the stator and rotor of such machines. Broadly speaking, the invention consists in the combination, with the stator and rotor, of an enclosing casing provided with an air-outlet and of means to establish a forced circulation of air through the casing from a point about the axis of the rotor to the periphery of the stator, thence between the coils of the latter to and about the rotor, and back between the coils of the stator into the casing of its air-outlet. The means for establishing the described circulation may be varied without departing from the spirit of the invention.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

An Electrical Speed Indicator.

The following interesting speed indicator has been devised by the firm of Siemens & Halske, Berlin. It consists of two parts: a small generator driven by the device, the speed of which is to be obtained, and an indicating device which may be placed at any convenient point. The first of these parts is merely a small inductor alternator. The stationary part is built up of stampings having inwardly projecting poles. The alternate ones are wound to form the field poles, and the others the armature poles. The indicator is driven from the shaft by a belt or in any suitable way. It sets up in the armature coils single-phase currents which are carried to the indicating instrument. This consists of a four-pole magnet, wound so as to produce a rotating field, the difference in phase between the two circuits being produced by a reactance coil. Within this field is mounted a movable part which is dragged around by the field, and which moves the indicating hand.—*Translated and abstracted from Electro (Brussels), November.*

The Reversal of Charge of Electrical Induction Machines.

In this communication Mr. George W. Walker, of the University of Glasgow, Scotland, describes a method of reversing static induction machines. He observed accidentally that on stopping a small Voss machine and giving it two turns in the wrong direction, and then restarting the machine in the right direction, the poles had been reversed. The experiment was repeated a number of times, and invariably the reversal occurred. The effect was then tried with a vacuum discharge tube connected to the knobs. While the tube was fresh, the reversal occurred, but after a little time the reversal occurred but seldom. It was found, however, that if the discharge was made to pass by connecting one terminal of the tube to earth, and the other terminal to one pole of the machine, while the second pole was kept insulated, the reversal invariably occurred when the procedure mentioned was followed. Next a large Wimshurst machine was tested, with the same results. It was noticed, however, that when the induction rods were so arranged that the machine excited both ways, the reversal did not occur. The author believes that this provides a simple way of getting the discharge to pass in whatever direction is required.—*Abstracted from Nature (London), January 5.*

A Contribution to the Study of Imperfect Contacts.

The first part of an interesting study upon the behavior of coherers, which was carried out by Mr. A. Fisch, is here given. After stating briefly previous work on imperfect contacts, and noting certain of their peculiarities, the method of experimentation is described. Certain early investigators found that coherers and other similar arrangements which do not obey Ohm's law have a resistance characteristic of hyperbolic form. The point of inclination of this curve has been called the critical value. It was found, however, by Guthe and Trowbridge that as the intensity of the current which is passed through an imperfect contact increases, the difference of potential at the terminals of the contact increases at first, but finally takes a constant value, depending only on the material of which the contacts are made. Robinson has shown that the difference of potential across the contacts may attain a value several times that of the critical potential, then falling suddenly to the latter value and remaining constant as the intensity of the current increases. Robinson calls the critical value of the potential that which immediately precedes the fall in voltage. All work previous to that carried out by the author had been done by means of continuous currents. They therefore thought it would be valuable to make a comparative investigation of the behavior of coherers and other similar devices when both alternating and continuous currents were passed through them. The work was done with three coherers, two formed of steel screws, and one of nickel. The results show that a coherer acts as a condenser. If the voltage is not sufficient to affect its resistance, the capacity varies greatly, corresponding to the variable state of the devices. The tests with alternating and continuous current show that for the nickel and one of the screw coherers the fall in potential occurred at a lower voltage for the alternating potential than for the continuous. This condition was reversed for the third coherer, showing that it was not due merely to the maximum voltage of the alternating current being greater than the effective. In fact, the characteristic curves lie too close together for this to be the case. Mr. Fisch concludes that the different results are due to fatigue of the coherer. The first two were tested with continuous currents first, and then with alternating, while with the third coherer the procedure was reversed.—*Translated and abstracted from L'Eclairage Électrique (Paris), December 31.*

Corrosion of Condenser Tubes.

In a paper entitled "Maintenance of Machinery in Merchant Ships," read before the Society of Naval Architects and Marine Engineers by Mr. Robert Hague, the corrosion of condenser tubes was discussed and reference made to the possibility of this being due largely to defects in the electrical supply system which allowed leakage of electric current to occur. As against this probability there is the fact that the trouble has been quite as acute in ships without electric generating plants as in those with such plants, and it does not seem to make any appreciable difference whether the vessel is wired on the single or double-wired system. While reasons have been advanced in support of the theory that the return currents in the single-wired system, or stray currents from defective insulation and connections in the double-wired system, should be accepted as a cause of deterioration in condenser tubes, it is at present difficult to take this as being the only cause. There does not seem to be any reason why electric currents should single out the tubes for attack when there are other metals of almost the same composition exposed to the same conditions, and which yet do not suffer to anything like the same extent. It is recognized that although an electric current of itself may not attack the tubes, the effect of an electric current passing through certain liquids is to split them up and set free corrosive elements from what may otherwise be a comparatively harmless liquid. Considering the conditions of the water in the engine room and stoke-hold bilges, which is a solution of fatty acids, fresh water, salt-water, drainage from hot ashes and all other sources, and in which the various metals are brought in contact. It is reasonable to expect some galvanic action to take place on the fittings so exposed, and such has been found to be the case to a considerable extent in some instances. In some ships corrosion in copper and other pipes from the bilges has been

Digitized by Google

traced to the use of certain animal or vegetable oils, but up to the present time little definite progress has been made in determining the cause of the trouble in condensers. At this time the theory of electric leakage from the generating current can not of itself be accepted as the only cause of condenser trouble. However, whether electric leakage is the cause or only a contributory cause, the fact remains that condenser troubles have become increasingly frequent since electricity came into more general use on board ships. It is suggested that should it be shown that condenser troubles are due to the electric current generated from any course whatever outside of the condenser, the latter might be insulated so as to protect it from such attacks.—*Abstracted from the Marine Review (Cleveland), January 5.*

The Separation and Analyses of Losses in Direct-Current Dynamos.

An interesting analysis is given here by M. E. J. Brunswick of the losses occurring in continuous-current dynamos. These are first classified according as they vary directly with the frequency or with the square of the frequency. In the former class are found friction and hysteresis losses, and in the latter, Foucault and windage losses. Secondly, the losses may be classified with reference to the induction: those proportional to the induction, such as hysteresis; those proportional to the square of the induction—Foucault losses, and those independent of the induction—friction and windage losses. From these hypotheses the equation for the losses in the generator is $P = a\omega + b\omega^2$, P being the power absorbed by the losses; ω, the frequency or speed, and a and b constants. From this equation characteristics for different inductions may be plotted, these being in the form of curves, the total power being laid off as ordinates, and the speed of frequency as abscissæ Writing the above equation in the form of $\frac{P}{\omega} = a + b\omega$, a system of straight lines may be plotted, having $\frac{P}{\omega}$ for the ordinates, and ω as the abscissæ. These lines, however, do not pass through the origin, but intersect the axis of abscissæ to the left. The equation shows that if P or ω is equal to zero, then a is equal to $-b\omega$; that is to say, at this particular point the torque required to furnish the friction and hysteresis losses is independent of the speed, and is just balanced by a second couple proportional to the speed and to the Foucault and windage losses. From the system of lines representing the relation between $\frac{P}{\omega}$ and ω a new characteristic may be drawn, representing the relation between $\frac{P}{\omega}$ and the induction or the shunt current. This curve will intersect the axis of ordinates at some point, and the ordinate at this point represents the torque required to overcome friction. The differences between this value and other ordinates is the torque required to overcome hysteresis. As this characteristic can not always be extended to meet the axis of the ordinates, an approximate point of intersection may be found by drawing a tangent to it at its lower extremity, since it at this point becomes flat. If this solution is not sufficiently accurate, the frictional torque may be found by drawing several such characteristics for different speeds, and then plotting a fresh characteristic between $\frac{P}{\omega}$ and ω. The part cut from the axis of ordinates by this curve gives a new determination for the frictional torque.—*Translated and abstracted from L'Industrie Électrique (Paris), December 25.*

German Electrical Installations—Mine Drainage and Ventilation.

The advantages of electrical transmission of power in mining operations are recognized in Germany to-day, according to M. E. Guarini, who discusses the subject in this article. In opening up new salt and coal mines it is becoming a practice to centralize the whole power in one electric generating station, except perhaps the main hoisting engines. Many large operators are replacing the greater part of their auxiliary steam-driven plants by electrically driven machinery. For power stations the electric generating units are frequently of 500 and 600 horsepower, and sets of 1,000 and 1,200 horsepower have recently been constructed. Electric power stations in mines are generally operated by steam engines, though gases from blast furnaces and waste gases from coke ovens supply the energy in some cases. It has proved exceedingly difficult to find an electrically driven pumping system satisfactory in all respects. At first, efforts were directed to the elimination of all intermediate gearing, but drainage pumps were all constructed for so low a speed that direct coupling was found to be absolutely impracticable, as it was decidedly wrong in principle to bring the speed of the motor down to that of a low-speed pump. Pumps for drainage purposes were constructed to run with increased speed, and at the same time with absolute certainty and greater efficiency. Pumps of 150 to 300 revolutions were designed to fulfill all conditions as to work in mines. The electric motor was also adapted to the changed conditions. An entirely new design of motor became necessary for obtaining good electrical proportions and ventilation, so that when running twenty-four hours a day the rise in temperature would remain within the permissible limit. Besides, the narrow space between the stationary and rotary parts of the three-phase-current motors—which are the only ones which can be considered for mine drainage—rendered an efficient mechanical adjustment necessary. Provision was made for adjusting the stationary part of the motor in a vertical as well as a horizontal position. Finally, transportation through the mine shaft and mine roads necessitated constructions, the largest piece of which could easily be transported to its final position. In the smaller type the rotary part is made in one piece; the stationary, in two pieces. In the larger type the rotary part consists of two, and the stationary of four pieces. A liquid starter for the full output of the motor is sometimes placed in front, connected with a small three-phase motor. The manipulation of the latter, and thereby of the large motor, is effected by a small controller placed at the side of the switchboard. The advantages of a well-designed electrical mine drainage plant are high efficiency, low working expenses and great reliability. While steam plants are subject to various restrictions as regards space and speed, in an electrically driven plant it is possible to use steam engines for the main generating station, which work with the smallest consumption of steam. Besides, for electric pumping plants superheated steam can be used, which is not suitable for underground steam pumps on account of the length of the pipes. A further advantage is that the dynamo machines, electric mains and motors work with a very high efficiency—probably as high as eighty-three per cent. The results with electric drainage plants will be more favorable when superheated steam is used in the primary station. When not working, the electric plant does not require any steam, whereas with steam pumps the entire line must be constantly kept under steam. The yearly cost of maintenance is much smaller for electric driving than for steam-driven or hydraulic plants.—*Abstracted from the Mining Magazine (San Francisco), January.*

Digitized by Google

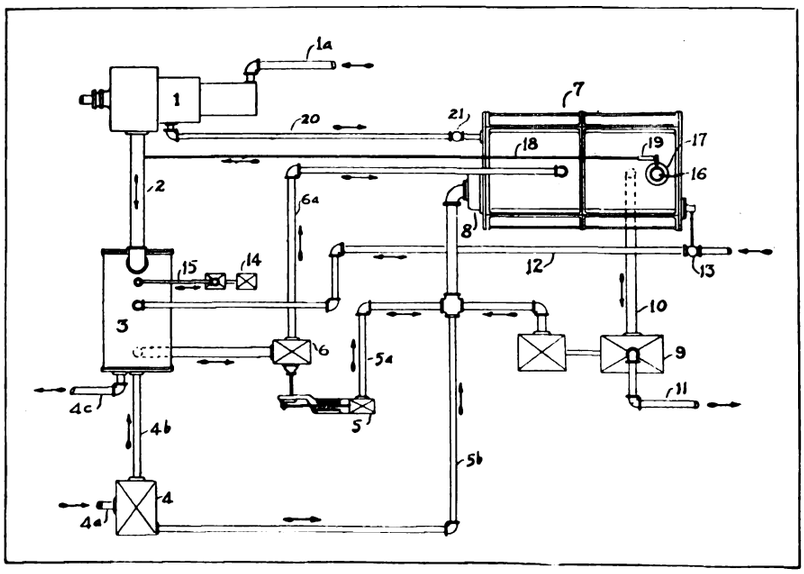
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Open Feed-Water Heaters in Connection with Steam Turbines.

The Harrison Safety Boiler Works, of Philadelphia, Pa., manufacturers of the well-known Cochrane feed-water heaters, have paid special attention to the adaptation of their Cochrane heaters to plants in which the auxiliary equipment is operated by turbine (the actual and contemplated installations of Cochrane heaters in connection with steam turbines already exceeding 25,000 horse-power), and they have developed some features in these installations which should prove of considerable interest to engineers.

The accompanying illustration shows



FEED-WATER HEATER ARRANGED FOR USE IN CONNECTION WITH A STEAM TURBINE.

an approved method, designed by the Harrison Safety Boiler Works and covered by letters-patent, for heating and regulating the boiler feed-water and is particularly adapted to plants where the steam turbines are operated in connection with surface condensers, although this method is also applicable to plants where surface condensers are used in connection with reciprocating engines.

In this illustration 1 is the main steam turbine taking steam through the pipe 1 *a* from the boiler; 2 is the exhaust-pipe from the turbine to condenser; 3 is the surface condenser receiving the exhaust from 2; 4 is a pump taking cold water through suction-pipe 4 *a* and forcing it through 4 *b* into the condenser to condense the exhaust steam therein; 4 *c* is the discharge for the circulating water from the condenser. An auxiliary engine 5 drives a pump 6 for drawing the condensed steam from the condenser and delivering it to the open heater through the pipe 6 *a*; 5 *a* is the exhaust-pipe from this auxiliary engine joining the exhaust 5 *b* from 4. A Cochrane feed-water heater 7 receives the exhaust from the auxiliaries through the oil separator 8, and a pump 9 takes the feed-water from the heater through the pipe 10 and discharges it into the boilers through the pipe 11. The exhaust from this pump, joining the other auxiliary exhaust, enters the separator 8.

The supplementary cold water feed supply 12 empties into the condenser 3 to make up any difference between the quantity of the condensation of the steam and the amount of water required by the boilers. The supplementary water is controlled by the valve 13 according to the level of the water in the heater 7. This valve is automatically closed or opened by the float and connecting mechanism; 14 is an air-pump exhausting air from the condenser 3 through the pipe 15. In cases where this pump is steam-driven, the exhaust also enters the separator 8.

The heater exhausts to the atmosphere through the pipe 16, which is provided with a back-pressure valve 17.

An air pipe 18 leads into the condenser and is provided with the air valve 19 for passing to the condenser the air which is liberated from the water by heating it in the heater. By this means the air in the heater is disposed of without permitting the escape of steam.

Should there be more exhaust from the auxiliaries than can be condensed in the heater, the pressure increases until it is high enough to open the back-pressure valve 17 and allow the surplus to escape to the atmosphere. It often occurs, however, that the steam from the auxiliaries is insufficient to heat the feed-water to the temperature of the steam itself. In order to cover such cases the pipe 20 is carried to the heater from such a point of expansion in the turbine as will ensure the least loss of effectiveness with the greatest gain potentially for the purpose of making up any possible deficiency in the auxiliary exhaust. In the pipe 20 is placed an automatic throttling valve 21, so adjusted that the pressure of the steam when it enters the heater shall be below the pressure at which the back-pressure valve 17 is set. Thus the supply of supplemental steam from the turbine depends upon the pressure in the heater and is regulated by the needs of the heater itself.

The operation of this novel arrangement has important advantages. In addition to all the condensation of the main exhaust being utilized in the heater, the supplementary cold water is automatically regulated and supplied, and is partially heated in the condenser by the utilization of the latent heat in the main exhaust. All of the exhaust from the auxiliaries is utilized up to the point where they provide more exhaust than is required in the heater, and should the supply fall below the maximum quantity required it is automatically supplemented by steam in the manner already described. The boilers are furnished with water at a uniformly high temperature, there being no sudden fall in the temperature due to variations in the quantity of steam available for heating the water or in the quantity of the supplemental cold water required. The methods by which these desirable results are obtained are simple, positive and entirely automatic.

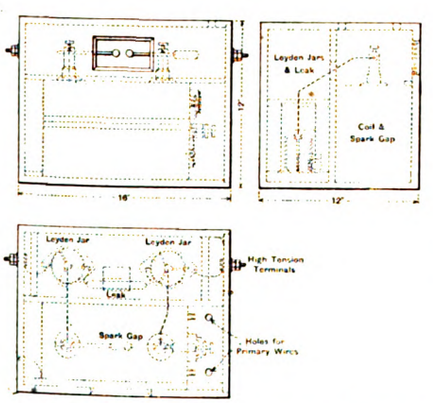
It will be seen that in a plant in which this method of heating and regulating the boiler feed-supply is used the auxiliaries are of the independent, steam-driven, non-condensing type. The manner in which the exhaust from these auxiliaries is utilized, however, makes them far more economical than the turbine or main engine run condensing, even though the latter may show an efficiency of fifteen per

Digitized by Google

cent or better. If the auxiliaries were run condensing they could not exceed and probably would not equal this efficiency of fifteen per cent, but when operated in the manner described above, their efficiency is practically 100 per cent, for all of the heat in the steam which is not converted into work or accounted for by losses from radiation, etc. (and these quantities would be identical whether the auxiliaries were run condensing or non-condensing), is utilized in heating the feed-water and turned back into the boilers. This efficiency of 100 per cent compares with the absolute loss of eighty-five per cent which must occur if the auxiliaries are run condensing and the heat in the exhaust dissipated and wasted in the condensing water.

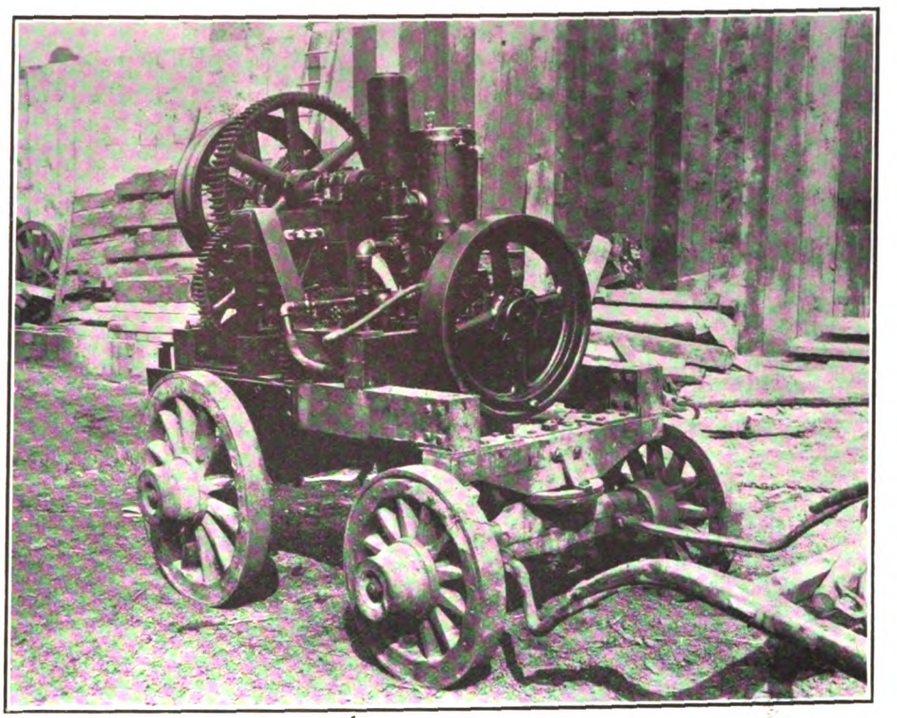
Lodge Electric Igniter for Internal-Combustion Engines.

In the issue of the ELECTRICAL REVIEW for December 31, page 1108, reference is made to a new form of ignition apparatus proposed by Sir Oliver Lodge. The following additional particulars are taken from the *Electrician* (London), December 30. This improved ignition device is manufactured by Messrs. Lodge Brothers & Company, of Birmingham. The chief claim for the new arrangement is that the firing of the explosive charge is rendered quite positive and independent of leaks due to moisture or soot at the spark plug. The general arrangement of the apparatus is shown in the accompanying figure. The constituent parts are: an induction coil, two Leyden jars, a leak,



IGNITION DEVICE FOR INTERNAL-COMBUSTION ENGINES.

and a spark-gap. The primary of the induction coil is fed from an eight-volt secondary battery, the current being given a pulsating character by a trembler or any other suitable device. Inspection of the drawing will show that the secondary of the high-tension induction coil is connected to the outer coatings of the two Leyden jars, the inners of which are connected to the adjustable spark-gap. This spark-gap is an auxiliary device for producing well defined disruptions. It is not to be confused with the working spark-gap within the engine cylinder. The last-named spark-gap is connected directly to the high-tension terminals of the induction coil, one of the connections usually being formed by the bed-plate of the engine. In order that the Leyden jars may be charged, it is necessary to have some form of leak between the outside coatings of the jars. This leak must be of sufficient value to allow the jars to charge rapidly, and yet not diminish the volume of the spark in the cylinder by allowing the discharge to pass through it. In the case of the gas engine igniter a special form of liquid resistance is used, which offers a fairly good path to the charging current, and offers a large resistance to the oscillating discharge. The jars have a capacity of the order of 0.0001 microfarad.



GRINNELL CABLE-HAULING MACHINE.

The Grinnell Cable-Hauling Machine.

The Knickerbocker Construction Company, New York city, uses the cable-hauling machine shown in the accompanying illustration in connection with the work of installing underground cables for telephone, telegraph, electric light and power companies throughout the country. This machine was patented by Mr. Grinnell, and is known as the Grinnell cable-hauling machine. It weighs about two tons. Power is furnished by a seven-horse-power gasoline engine, which will pull in a 750-foot length of cable weighing eight pounds to the foot.

By means of the machine and five or six men, 5,000 to 6,000 feet of cable can be pulled in in one day. A special feature of the apparatus consists of an iron shoe which fastens to the machine and extends down into the manhole, and which is easily adjusted so as to lead into each duct which is to be used. The shoe is grooved and curved, so that it easily takes the pull rope and the cable without friction, and ensures a steady pull on the cable without injury to the latter. For pulling out cable a similar machine with larger pull wheels is used. The grooves on the wheels prevent buckling of the cable.

Mr. E. B. Baker, of the Knickerbocker Construction Company, has installed over 150,000 feet of cable for the Northeastern Telephone Company at Lewiston, Auburn and Portland, Me., by the use of this machine.

Wireless Telegraphy in Arctic Exploration.

It has been announced that an effort will be made to keep in communication with Lieutenant R. E. Peary in his proposed search for the North Pole by means of wireless telegraphy. Lieutenant Peary will erect stations at proper points to keep in touch with the coast of Labrador, from which place he hopes to be able to communicate with New York.

Digitized by Google

Lundell Universal Motors.

The announcement made some time ago that the National Electric Company, of Milwaukee, Wis., had completed arrangements with Mr. Robert Lundell to manufacture and market a new line of Lundell universal motors, was received with a great deal of interest. It was intimated that this line of motors would possess some entirely new features in design and construction, and that their performance characteristics would establish new ideas in motor operation. The company states that these motors are remarkable for their overload capacity, and that their construction is a radical change from other machines on the market at the present time. The component parts have been proportioned and combined to produce a line of motors remarkable for efficiency, low temperature, compactness and rigidity of structure.

The accompanying illustrations give a good idea of the design and assembly of

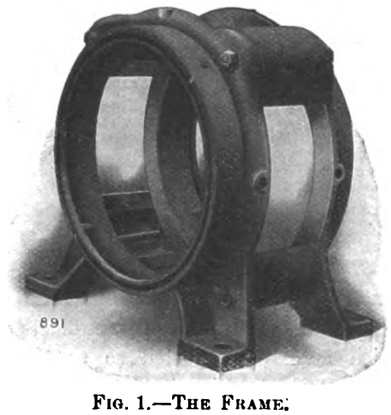


FIG. 1.—THE FRAME.

the motors. Fig. 1 shows the frame, and Fig. 2, the laminated yoke. The cast-iron frames or housings, which contain the laminated yoke rings and support the bearing brackets, consist of a rigid open casing made in two parts—front and rear. The rear portion has four hollow extension-arms of strong cross-section, accurately bored to engage and support the laminations assembled therein. The front frame is identical with the rear, except that the extension-arms are omitted. Bolts pass through these arms, securing the frames together, ensuring a rigid construction. These frames or housings, when bolted together, possess exceptional stiffness. This rigidity, however, is in no way dependent upon the laminations. In fact, it makes no difference to the stability and alignment of the machine whether the yoke laminations are inserted or not. At the same time, the overall dimensions—height and width—of the yoke are not made excessive. The laminated yoke is built up of punched mild steel rings, secured and accurately centered in the rigid frame. The outer and inner diameters of these rings are absolutely concentric. The pole-pieces are separately punched from the same material as the

FIG. 2.—THE LAMINATED YOKE.

yoke rings. These pole-pieces are provided with end-plates, so constructed as to provide ventilating ducts to carry off the heat generated in the field-coils. These end-plates are tapped, and retaining-bolts passed through the frames, accurately seating the pole-pieces and causing them to make perfect contact with the inner diameter of the yoke rings. By removing these bolts, the pole-pieces and field-coils can be readily taken out. Fig. 3 shows the pole-piece in place.

The armature coils are all form-wound on the latest types of frames, and are separately insulated, independent of the slot insulation. The coils are of standard proportions, and provide for ample room at both the back and the front ends. Supporting rings, cast in one piece with the end-plates of the core, serve to hold all ends of the armature coils firmly in place.

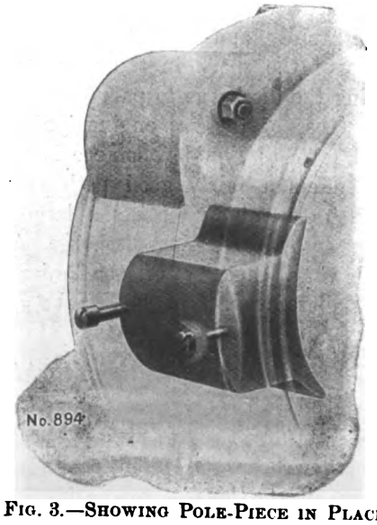


FIG. 3.—SHOWING POLE-PIECE IN PLACE.

In machines up to sixty horse-power it is not necessary to introduce ventilation into the centre of the armature, as in this new line of machines the losses are exceptionally low. These low losses make it possible to enclose these motors at extremely low temperature rise. Fig. 4 shows the armature.

The commutators are built on the lines of standard street railway practice, giving a rigid support to the bars, which are made of hard-drawn copper insulated by selected mica. The commutator shells are ventilated through their centres, this construction bringing about a remarkably cool running of the commutators.

A new principle is involved in the brush device of the Lundell universal machines. This device not only has improved commutation features, but has an operative bearing upon the running of the brush, securing an extremely good performance. Instead of placing the brushes side by side in a line parallel to the commutator bars and the mica, the brushes on the new apparatus are placed one directly in front of the other, in tandem. The total brush surface is the same as when the commutator space is occupied by the side-by-side brushes. Each brush has its independent tension spring. Any irregularity of the commutator surface, however, will not cause both brushes to jump together. The irregularity—if there should be any—strikes only one brush at a time, so that

FIG. 4.—THE ARMATURE.

one may rise while its mate is making contact, the circuit being always closed for that stud. It has been found that this materially reduces the temperature of the commutator, and gives it a much better surface. Where field control is used to obtain broad ranges required by variable-speed work, or where conditions of service call for special commutating conditions, the brush at the leaving edge is made of high-resistance carbon, to take care of sparking conditions, and the other brush of high conductivity to carry the current. In this manner both conditions of service, which are ordinarily opposed to each other, are successfully performed by this dual brush.

Fig. 5 illustrates the simplicity of construction of this motor. Fig. 6 shows the style of motor built in sizes from seven and one-half horse-power up, and Fig. 7 shows a two-arm type built in capacities up to and including five horse-power.

The magnetization losses in the iron,

Digitized by Google

and resistance losses in the winding, commutator and brushes are so low, due to the economical proportioning of these parts, that the motors run cool, independent of forced ventilation. When running under full load continuously, the temperature rise is kept so low that the quality of the insulation is not impaired in the least. Full loads are carried continuously without sparking, and because of the peculiarities of the Lundell tandem brushes, heavy overloads are carried without injury to the commutator or the brushes.

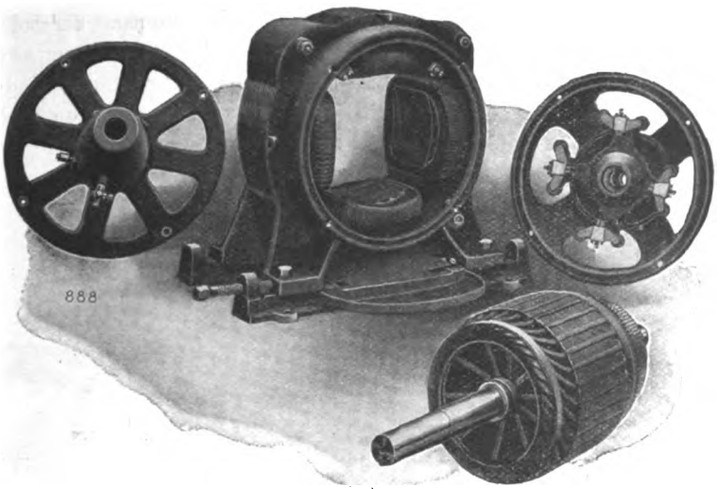


FIG. 5.—ILLUSTRATING SIMPLICITY OF CONSTRUCTION.

Variable speeds of standard fixed-speed motors, obtained by field control, are permissible within certain limits. For broad ranges of speed, motors of properly selected capacities are used. A range of speed, the lowest and highest points of which are represented by a ratio of three to one, meets most practical cases, and is recommended by the company as the ratio of speed to be obtained by field control. These variable-speed motors are remarkably compact, and, the company states, have ample margins for carrying overloads, even when working under difficult conditions of commutation.

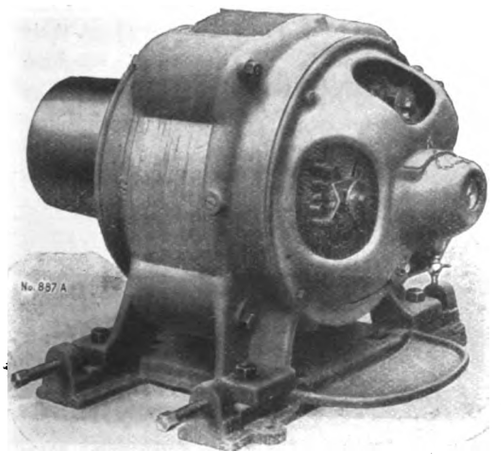


FIG. 6.—SHOWING TYPE FROM SEVEN AND ONE-HALF HORSE-POWER UP.

The De Cew Falls Power Station, Ontario.

The Hamilton Cataract Power, Light and Traction Company has recently started the two 5,000-kilowatt Westinghouse generators in its De Cew Falls power station in Ontario. Power is supplied from Welland canal feeders, tapped in about fourteen miles above the power station, and at the station the water has a head of 267 feet. The Westinghouse generators are of the two-bearing type, direct-connected to Escher-Wyss waterwheels, and run at a speed of 286 revolutions per minute. They generate three-phase current at a frequency of sixty-five cycles, and a pressure of 2,400 volts. The power is transmitted to the city of Hamilton, Ontario, where it is used for lighting, street railway and manufacturing purposes. A reserve steam-driven station is located at Hamilton, which contains two 1,000-kilowatt Westinghouse generators.

The entire station and high-tension apparatus are of Westinghouse design. The company has two separate three-phase transmission lines to Hamilton, a distance of about thirty-five miles. The high-tension apparatus is designed for a pressure of 40,000 volts, but will be operated for a time at 20,000 volts.

Mr. William V. C. Hawkins is general manager of the Hamilton company, and is also engineer in charge of the installation.

New Electrical Specialties.

Several new electrical specialties have been placed upon the market by Colman J. Mullin, 430 Kent avenue, Brooklyn, N. Y. One of these is a new form of pipe-hanger or ceiling fixture support. This consists of a malleable iron T and a short section of gas-pipe long enough to reach from the floor above to the ceiling below, and supporting a heavy outlet box. This form of hanger obviates the necessity of using scrap pipe for the adjusting of these hangers. The hangers are made in various sizes, and can always be carried in stock.

Another specialty which Mr. Mullin makes is the "Gem" come-along. This apparatus is being used by a number of large construction companies, and it is claimed that it will pull a wire through a conduit without hooks or lugs, and can be slipped over the wire with a minimum of effort and time.

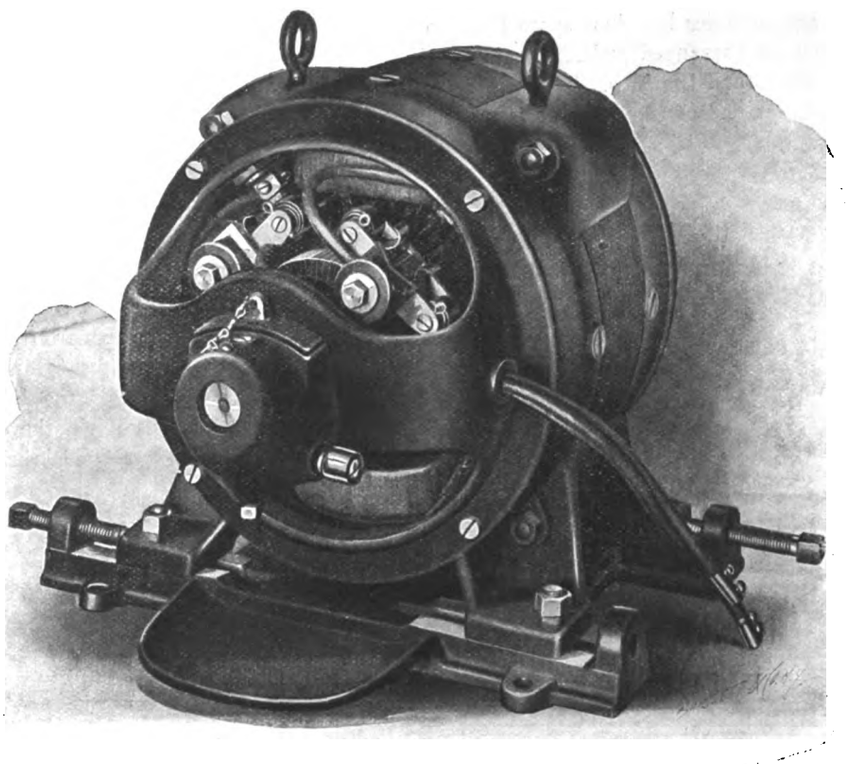


FIG. 7.—SHOWING TWO-ARM TYPE, BUILT IN CAPACITIES UP TO AND INCLUDING FIVE HORSE-POWER.

The "Hold Fast" locknut placed on the market by Mr. Mullin is guaranteed to save time in adjusting and tightening.

In addition to this material, Mr. Mullin manufactures a complete line of pipe-clamps, pipe-hangers, switchboard ironwork, braces, etc.

Digitized by Google

A New Form of Belt-Driven Alternator.

The General Electric Company, Schenectady, N. Y., has brought out a new form of belt-driven alternator which it designates as form P. This is shown in Fig. 1. The machine is built with two bearings which are mounted one on each end of the shaft. It is of compact design, and occupies less floor space than do machines arranged with separate pillow blocks and bearings. The bearing at the pulley end of the machine is made large, and is placed close to the revolving field spider, in order to bring the pulley close to the machine.

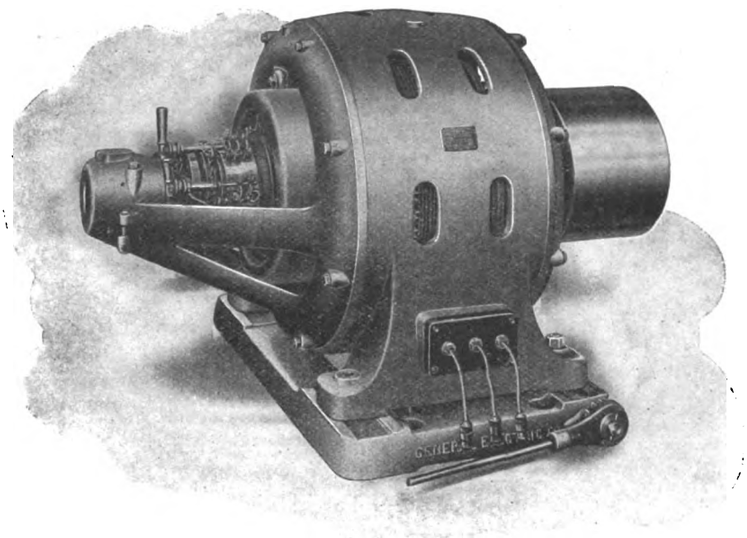


FIG. 1.—REVOLVING FIELD, BELT-DRIVEN ALTERNATOR.

The alternator is of the revolving field type with a stationary distributed armature winding. The revolving field, together with collector rings and exciter armature, is shown in Fig. 2. The machine is designed so that thorough ventilation is maintained in all parts. The base and the stationary armature are shown in Fig. 3.

The poles of the field are built up of laminations, and are fitted into dove-tailed slots in the steel hub by taper keys. The field coils are made from flat copper strip, wound on edge, and are designed for 125 volts excitation. The field poles and edgewise winding of the field coils are shown in Fig. 4. The pulley has a cast-iron centre and pressed paper rim. This type of pulley is considerably lighter, and is able to transmit more power per inch of face than an iron pulley, thus tending to increase the life of the belt and to diminish the strain on shaft and bearings.

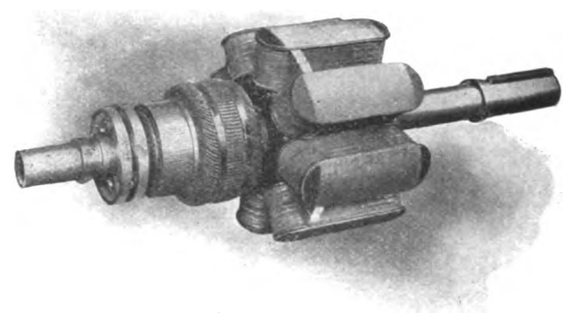


FIG. 2.—REVOLVING FIELD OF BELT-DRIVEN ALTERNATOR.

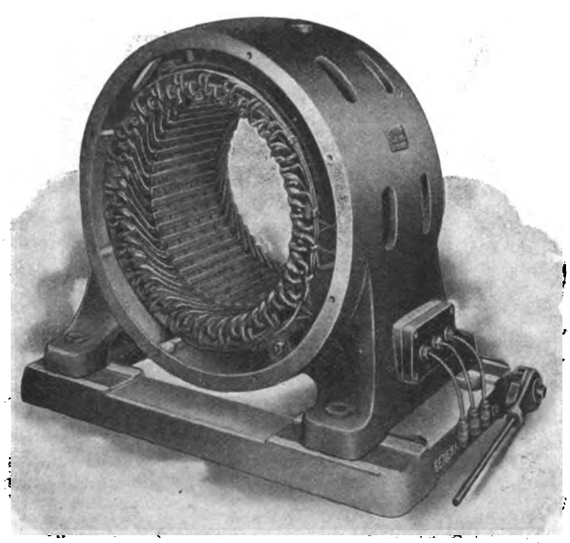


FIG. 3.—BASE AND ARMATURE OF BELT-DRIVEN ALTERNATOR.

The collector rings are of cast iron split in two pieces. Insulated pins, mounted directly on the shaft, support the rings.

The alternators are built with and without direct-connected exciters. The armature of the direct-connected exciter is mounted on the shaft, at the opposite end from the pulley. The magnet frame of the exciter is bolted to the end shield.

The standard designs are adapted to two or three-phase windings without change, except in the armature coils. The exciter and all accessories are the same for both phases. The General Electric Company recommends a standard three-phase winding with a load carried by any two of the three legs, for single-phase work. For this reason no single-phase winding has been standardized.

The machines will carry their full rated capacity continuously on two or three-phase, non-inductive load, the temperature of any part of the machine not exceeding forty degrees centigrade above that of the surrounding air. A twenty-five per cent overload for two hours can be carried with a rise of temperature not exceeding fifty-five degrees centigrade. All machines with three-phase windings will carry seventy-five per cent of their rated polyphase capacity in single-phase current with the same temperature rise as is given for two and three-phase windings. They will carry the full rated capacity in single-phase current for a period of three hours without injurious heating. Three-phase machines are designed for potentials of 240, 480, 600, 1,150 and 2,300 volts, and two-phase machines are designed for potentials of 240, 480, 1,150 and 2,300 volts.

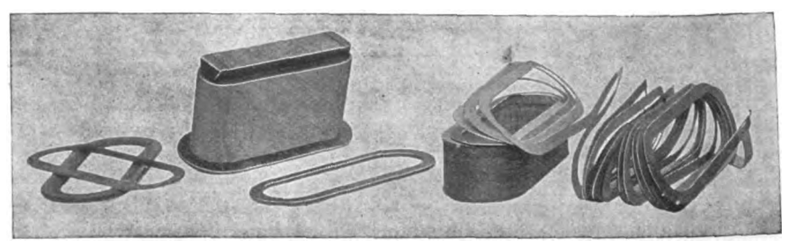


FIG. 4.—FIELD POLES AND COILS OF BELT-DRIVEN ALTERNATOR.

Digitized by Google

Cable-Laying Engine.

Fairbanks-Morse & Company, Chicago, Ill., build a power, cable-laying engine for telephone work. Telephone companies as well as other corporations are realizing that field work can be greatly facilitated by the use of power. There was a time when the laying of cables was done by hand and on account of the size of the cable and other conditions, the hand work was sufficiently rapid. Later on either more extensive hand power or in some cases animal power was required, but even this was not sufficient to take care of the present demands and the increasing size of cable. Therefore, the gasoline engine was called into service; a very ingenious combination of a vertical engine and winding drum together with a winch head has been arranged. The winch and engine are built complete on one iron base, making them self-contained and rigid, but at the same time light. This apparatus is then mounted onto an ordinary platform wagon, which can be hauled either by hand or by horse. The wagon also answers to carry tools and other material and apparatus which would be used in connection with the work. A small tank holding the fuel for the engine completes the outfit. The engine being electrically ignited is free from any danger, and is not affected in winter weather.

FAIRBANKS-MORSE CABLE-LAYING ENGINE.

An apparatus on the style of the above described was recently installed by the Independent Telephone Company at Salt Lake City, and while laying some of its cable, it established a new world's record on telephone cable work. The crew, under the direction of Chief Engineer Frank B. Hall, succeeded in laying 14,719 feet of 200-pair cable in seven hours and forty minutes, and the best previous record which was made in St. Louis in 1898 with nine men and a foreman was 7,556 feet of 120-pair cable; eight and one-half hours being required to accomplish the laying of the small cables. The chief engineer in charge of the new apparatus expressed himself as being entirely satisfied with the new apparatus, and feels that it is without doubt the best method of laying cable yet discovered. The six-horse-power Fairbanks-Morse combined vertical engine and winding gear is arranged with a sixteen-inch diameter drum and a five-inch winch or nigger head. The wagon upon which the apparatus is mounted is constructed with a three and one-half-inch running gear, having a reasonable heavy bed made of the best six-inch by eight-inch Oregon pine. The engine is arranged with a speed-regulating device so designed that it can be operated from either side of the running gear, and by the use of the speed change the engine can be controlled to any speed you desire.

In laying the large cable a one-half-inch wire rope was used, one end being attached to the large cable, passed through the subway and connected to the drum of the engine, and a pull of any distance can be made, as the engine has ample power to take care of long pulls. As much work has been accomplished by the use of the above described apparatus in five minutes as would have been accomplished formerly by four men in two hours. It would, therefore, appear from the description and the records that an apparatus of this kind would find great favor among many of the large telephone companies throughout the country.

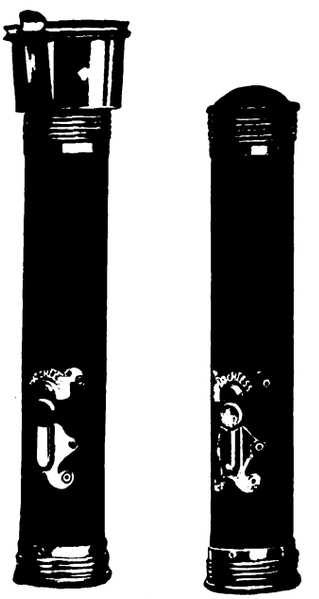
Electric Flashlights.

The accompanying illustrations show the "Matchless" flashlights placed upon the market by Stanley & Patterson, 40 Cortlandt street, New York city. These electric flashlights have become very popular for service in many directions. Where there is any liability of explosion, due to elements with which the air may be permeated, the pocket electric light is deemed a great safeguard over other forms of lighting apparatus in which a naked flame is used.

The flashlight apparatus here illustrated is provided with a patented contact device. This makes it possible to manipulate the flashlight with one hand, and the illumination may be either momentary or of longer duration.

A knurled button is attached to a spring, and slides forward on the surface of this spring. For momentary lighting it is only necessary to press down upon the button. When it is desired to continue the illumination it is only necessary to move the knurled button slightly forward with the thumb. This will carry forward a metal tongue under the lock, and until the button is moved back again the light will remain burning.

The flashlight cylinders are made of vulcanized fibre which is given an extra finish and polished in oil. This makes the case impervious to moisture. The appearance of the tube after this process is completed is similar to polished ebony. All of the metal parts are riveted to the cylinders with hollow rivets, securely clamping the fittings to the fibre.



ELECTRIC FLASHLIGHTS.

The flashlights are made in eight sizes, giving various numbers of flashes from 500 to 5,000, and containing in the various forms different types of reflectors and incandescent bulbs.

Two English inventors have made an adaptation of wireless telegraphy for entertaining purposes. Music boxes placed in different parts of the room are caused to play on the placing of a coin in a receptacle at a common centre.

Digitized by Google

Valuable Convention Souvenirs.

At the convention of the Northwestern Electrical Association, held in Milwaukee, Wis., last week, a number of the companies distributed valuable souvenirs. The accompanying illustrations show the watch fobs distributed by the Allis-Chalmers Company and by the National Electric Company. The pendant on the fob given

SOUVENIR OF THE NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

to the delegates by the Allis-Chalmers Company was ornamented on one side with the trade-mark of the Bullock Electric Manufacturing Company, and on the other side with the trade-mark of the Allis-Chalmers Company.

The pendant on the fob distributed by the National Electric Company was a reproduction of the trade-mark of the company. This showed the field-poles of a direct-current machine on the upper half portion, and the armature ring of a revolving-field alternator on the lower half portion. The two halves are joined together by a scroll bearing the word "National." On the reverse side of the medal was inscribed, "Northwestern Electrical Association, Milwaukee, Wis., January 18, 19 and 20."

Electric Power in New Zealand.

Mr. L. M. Hancock, electrical engineer, spent some time during the fall of last year in New Zealand, investigating the possibilities of water-power development there for the New Zealand government. A brief summary of his conclusions is given in a recent report from United

SOUVENIR OF THE NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

States Consul-General F. Dillingham, at Auckland, New Zealand.

Mr. Hancock says that both islands have great water-power resources which will repay investment, and that the development which has already taken place is excellent. He believes that the business of the colony has reached such a stage that larger investments in plants for generating and transmitting power will be profitable, and that development in this direction will do more to advance the material interests of the country than any other agency.

The Wairua river, which is about fourteen miles from Whangarei, and eighty-four miles from Auckland, is the nearest power to the great industrial centre of Auckland. At this point a dam from thirty to fifty feet high can be built, which will give the benefits of storage and increase the possible power production. The main disadvantage of this water power is its distance away. At Aratiatia rapids, on the Waikato river, there is a valuable power location, and there is another at Huka Falls.

While there is no question that the water power of the islands is ample to handle the entire railway system, Mr. Hancock believes that the question of doing this is one of business policy, and should be approached with caution. At the present time New Zealand is distinctly an agricultural and dairying colony. It is thought that the development of these water powers may tend to make it a manufacturing centre.

New Battery Switch.

The Atwater Kent Manufacturing Works, 112 North Sixth street, Philadelphia, Pa., is placing on the market a new battery switch which is intended to be convenient and durable, and which is designed on the style of larger electrical apparatus. This switch is shown in the accompanying illustration.

The handle-end of the lever is provided with notches to keep the lever in the position desired. The handle is substantially made, and can be easily manipulated when the hand is covered with a heavy glove. Locking devices have been omitted on this switch, as these are easily rendered ineffective, and the owner is often annoyed by mislaying the removable part.

Another convenient feature of the switch is that all connections are made after the switch has been mounted on the dash, and the hole is then covered

NEW FORM OF BATTERY SWITCH.

by the name-plate. This avoids bending the wires, making a poor connection. Examination of the connections may be made by simply removing the name-plate. The switch is well designed and substantially made. All the brass parts are made of heavy metal, and the only two holes that are tapped in the insulating part are bushed with brass.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TWENTY MILLIONS NEEDED FOR IMPROVEMENTS ON BROOKLYN RAPID TRANSIT—The New York State Board of Railroad Commissioners has recommended that the Brooklyn Rapid Transit Company spend $20,000,000 in order to improve its service. The expenditure should be divided over a period of three years, $8,500,000 being spent the first year, $5,000,000 the second year, and the balance the third year. It is recommended that 100 new cars be placed on the surface lines, and 200 on the elevated lines, and that $2,300,000 be spent in additional power supply.

ELECTRIFICATION OF LAKE ERIE & WESTERN RAILROAD—It has been announced that the Lake Erie & Western Railroad Company will put electric cars on its road next spring. Negotiations between officials of the road have been going on for some time with several of the motor car companies in regard to supplying cars for the use of the road. The Lake Erie has had the matter under advisement for some time and has been watching the result of the electrical experiments on the New York Central lines. It is expected that an hour schedule will be arranged for, and it is reported that the cars will be geared to make sixty miles an hour.

INCORPORATION OF GREAT NORTHERN POWER COMPANY IN MINNESOTA—Amended articles of incorporation of the Great Northern Power Company, which purposes to furnish electric power and light to Duluth, Superior and the towns of the iron ranges in Minnesota, were filed in the office of the clerk of the court in Duluth, increasing the amount of the capital stock from $100,000 to $2,000,000. Charles D. Barney & Company, bankers, of New York and Philadelphia, Tucker & Company, bankers, of Boston, and the Knickerbocker Trust Company have provided $4,000,000 for the completion of the work, and the officials assert that power will be delivered at the head of the lakes within eighteen months.

NEWS NOTES FROM MEXICO—The work of constructing a telephone line between San Luis Potosi and San Felipe, Mexico, has been completed. The Mexican government has declared forfeited the concession which was held by J. Woesner, of Saltillo, for the construction and operation of a system of long-distance telephone lines in northern Mexico. Part of this system has been constructed and is in operation. The Mexican Light and Power Company has projected a transmission line to transmit electric power to the districts of Temascaltepec, Zacualpam, Sultepec, Taxco and Malinaltenango. The company contemplates furnishing electrical energy to these districts, and the final surveys are now being made. A transmission line from Mexico City to El Oro is now under way, and it is expected that it will be completed by June.

REORGANIZATION OF SODUS BAY ROAD—The Sodus Bay (N. Y.) road has been reorganized by the filing of a certificate of reorganization of the company known as the Corning, Lake Keuka & Lake Ontario Railroad. The certificate of reorganization was filed by R. H. Curtis, of Bradford, N. Y., who has joined with Pittsburg capitalists in the company, which is capitalized at $1,500,000. The new company will construct the division of the road between Savona and Penn Yan, and work will be commenced immediately. The directors of the road are Benjamin Hedges, Frank Hedges, Robert Curtis, John C. Zimmerman, Frank Plaisted, William Barcley, Fred Crosby, Dwight Little, Frank Sears, Solomon R. Wilson, Guy M. Crane, David Hoover and Henry Knickerbocker. Connections will be made with the Erie at Savona, and the road will touch Bradford, Sonora, Tyrone, Lake Lamoka, Wayne, Keuka, Barrington, Warsaw and Penn Yan.

MICHIGAN ELECTRIC LINES MERGER—A merger of practically all of the electric railroads and light and power companies in the southwestern part of Michigan is announced in connection with the filing of a $1,200,000 mortgage given by the Commonwealth Company to N. W. Harris & Company, of Chicago. The mortgage is to secure bonds of the new merger company, Harris & Company having undertaken to finance the Commonwealth Company. This company purposes to supply power for all the interurban electric roads now in that section, and also to supply light and power to all cities and towns along its lines. The Commonwealth Company absorbs the Battle Creek & Jackson Electric Railway Company, the Kalamazoo Valley Electric Company, the Plainwell Electric Company, Limited, the Otsego Power Company, the Kalamazoo electric lighting plant, the dam sight at Allegan, and all the Battle Creek, Jackson, Kalamazoo, Otsego, Allegan and Plainwell lighting franchises.

ENGINEERING SOCIETIES.

WASHINGTON UNIVERSITY BRANCH OF A. I. E. E.—The Washington University branch of the American Institute of Electrical Engineers held a meeting on January 20, 1905, at St. Louis, Mo. The topic of discussion was "Engineering Features of the New York Subway." The regular date of meeting is the first Friday of each month. Present irregularities in the meetings are due to the removal of the university to its new site.

PENNSYLVANIA STATE COLLEGE BRANCH OF A. I. E. E.—The Pennsylvania State College branch of the American Institute of Electrical Engineers met Wednesday evening, January 18. A paper on "Some Hints on Conduit Work" was read by R. B. Arnold; L. F. Adams read an article on "Some New Westinghouse Crane Motors," and T. H. Arnold read a report of research work on the "Separation of Electrolytic White Lead." A question box was then discussed, and the meeting adjourned. The next meeting will take place on February 1, 1905.

THE WESTERN SOCIETY OF ENGINEERS—The Western Society of Engineers, Monadnock Block, Chicago, Ill., has elected the following officers for 1905: president, Edward C. Carter; first vice-president, G. A. Liljencrantz; second vice-president, Charles F. Loweth; third vice-president, L. P. Breckenridge; treasurer, Andrews Allen; secretary, J. H. Warder. Trustees: B. E. Grant (one year), T. W. Snow (two years), George M. Wisner (three years). Past-presidents in the board of directors: W. H. Finley, Ralph Modjeski and H. W. Parkhurst.

NEW YORK ELECTRICAL SOCIETY—At the 247th meeting of the New York Electrical Society, held on January 18, Professor William S. Franklin, of Lehigh University, lectured on "Electric Waves and the Reaction of Transmission Lines." Professor Franklin illustrated his lecture by a number of lantern slides, and brought to the notice of the large audience several new ideas with regard to the progress of theory in this field. The following members were elected: William C. Ward, C. G. Owens, G. H. Hodges, Joseph M. Roman, H. G. Stott, C. D. Gray, C. H. Nichols, Robert P. Parrott, M. J. Maguire, Charles C. Mathews, Walter Lawrance, Frank W. Uttal, R. B. McVey, W. G. Ritter, F. G. McMahon, Robert Thistlewhite and Paul T. Kenny.

THE ELEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS—The eleventh annual meeting of the American Society of Heating and Ventilating Engineers was held at the Hotel Astor, New York city, from January 17 to 19, 1905. At the evening session on January 17 the report of the tellers of election was received, and a paper on "Appliances and Results in Exhaust Steam Circulation," by James A. Donnelly, was read. The second session was held on Wednesday afternoon, January 18, when the following papers were read: "Investigation of Accuracy of a Direct-Reading Hygrometer," by R. C. Carpenter; "Gas as a Fuel for Hot Air Heating," by R. S. Thompson, and "Steam Heating in Connection with Condensing Engines," by Reginald Pelham Bolton. At the morning session on Thursday, January 19, papers were presented on "Experience with Radiators in the Top Story of a Building," by A. B. Reck; "Circulation of Hot Water," by John S. Brennan, and at the afternoon session a paper on "European Methods of Heating Fifty Years Back," by R. C. Carpenter, was read. The following officers were elected for the ensuing year: president, Professor William Kent; first vice-president, Reginald Pelham Bolton; second vice-president, C. B. J. Snyder; treasurer, U. G. Scollay; governors, B. H Carpenter, B. F. Stangland, James Mackay, A. B. Franklin and J. C. Trachsel. On the evening of Wednesday, January 18, the annual dinner of the society was held at the Hotel Astor. New York State Senator Wray was present and made an address.

Digitized by Google

TELEPHONE AND TELEGRAPH.

RIVERSIDE, CAL.—The Home Telephone Company is now connected with Beaumont.

FARMINGTON, WASH.—A new telephone line is being extended from Oakesdale to Farmington.

SPRINGFIELD, ILL.—The work of stringing a line from Bloomington to Springfield has been completed.

RUSHVILLE, IND.—The Spiceland Cooperative Telephone Company has applied for a franchise in Rushville.

FARGO, N. D.—The Northwestern Telephone Company is expected to extend its line from Jamestown to Bismarck later in the year.

OWINGSVILLE, KY.—A company has been organized to build a telephone line from Moore's Ferry to Salt Lick, a distance of five miles.

SCRANTON, PA.—The Pennsylvania Telephone Company has installed a new switchboard in its exchange in Scranton at a cost of $200,000.

PHILADELPHIA, PA.—The Diamond State Telephone Company will shortly build lines from Easton to Welsh Point and Cowantown.

CUMBERLAND, MD.—The Western Maryland Telephone Company has completed connections through to Uniontown and Connellsville, Pa.

FULLERTON, CAL.—On account of rapidly increasing business, the Sunset Telephone Company has decided to again rebuild its system in Fullerton.

HUNTINGTON, W. VA.—The Southern Bell Telephone and Telegraph Company has purchased the Catlettsburg & Ashland Telephone Company's lines.

ST. CHARLES, MO.—The new switchboard at the Bell Telephone Company's exchange has been put into operation. It has connections for 2,800 telephones.

EDWARDSVILLE, ILL.—The Central Union Telephone Company is installing a new telephone system in Edwardsville, representing an expenditure of about $10,000.

CHANUTE, KAN.—The Wareham & Wood Telephone Company has made a proposition to the Chanute city council to sell the telephone system to the city for $60,000, payable $10,000 a year in quarterly instalments.

MORGANTOWN, PA.—The Conestoga Telephone Company has decided to build a new line to Elverson and also a new one to Joanna. The line has been completed to Plowville. Work will begin in the near future on a line to Reading.

RICH HILL, MO.—The Rich Hill city council has received a proposition from S. J. McComb, of Humansville, Mo., to put in a local telephone system, give the city two per cent of the gross receipts and free municipal telephones, providing a twenty-year franchise is granted.

UTICA, N. Y.—During the past two months the Bell Telephone Company has spent about $50,000 in subway extensions in Utica. These subways will average six ducts each, with a carrying capacity of six cables, containing 3,600 wires. The company expects to make further subway extensions the coming spring.

MARION, S. D.—The telephone exchange in Marion is now completed and in good working order. It was established by the Marion Telephone Company, which has been incorporated with a capital of $10,000. The officers are: president, Jacob Hieb; vice-president, Fred Hausauer; secretary-treasurer, A. E. Hofer.

OXFORD, N. Y.—The new telephone line of the Oxford Valley Company has been constructed from Oxford to Brisbin, where it connects with the Chenango Valley line. It is reported that a large share of the $2,000,000 to be expended by the Central New York Telephone and Telegraph Company will be used to improve the service in this section.

HUNTSVILLE, ALA.—The Seyforth Building has been leased for a term of ten years by the Southern Bell Telephone and Telegraph Company, which will establish its local exchange there. The company will send a large force of men to Huntsville to install a common battery system and make other extensive improvements in the telephone service.

LEBANON, OHIO—The stockholders of the Valley Telephone Company have elected the following members to serve on the board of directors: O. M. Bake, George G. King, H. S. Conover, Gibson Lowe and James Stoops. This company represents an outlay of $107,000 and has real estate valued at $3,000. During 1904 the company cleared $10,000.

ALLENTOWN, PA.—The Consolidated Telephone Company, of Pennsylvania, has completed its trunk lines from Reading to Lebanon, and will be in a position in a few days to give direct communication between Reading and Lancaster, Lebanon and Dauphin counties. In a short time the line between Hamburg and Pottsville will be completed.

MIDDLETOWN, N. Y.—Harvey Albee, receiver for the Beaverkill Telephone Company, recently sold the line at Roscoe to creditors for $1,250. These are S. D. Maynard, E. B. Palen, J. W. Johnston, Harley Albee, Jay Davidson, M. N. Dodge, W. E. Sprague, J. Campbell and O. P. Sprague. The probability is that a new company will be formed and the line reconstructed.

GOSHEN, IND.—J. K. Johnston, formerly of Louisville, Ky., has, with business associates, leased the plants of the Home Telephone Company, comprising the big exchanges at Elkhart and Goshen and smaller systems at New Paris, Wakarusa and Middlebury. The Home Telephone Company is headed by Braley & Barber, of Cleveland, who have large telephone interests at Kansas City and other western points.

TACOMA, WASH.—Seven telephone lines, covering the largest part of the Palouse wheat district in Eastern Washington, are to be merged by their farmer owners into one company, to be governed by a board of seven farmers, one to be elected by each line. A central exchange will be established in each town through which the lines run. Stockholders will be given free connections, and all lines will be charged a small fee in order to maintain central exchanges. The present lines are the outgrowth of private lines started three years ago.

UTICA, N. Y.—The Independent Telephone Securities Company has purchased a controlling interest in the Black River Telephone Company. The Independent Telephone Securities Company has been incorporated with the idea of merging the independent companies in the northern part of New York state. The Black River Telephone Company's lines extend from Utica north along the lines of the Rome, Watertown & Ogdensburg and Black River railroads. The company has exchanges in twenty-two villages and operates over 1,000 telephones. It has more than 500 miles of toll lines, which reach nearly every village in the northern part of the state.

YOUNGSTOWN, OHIO—The Youngstown Telephone Company has completed several important extensions to its local telephone service. New lines have been put up to Sharon and Greenville. A private branch exchange has been installed in the office of the Youngstown & Sharon Railway Company, and a deal has been closed for a private line to the Bessemer limestone quarries near Lowellville. During the past year the Youngstown Telephone Company put in 800 new telephones. Quite a number of farm lines have been erected and several toll lines have been added to the system. The latter include one to Canfield. The new Sharon and Greenville lines give direct connection from Youngstown to many towns in Western Pennsylvania and New York state.

UTICA, N. Y.—The independent telephone exchanges at Cooperstown and Richfield Springs, together with the rural lines of the Otsego Home Telephone Company in and about Cooperstown, have passed into the hands of the Independent Securities Company, of Buffalo, a branch of the syndicate now controlling the local companies in Rochester, Syracuse and Utica. It is reliably stated also that other independent companies are considering a proposition for a sale to the Utica company. The Cooperstown exchange has about 250 telephones, and the Richfield Springs exchange about the same number. In the towns about Cooperstown there are some 200 telephones of the Otsego Home company, and these will be connected with the exchange at the county seat and given service from that point. The companies at Cooperstown and Richfield Springs were organized by Fred C. Ward, formerly of Delhi, about three years ago, and he soon connected the two towns. The Otsego Home company was capitalized at $40,000.

Digitized by Google

CLINTON, N. J.—The Lebanon Telephone Company has extended its line to Flemington.

CALEDONIA, N. Y.—The Bell Telephone Company will build a line south from Chili Station.

SANTA MONICA, CAL.—The Home telephone franchise has been sold to Louis Blankenhorn.

AURORA, ILL.—The Chicago Telephone Company is making extensive improvements to its system in the vicinity of Aurora.

WEST CHESTER, PA.—The Western Union Telegraph Company will erect a new line between Chester and Darby, and upon its completion will start work on a line from Wilmington to Cape Charles.

BESSEMER, ALA.—The Southern Bell Telephone Company will at once commence the construction of a line from Bessemer to Virginia Mines, a number of subscribers having been secured at that point.

ALTON, ILL.—A franchise has been granted by the Madison County board of supervisors to the Fosterburg Farmers' Mutual Telephone Company to construct and operate a telephone line from Fosterburg to Alton.

SALEM, MO.—The Salem city council has passed an ordinance granting the Bell Telephone Company the right to erect poles and wires on the city streets. It is expected that the line will be built at once from Steelville.

DRYDEN, N. Y.—A farmers' telephone company is constructing a line from Chenango Forks to Whitney's Point, Killawog, Marathon, Messengerville, and Virgil, where it will connect with the line of the Dryden Telephone Company.

UPPER LISLE, N. Y.—At the annual meeting of the Upper Lisle Telephone Company the following officers were elected: president, Frank Brannan; secretary, Arthur Rooks; treasurer, Martin Sherwood; directors, John Stalker and George A. Landers.

HAMLET, IND.—Surveyors are running a line for the erection of a new telephone line which will be built to connect Plymouth with a number of Marshall County and Starke County towns, with the western terminal at Knox. The line is to be put in operation the coming spring.

RAWSON, OHIO—The following officers have been elected by the Farmers' Mutual Telephone Company, at Berton Ridge: president, J. H. Kirtland; treasurer, Daniel Jackson; secretary, P. A. Kemerer; trustee, G. C. Clymer. The line will be built at once, and will have connection with Findlay.

CLIFTON, TENN.—The Consolidated Telephone Company, which recently acquired all the various telephone systems in the neighborhood of Clifton, is arranging to install an exchange at Waynesboro. It is probable that the line will be extended to the Nashville, Chattanooga & St. Louis Railway at Allen's Creek.

OSWEGO, N. Y.—At the annual meeting of the stockholders of the Ontario Telephone Company. the following officers were elected: president, F. A. Emerick; vice-president, Niel Gray, Jr.; secretary, Elisha B. Powell; treasurer, R. Arthur Downey. The company now operates about 1,175 telephones, 925 of this number being in Oswego.

BERGEN, N. Y.—At the annual meeting of the Bergen Telephone Company officers were elected as follows: president, G. M. Gillette; vice-president, J. S. Gleason; treasurer, C. E. Housel; secretary, H. C. Miller; directors, the officers and R. M. Andrews, W. F. Smeltzer, W. E. Gillette, W. M. Sage, George E. Parish, George A. Johnson, George E. Best, George Sands.

CAMDEN, MICH.—At the annual meeting of the Camden Rural Telephone Company, the following officers were elected for the ensuing year: president, Henry Haynes; vice-president, George A. J. Palmer; secretary, S. E. Haughey; treasurer, B. R. Alward; directors, S. S. Townsend, James Crow, Charles Small, Alfred Small and F. W. Rowe. The company installed 300 telephones during 1904.

ST. LOUIS, MO.—The Suburban Telephone Company, of Clayton, has completed connection with the Kinloch company, of St. Louis, bringing the residents of Clayton and other towns in St. Louis County into direct telephone connection over the Kinloch wires with St. Louis. There are about 100 telephones in use in Clayton and thirty-five in Ferguson. The Suburban company has in use automatic telephones.

BUFFALO, N. Y.—It is reported from Columbus, Ohio, that the Hocking Valley Railroad has contracted with the Bell Telephone Company to place a long-distance wire along the line with a view of installing a telephone system similar to the one recently completed on the Lake Shore. There are to be stations at Toledo, Walbridge, Upper Sandusky, Marion, Delaware, Lancaster, Logan, Athens and Nelsonville.

HORNBY, N. Y.—The Hornby Telephone Association has been reorganized under the laws of the state of New York. The directors are H. T. Jimmerson, Walter Davis, E. J. Easterbrook, C. C. Roloson, A. C. Gifford, C. R. Adams, Edwin Dodge. Officers were elected as follows: H. T. Jimmerson, president; C. R. Adams, vice-president; C. C. Roloson, treasurer; A. C. Gifford, secretary. Fifteen miles of new line were added to the system during the past year.

PITTSBURG, PA.—At the annual meeting of the Maryland, Pennsylvania & West Virginia Telephone Company all the old directors were reelected except E. H. Reid, of Scottdale, and E. T. Norton, of Connellsville, who declined reelection, and whose places were filled by S. M. Graham, of Uniontown, and A. C. Sherrard, of Vanderbilt. The company will extend its lines over Fayette County, and will provide 400 more telephones in both Uniontown and Connellsville.

DECATUR, ALA.—The Morgan County Telephone Company has completed its long-distance line to Hillsboro, thirteen miles from Decatur. It has only to build to Tuscumbia, about forty-five miles, where it will connect with the independent company from Memphis. When this link is completed Decatur will have long-distance connection with all of the northern states, both through the Morgan company and the Bell system. The Morgan County people expect to build from Decatur to Birmingham at an early date.

TRENTON, N. J.—The stockholders of the Inter-State Telephone Company have elected the following board of directors: W. S. Hancock, Barker Gummere, Governor-elect E. C. Stokes, Hugh H. Hamill, H. C. Loudenslager, of Camden; C. W. Kline, of Hazleton, Pa.; G. R. Bedford, of Wilkesbarre, Pa.; John Markle, A. C. Markle, of New York; G. N. Reichart, of Wilkesbarre, Pa.; R. P. Wilson, of Trenton; Louis Kuehnle, of Atlantic City, N. J.; J. W. Crelin, of Hazleton, Pa.; Thomas Daugherty, of Allentown, Pa.; F. A. Demarest, Trenton.

BALTIMORE, MD.—The Cecil Farmers' Telephone Company has placed in operation its line from Rising Sun to Port Deposit, where it has connection with the Maryland company. A spur has also been extended to Colora. The company will have the connections at the Pennsylvania line with the United Telephone Company of Chester County. The Cecil Farmers' Telephone Company is an independent concern, organized by the Cecil Farmers' Club and granted a charter by the last legislature of Maryland. The members of the Farmers' Club constitute the board of directors, with Elwood Balderston, president, and Cecil E. Ewing, secretary. The work of installing telephones is being pushed.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has closed a contract with the Southern Maryland Telephone Company whereby the lines of the companies will be connected at Brandywine. By this move all southern Maryland towns through the exchange at Upper Marlboro will have long-distance connection with Baltimore and the North. The Southern Maryland company has agreed to use the instruments and apparatus of the Chesapeake company, and thus become virtually a part of that system. The Southern Maryland company is already operating exchanges at Leonardtown, Mechanicsville and Charlotte Hall, and in the near future expects to open exchanges at La Plata, Brandywine and other points. Early in the spring, it is said, it is the intention of the company to extend its lines south to Point Lookout, and westward to La Plata and all Potomac river points, by which combination southern Maryland is assured of connection with Washington. It is also understood that negotiations are under way between the Southern Maryland company and the Chesapeake company for the leasing of the latter's lines in Calvert County.

Digitized by Google

ELECTRIC LIGHTING.

UVALDE, TEX.—A franchise has been granted for the installation of an electric light plant.

COLUMBIA, KY.—The franchise for the operation of an electric light plant in Columbia has been sold to Myers Brothers.

GOLDFIELD, COL.—The new electric light plant, which has a capacity of over 1,200 lights, has been placed in operation.

JONESBORO, ARK.—J. F. Gautney contemplates the erection of an electric plant to transmit power a distance of 100 miles.

FORREST CITY, ARK.—Eugene Williams, cashier of the Bank of Forrest City, has purchased the electric light plant for $10,000.

STOCKETT, MONT.—The Cottonwood Coal Company is arranging for a larger and more adequate electric light plant. A 2,000-light dynamo has been ordered.

TROY, N. Y.—The Ballston Spa Light and Power Company has plans completed for the installation of arc lights to illuminate the main streets of Ballston Spa.

PASSAIC, N. J.—The council of Passaic has awarded the contract for electric lighting for the coming five years to the Weehawken Construction Company.

YREKA, CAL.—The Siskiyou Electric Light and Power Company, with headquarters at Yreka, has secured control of the Kappler plant at Etna, through lease.

HUNTINGDON, TENN.—W. J. Holman has made a deal with a committee of the municipal board of aldermen whereby he will lease the electric light plant and waterworks.

DENVER, COL.—The Montrose Electric Light and Power Company has completed a two-story brick building sixty by 142 feet at Montrose. New machinery will be installed throughout.

CHARLOTTE, N. C.—The Catawba Power Company has taken over the electric plant of the Highland Park Manufacturing Company, located near the large cotton mills, north of Charlotte.

ALBUQUERQUE, N. M.—A deal has been consummated whereby Gregory Page, of Gallup, takes over the Gallup Electric Light and Power Company. The company has a capital of $50,000.

SHENANDOAH, PA.—The Shenandoah borough council has awarded the contract for lighting the town to the People's Light Company, at a contract price of $63.50 per light per year for three years.

FINDLAY, OHIO—The village council of Ottawa has granted a franchise to the electric light company of Findlay to construct, maintain and operate a heat and power plant for a period of twenty-five years.

QUINCY, ILL.—The controlling interest in the Independent Light and Power Company, of Quincy, has been sold to a Chicago capitalist. The new manager will be N. J. Ferris, of Chicago. The terms have not been made public.

KNOXVILLE, TENN.—At a special meeting of the city council a resolution was passed calling for the framing of a bill for presentation to the legislature asking authority to issue $200,000 worth of bonds with which to construct an electric light plant.

WHEELING, W. VA.—The stockholders of the Moundsville Electrical Company at a meeting held recently reelected the old board of directors, as follows: B. B. McMechen, T. S. Riggs, Fred Kemple, H. W. Thompson, S. M. Steele and J. E. Roberts.

TRENTON, N. J.—Vice-Chancellor Grey has made an order appointing Clifton C. Shinn receiver for the Shore Electric Light, Heat and Power Company. The defendant company has contracts for lighting Pleasantville and Absecon, in Atlantic County.

HARTFORD, KY.—The work of erecting an electric lighting plant at Hartford has been begun. In the city of Hartford 1,000 lights will be utilized. A line will also be run to Beaver Dam and arrangements made to light that town from the Hartford plant.

FLORENCE, COL.—The Arkansas Valley Electric Light Company is planning to change its system of electric lighting to an alternating-current system. Plans are now being draughted and arrangements made to light Rockvale, Coal Creek and Williamsburg.

RAPID CITY, S. D.—Articles of incorporation have been filed for the Black Hills Electric Power and Mining Company. The company will put in a power plant at Silver City that will generate 5,000 horse-power, which is to be sold at $120 per horse-power per year.

GREELEY, COL.—The National Construction Company, of South Bend, Ind., has commenced work on the erection of a $20,000 water and electric light plant for the town of Evans, four miles south of Greeley. The contract calls for completion of the plant within seventy-five days.

HARRISBURG, PA.—Steelton may be lighted by electricity generated at the plant of the York Haven Light, Heat and Power Company. The plan is to bring the electricity to Steelton by a heavy cable stretched across the river at York Haven and thence to the borough along the old canal bed.

CANON CITY, COL.—The Park Center Land and Ditch Company will install an electric plant at a point four miles from Canon City. The plant will light Four Mile, Park Center, Fruitmere and Orchard Park, and will also supply power to operate an electric car line connecting these places with Canon City.

WHEELING, W. VA.—The Benwood & McMechen Electric Light and Heat Company and the McMechen Home Electrical Company have consolidated and the machinery from the latter concern will be moved to the former company's plant. The new company will be known as the Ohio Valley Electric Light and Power Company.

MT. VERNON, OHIO—The Citizens' Electric Company is being formed. The entire bond issue has been taken and construction work will begin as soon as the weather permits. A dam thirty-six feet high and 565 feet long is to be constructed across the river at a point a short distance northwest of Zuck, where the plant will be built.

KNOXVILLE, TENN.—The Knoxville city council has passed resolutions favoring municipal ownership of the electric light plant and has appointed a committee to confer with the light commission and report back to the council the cost. The commission submitted a report some months ago. The contract with the present company expires in July.

BURLINGTON, VT.—A contract has been entered into between the village of Northfield and the firm of Moody & Almon, whereby the village is to be supplied with electric lights. The firm will supply a twenty-four hour service. In order to carry out the contract the firm will have to install a steam plant to be run in connection with its water power on the Mad river.

HONDO, TEX.—Hondo is about to have two electric light plants, both to be put in by local firms. Holloway & Thallman have secured a permit from the commissioners' court to place poles and wires along and across the streets of the town for the purpose of installing a lighting plant, while the Hondo Gin and Milling Company has ordered the necessary machinery and expects to have its plant in operation within the next sixty days.

TROY, N. Y.—Within the next thirty days electric power for all purposes will be in readiness at the plant of the Empire State Power Company, at Schoharie Falls. Early next spring a pole line will be erected from Ballston Spa to a permanent substation near Amsterdam, and a connection will be made with the wires of the Hudson River Water Power Company. E. L. Ashley, of Glens Falls, president of the latter company, controls the Empire State Power Company.

MEMPHIS, TENN.—The Merchants' Power Company has been organized with a capital of $500,000 to install a new lighting plant in Memphis. Those interested in the organization of the new company are all Memphis merchants and bankers, and in addition to the $500,000 of stock, which has all been subscribed, the promoters of the enterprise assert that sufficient additional capital is behind the company to build, equip and operate the plant until it is placed upon a paying basis.

MUSKOGEE, I. T.—The Commercial Club, of Muskogee, has undertaken to harness the falls of the Grand river, ten miles from

Digitized by Google

Muskogee, that it may utilize them to develop power for Muskogee. An investigation has been made, and it is reported that the plan is entirely feasible. Engineers have been employed to locate definitely the best place for building the large power-house, and as soon as the plans can be completed the Commercial Club will undertake to finance the project.

LOGAN, UTAH—At a regular meeting of the Logan city council Orson Smith, superintendent of the Logan city electric light plant, presented a partial report of the condition of that enterprise. According to the report the city now has 3,750 lights connected up, 500 of them being street lights. Since May 1, 1904, the expenses of operating the plant amounted to $3,749,21, and its earnings amounted to $10,855.35, leaving a profit of $7,106.14. The total cost of installing the plant is given as $99,495.98.

PORTLAND, ME.—The annual meeting of the Consolidated Electric Light Company of Maine was held recently in Portland. The following officers were chosen: president, Leander W. Fobes; vice-president, Charles W. T. Goding; treasurer and general manager, George E. Raymond; board of directors, Leander W. Fobes, Clarence Hale, James English, of New Haven, Charles W. T. Goding, Fred E. Richards, George E. Raymond, Charles R. Milliken, William M. Bradley, Henry P. Cox, Seth L. Larrabee, George F. West.

NORTHVILLE, MICH.—The Northville common council has granted a franchise to C. A. Ward, of Ann Arbor, for furnishing electricity for lighting the streets and residences and power for factories in the town. The franchise is for thirty years, and carries with it a ten-year contract to supply the village and private consumers. The company which Mr. Ward represents will develop electricity near Hamburg on the Huron river, where it will build three large dams. Wires will run to Northville, South Lyon, Ypsilanti, Ann Arbor and other points.

FREEHOLD, N. J.—The Freehold Electric Light, Heat and Power Company plant has been sold at public sale by Richard Stockton, receiver of the concern. The plant was bid in by P. Van Dorn, of Princeton, for $2,100. Mr. Van Dorn represented the Harrisburg Foundry and Machine Works, which was one of the largest creditors of the company. The plant includes five miles of wire, 150 poles, two dynamos, forty-horse-power boiler, 100-horse-power engine, switchboard and fixtures, and the building and land containing the machinery. The sale also includes the franchise to erect poles and string wires in certain streets in Freehold.

BIRMINGHAM, ALA.—The latest water-power-electrical enterprise projected in the South is the Tallapoosa Water Power and Electric Company, articles of incorporation for which are now being prepared. This company purposes to build a $500,000 power plant at Sturdivant, on the Tallapoosa river, four miles from Alexander City, in Tallapoosa County. Birmingham people are organizing the company and eastern capitalists are now corresponding relative to locating manufacturing industries to use the electric power that will be developed. The company's plans include the transmission of the electricity to Birmingham, a distance of about seventy miles.

PERTH AMBOY, N. J.—Alleging that the Public Service Corporation is unduly discriminating against Perth Amboy, a number of local merchants is planning to form an independent electric light company and manufacture current for their own use. Some of those interested in the movement are Peter Floersch, Kelly & McAlinden, Sickles Brothers, Gannon & Sheehy, F. W. Woolworth & Company, L. Briegs and S. M. Jacobsen. It is planned to construct a power-house in the rear of some of the business houses whose owners are in the company. It is claimed that no franchise is needed to string wires from building to building, even when it is necessary to cross streets.

ELECTRICAL SECURITIES.

Apparently there was a revival of interest in the stock market last week, which, while not reaching the proportions of a boom, actually produced three "million-share" days—the first since the beginning of the year. Prices averaged higher, also, and while the advance was irregular it was well maintained. The breaking of the deadlock which has existed in the building trades and the suspension of hostilities in the textile industry indicate that working conditions may be expected to improve. The possibility of an extensive strike on the Pennsylvania system and rumors of a $3,000,000 strike fund among the coal miners have had little unsettling effect. What is particularly disheartening is the shadow which is now cast over all of Russia, with war on the one hand and civic strife on the other.

Excess of exports in December were only $48,722,725, or the smallest in any December since 1895. While the domestic exports decreased $33,598,000, the total exports only decreased $29,532,000. Imports increased $18,796,000 and the excess of exports decreased $48,328,000. The December figures complete the foreign trade record for the year 1904. In this period imports reached a new high record of $1,035,907,000, or an increase of $40,413,000, while exports were $1,451,352,000 or a decrease of $33,401,000. The excess of exports for the year was $415,445,000, or the smallest of any calendar year since 1897.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 21.

New York:	*Closing.*
Brooklyn Rapid Transit	62½
Consolidated Gas	198¾
General Electric	187
Interborough Rapid Transit	197½
Kings County Electric	200
Manhattan Elevated	170¼
Metropolitan Street Railway	116
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	193½

Since January 1 the earnings of the Brooklyn Rapid Transit Company have shown an increase of $5,000 per day. From July 1 to January 7 the earnings of the system have increased $600,000, an average increase of about $100,000 per month.

Kuhn, Loeb & Company have purchased from the Western Union Telegraph Company $3,000,000 of its funding and real estate and mortgage bonds. This is part of an issue of $20,000,000. The bonds will bear 4½ per cent interest.

Boston:	*Closing.*
American Telephone and Telegraph	145
Edison Electric Illuminating	253½
Massachusetts Electric	61
New England Telephone	138
Western Telephone and Telegraph	93½

The directors of the Western Telephone and Telegraph Company have declared a regular semi-annual dividend of 2½ per cent on the preferred stock. The dividend is payable February 1.

The Boston Elevated Railway Company has declared a regular semi-annual dividend of 3 per cent, payable February 15.

The instrument output of the American Telephone and Telegraph Company for the year 1904 was the largest year's output in the history of the Bell telephone system, amounting to 701,047 net. The largest previous output was in 1903—629,197 instruments. The total number of instruments outstanding is now 4,480,564, the growth during 1904 being 18½ per cent. The number of subscribers at the close of the year was approximately 1,800,000.

Philadelphia:	*Closing.*
Electric Company of America	10¾
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	24⅞
United Gas Improvement	108¾

Chicago:	*Closing.*
Chicago Telephone	138
Chicago Edison Light	167
Metropolitan Elevated preferred	60
National Carbon common	40
National Carbon preferred	112
Union Traction common	11½
Union Traction preferred	45

Chicago Edison directors have declared the regular dividend of 2 per cent on the preferred stock, payable February 1. Books closed January 4, and reopen February 2.

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable February 15. Books close February 4 and reopen February 16.

Digitized by Google

ELECTRIC RAILWAYS.

ABERDEEN, S. D.—Farmers living in the vicinity of Leola, in McPherson County, have taken up the project of building an electric line between that town and Aberdeen.

WASHINGTON, PA.—The Donora, Webster & West Newton Street Railway Company is preparing to connect the three towns by trolley. All rights of way have been secured.

PITTSFIELD, MASS.—It is announced that the Pittsfield Street Railway Company is to build during next season a power plant. Its power is at present secured from the Pittsfield Electric Company.

MINERAL WELLS, TEX.—A fifty-year franchise for an electric street railway and power plant has been granted to a party of Dallas capitalists. The franchise calls for the use of about five miles of the principal streets.

HAMILTON, ONTARIO—The Hamilton, Ancaster & Brantford Railway will build an electric railway to Galt and Guelph, branching off from the Hamilton, Ancaster & Brantford Railway on the way from Hamilton at Ancaster village.

BOWLING GREEN, OHIO—The mayor of Bowling Green has signed an ordinance granting a franchise to the Lake Erie, Bowling Green & Napoleon Railway Company to extend its lines to a point seven miles west of Bowling Green by January 1, 1906.

ARKANSAS CITY, KAN.—The right of way for the Kansas-Oklahoma interurban railway through the government's Chilocco reservation has been agreed upon, and the construction of the road will be completed between Arkansas City and the Chilocco schools before other lines are commenced.

SPRINGFIELD, ILL.—Directors of the Springfield, Beardstown & Quincy Railroad Company have arranged with representatives of the United States Construction Company, of New York and Washington, to finance and build an electric road from Springfield by way of Petersburg and Beardstown to Quincy.

PORTLAND, ORE.—The Willamette Valley Electric Railroad Company has started a force of men at work clearing the right of way for the power canal at Martin's Rapids, on the McKenzie river, twenty miles east of Eugene. It is stated that active construction of the trolley lines will begin in the early spring.

READING, PA.—The Kunztown & Fleetwood Street Railway Company has elected the following officers: president, H. E. Ahrens; directors, John R. Miller, George B. Schaeffer, W. D. Mohn, P. L. Diener, F. R. Wagner, S. K. Hoffman, L. T. Custer, James W. Shepp, Richmond L. Jones, W. A. Rosen, John A. Rigg and John M. Frame.

READING, PA.—At a meeting of the Pottstown & Suburban Street Railway Company these officers were elected: president, T. F. Durham; vice-president, George O. Runyeon; secretary, H. W. Snyder; treasurer, C. Q. Guldin; directors, T. F. Durham, George O. Runyeon, H. W. Snyder, John S. Gilbert and I. B. Stoudt.

FREDERICK, MD.—James E. Ingram, Jr., president of the Baltimore & Frederick Electric Railway Company, which has secured an extension of its franchise for the use of the streets of Frederick, states that the road will be completed and in operation by September 5, 1905, the date to which the franchise was extended.

PETERSBURG, W. VA.—The Mineral county court has granted to the Keyser, Burlington & Petersburg Electric Railroad Company the privilege of crossing the county roads and of using certain portion of said roads for the purpose of building and operating an electric railroad. The company is composed of Cumberland (Md.) capitalists.

GRAND RAPIDS, MICH.—Money has been raised for the building and equipment of the road of the Kalamazoo & South Haven Traction Company at a cost of $2,200,000. The road will run from Saugatuck through South Haven to Paw Paw lake; from there the company will run two lines, one to St. Joseph and the other to Kalamazoo. G. E. Bardeen, C. W. Williams and W. S. Dewing hold the franchise.

WELLSVILLE, OHIO—Petitions will be presented to the next council by the United Power Company asking permission to build a street railway to the Jefferson County line. This will give the company a connection with the Steubenville traction lines at Empire, and will give through trolley service from Smiths Ferry to Wheeling, W. Va.

GREENVILLE, PA.—A syndicate is being formed in New York to finance the Shenango Traction Company, which purposes to build a line from New Castle to Meadville by way of Wheatland, Sharon, South Sharon, Sharpsville, Greenville and Conneaut Lake. The promoters expect to make the line a connecting link of a continuous trolley line from Pittsburg to Buffalo.

RICHMOND, IND.—It is understood here that the Columbus, Greensburg & Richmond Traction Company, which purposes to begin construction early next spring, will not enter Richmond, but will make Centerville, which is six miles west of this city, its northern terminal. If this is done the company expects to make tariff arrangements with the Richmond Street & Interurban Company to reach Richmond over its tracks.

GLENWOOD, IOWA—James A. Swope, L. B. Hanson and A. J. Howe comprise the directorate of the proposed Iowa & Nebraska Interurban Electric Transit Company, which will effect the rapid handling of passenger and freight business between Rockport, Mo., and Omaha, the primary terminals. The line will touch Sidney Hamburg, Taber, Glenwood and Malvern, Iowa, crossing the Missouri river at a point opposite Bellevue, Neb. Contracts covering a portion of the right of way have already been let, and the actual work of construction will begin about May 1, 1905.

MONTREAL, CANADA—The Montreal Street Railway Company has decided to spend $500,000 in improving the system during the present year. The plan of improvement includes the erection of three subpower stations at different terminals of the system. Each substation will have 1,000 horse-power, thus enabling the company to put a much larger number of cars on all parts of the system any time during the day. The company has concluded arrangements for the purchase of twenty acres of land north of the car sheds on St. Denis street. This will enable the company to extend its system of sheds when the requirements demand it.

PHILADELPHIA, PA.—The West Chester Traction Company has for the first time in its history made public a statement of earnings. The report is for the year ended November 30 last and shows gross earnings from operations to have been $171,289; operating expenses, $111,257; net earnings, $60,032; other income, $2,794; fixed charges, $38,262. This shows a surplus, minus a small capital reduction, of $24,138. These directors were elected: John Sellers, A. Merritt Taylor, Anthony A. Hirst, S. H. Austin, Jr., William Sellers, C. S. Hinchman, William Taylor, W. C. Alderson, J. R. Wainwright, H. A. Doan, C. C. Tayler, Howard Sellers and P. S. Williams.

LEGAL NOTE.

GENERAL ELECTRIC COMPANY LAMP SUITS—In the two suits brought by the General Electric Company against James McLaren, trading under the name of the Standard Incandescent Lamp Company, in the United States Circuit Court for the District of New Jersey, for infringement of patents No. 537,693 and No. 726,293, decrees for the complainant, granting an injunction and appointing a master for the purpose of taking testimony on an accounting for profits and damages, were filed on January 10, and the injunctions issued and handed to the marshal for service. The two patents involved in these suits are those known to the electrical lamp manufacturers as the "chemical exhaust" patents. In the two suits brought in the United States Circuit Court for the Southern District of New York against the Talmont Electric Engineering Company by the Edison Electric Light Company and the General Electric Company, for infringement of patents No. 444,530 and No. 532,760, final decrees were filed on January 13 and injunctions issued and served upon the defendant. The Talmont Electric Engineering Company has made satisfactory arrangements whereby it is permitted to handle in future lamps licensed under these patents.

Digitized by Google

PERSONAL MENTION.

MR. H. C. ABELL has been appointed Wrinkle editor for the Denver-Colorado Springs meeting of the National Electric Light Association.

MR. GEORGE R. NEWCOMER has been placed in charge of the Memphis, Tenn., office of the Columbia Incandescent Lamp Company, of St. Louis, Mo.

MR. L. U. FRENCH, of Jefferson, Ohio, took charge, as manager, of the Delaware, Mo., office of the Bell Telephone Company, to succeed Mr. W. A. Reyburn, resigned.

MR. H. J. PETTINGILL, of Boston, vice-president of the Wisconsin Telephone Company, has been elected head of the Bell telephone interests in Minnesota and the two Dakotas.

MR. FRANK M. DUNCAN, formerly chief clerk to Superintendent Deuel, of the Union Pacific, has been appointed manager of the Denver office of the Western Union Telegraph Company.

MR. V. E. RAGGIO has been appointed manager of the new branch office of the Wesco Supply Company, at Fort Worth, Tex. He was formerly traveling salesman in Texas for the company, and later the general sales manager.

MR. RAYMOND W. STEWART, formerly of Camden, has accepted a position as manager of the Greenville Electric Light and Power Company. Mr. Stewart for the past year has been employed by J. N. V. Lane & Company, of Bangor, Me.

MR. MAX LOEWENTHAL, secretary of the Prometheus Electric Company, New York city, has been awarded a medal by the International Jury of Awards of the St. Louis World's Fair for his personal contribution to the art of electric heating.

MR. CHARLES B. GRAVES has accepted a position with an electrical concern in Manila, P. I. Mr. Graves was at one time superintendent of the municipal lighting plant at Marblehead, Mass., and later had charge of installing a large electric plant in Brazil.

DR. P. L. T. HEROULT, one of the pioneers in the application of the electric furnace to the production of metals, has been granted the Chemical Arts gold medal by the Société d'Encouragement pour l'Industrie Nationale, of Paris, for his works on electrometallurgy.

MR. WILLIAM R. KING, M. E., formerly of 39 Cortlandt street, New York city, is now associated with Messrs. Sanderson & Porter, 52 William street, New York city, in their practice as consulting engineers and contractors for the development of railway, light, hydraulic and power propositions.

MR. S. S. NEFF, the general superintendent of the Mexican Electrical Tramways, Mexico City, has, owing to ill health, tendered his resignation and it has been accepted by the company. For the present Mr. Wheatly, general manager of the system, will attend to the business of the general superintendent's office, and the various division superintendents have been instructed to report to him.

MR. DEAN B. SMALL, manager of the Lawrence, Mass., telephone exchange, has retired from that position. He will assume the position of chief clerk in the executive office of the telephone company in Boston. Mr. Small has held the position of local manager in Lawrence since three years ago last February. He succeeded the late Mr. H. O. Pond. Mr. Small gained his training in the business in the office of the division superintendent at Lowell.

MR. THOMAS A. EDISON was operated on for the removal of a mastoid abscess, on the evening of Monday, January 23, at his home, Glenmont, in Llewellyn Park, West Orange, N. J. Mr. Edison has been suffering for some time from a growth at the base of the skull, near the left ear. Quite recently this became more painful, and it was decided to operate in order to prevent the possible formation of blood poisoning. The operation was considered highly successful by the attending physicians and Mr. Edison pronounced entirely out of danger on Tuesday morning.

PROFESSOR MONROE B. SNYDER, director of the Philadelphia Observatory, announces that he has discovered the existence of radium in the solar photosphere, and of radium emanation in the solar corona, and in the auroral streamers of the earth. He also finds that radium and radium emanation, the latter identical with coronium, are widely and correlatively distributed in stars, nebulæ, and very probably comets. Professor Snyder read his first paper on "Universal Celestial Radioactivity" before the American Philosophical Society Friday evening, January 20.

MR. G. M. GEST, the expert subway contractor of New York and Cincinnati, and a crew of fifteen assistants sailed on the steamer Vigilancia, on Thursday, January 19, bound for Mexico. Mr. Gest has the contract in Mexico City for the building of a subway system through the entire city for the Mexico Light and Power Company. Several carloads of tools have been forwarded by the all-rail route. This is one of the largest contracts Mr. Gest has ever undertaken, but is not the only foreign project in which he is interested, it being his intention to send other crews abroad on work which is now being put in contract form.

DR. W. ELWELL GOLDSBOROUGH, director of the school of electrical engineering, Purdue University, Lafayette, Ind., and during the past three years chief of the department of electricity at the Louisiana Purchase Exposition, has become associated with J. G. White & Company, New York city. Dr. Goldsborough will ultimately be permanently located in New York. For the present, however, his time will be divided between Lafayette and New York city. Incidentally, he is still giving attention to the matter of closing up the affairs of the department of electricity of the Louisiana Purchase Exposition, which will necessitate his being in St. Louis at times during the next month or so. Dr. Goldsborough was graduated from Cornell University in 1892, with the degree of mechanical engineer. During 1892 and 1893 he was electrical engineer for the Colliery Engineering Company, Scranton, Pa. In 1893 and 1894 he was in charge of the department of electrical engineering of Arkansas University, Fayetteville, Ark. He was assistant professor of electrical engineering at Purdue University from 1894 to 1896, and professor of electrical engineering at Purdue from 1896 to 1898. From 1898 to the present time he has been professor of electrical engineering and director of the electrical laboratory at Purdue. In 1894 and 1895 he was consulting engineer of the Edison Electric Illuminating Company of Baltimore, Md., during which time an extensive series of tests on the Pratt street station was carried out, these tests forming the subject of a paper before the American Institute of Electrical Engineers, and comprising a complete report of central station performance. In 1901 Dr. Goldsborough conducted a comprehensive series of tests on the system of the Union Traction Company, of Indiana, reports of which were made the subject of papers before the American Institute of Electrical Engineers. Dr. Goldsborough is a member of the committee on the photometry of arc lamps of the National Electric Light Association. Under the direction of this committee a very comprehensive series of tests on the photometry of arc lamps and various other sources of illumination has been carried out at Purdue University. These tests, issued in four annual reports, are included in the transactions of the association. Dr. Goldsborough is a frequent contributor to the scientific and the technical press, and to the transactions of engineering societies. He is a vice-president of the American Institute of Electrical Engineers, a vice-president of the International Electrical Congress, St. Louis, a member of the Institution of Electrical Engineers, of Great Britain, and a member of the American Electrochemical Society and of the Association for the Promotion of Engineering Education. He was awarded the grand prize by the superior jury of the Louisiana Purchase Exposition for an effective presentation of scientific and commercial development in electricity. He is chairman of the executive committee of the Electric Railway Test Commission, under whose direction an elaborate series of wind-resistance tests is now being conducted at Anderson, Ind. He was recently decorated by the King of Italy with the order of Knight of the Crown.

DR. W. ELWELL GOLDSBOROUGH.

Digitized by Google

INDUSTRIAL ITEMS.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, 42 West Jackson boulevard, Chicago, Ill., and 27 Thames street, New York, will send its new catalogue, B-15, on request. This catalogue describes and illustrates Benjamin wireless clusters and lighting specialties.

THE INDIANA RUBBER AND INSULATED WIRE COMPANY, Jonesboro, Ind., manufacturer of "Paranite" and "Peerless" rubber-covered wires and cables, is distributing a valuable office calendar. The calendar pad is larger than usual, and the numbers are large enough to be seen at a considerable distance.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., in its circular No. 1096 describes and illustrates oil switches and oil circuit-breakers. This circular is replete with interesting data concerning these important devices. A number of forms of oil switches and circuit-breakers are shown, giving a good idea of modern practice in this respect.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., describes and illustrates in bulletin No. 141 S. K. C. polyphase induction motors. Bulletin No. 142 describes and illustrates a line of single-phase induction motors. The bulletin takes up in detail the various types of small induction motors, and gives the reasons for the determination of the design in each group.

THE PROMETHEUS ELECTRIC COMPANY held its annual meeting in the city of New York on Monday, January 9, 1905. The following officers were elected: president, D. T. Davis; vice-president, Dr. S. S. Wheeler; secretary, Max Loewenthal; treasurer, William B. Symmes, Jr.; also the following directors to serve for one year: David T. Davis, Dr. S. S. Wheeler, William B. Symmes, Jr., F. S. Blackall, Max Loewenthal.

THE CONTROLLER COMPANY OF AMERICA, Chicago, Ill., is distributing a series of pamphlets relating to measured telephone service. They are entitled, respectively, "The Stroud System of Measured Service," "Deadheads *versus* Dividends," "Press Opinions on Nickel Service." The company is also sending out a brass check, issued by the Hyde Park Provision Company, which can be used in the measured service instruments in place of a nickel.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., has issued catalogue No. 5, dated January, 1905. This catalogue describes and illustrates the company's electrical specialties, including switches, cutouts, rosettes, combination switches, weatherproof sockets, porcelain base switches, flush receptacles, cord adjusters, pendant switches, switchboards, panelboards, iron service boxes, fuse blocks and panel cutouts.

THE BISHOP GUTTA-PERCHA COMPANY, 420-426 East Twenty-fifth street, New York city, at the stockholders' meeting, January 11, elected the following persons as directors for the ensuing year: Amos A. Browning, Norwich, Ct.; Ellen I. Anderson, Rochester, N. Y.; Henry A. Reed, Newark, N. J.; Harry D. Reed, New York city; W. Boardman Reed, Mount Vernon, N. Y. The usual semi-annual dividend of five per cent on the capital stock was declared. The directors elected for president and treasurer, Henry A. Reed; for vice-president, W. Boardman Reed; and for secretary, Louis F. Reed.

THE BUCKEYE ENGINE COMPANY, Salem, Ohio, has issued a handsome catalogue descriptive and illustrative of the various forms of Buckeye engines. The first sixty pages of this catalogue are given up to illustrations of the various types of engines of every capacity. In addition to views of complete engines there are numerous sketches of details. The second section of the catalogue describes at length the mechanical construction and the performance of simple Buckeye engines. In the third section the characteristics and performances, together with complete descriptive data, of compound engines are given.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through its general passenger agent, Mr. George H. Daniels, is presenting No. 33 of its "Four-Track" series. This booklet is entitled "The Centre of the First City in the World." The booklet is intended to convey to the stranger in New York an idea of what the imperial city is to-day. There has probably never been issued a more complete and accurate presentation of so much information concerning New York city. A double-page map in the centre of the booklet gives the reader a splendid idea of the contour of the city, and is a ready reference for almost any sort of information.

RICHARD TOENNES, box 344, Boonville, Mo., is presenting to electric supply houses and electric light and power companies a new form of heating device called the "Little Giant" electric water heater. This heater can be used on alternating current, from 50 to 220 volts. The manufacturer states that if the apparatus is connected to a 110-volt alternating current of 16,000 alternations, it will boil a pint of water in one minute and use about the same amount of current as four or five sixteen-candle-power lamps. The electric water heater is carefully packed, and the outfit includes an Edison attachment plug, a Thomson-Houston adapter, and one yard of wire.

FRANK B. COOK, 249 West Lake street, Chicago, Ill., has been making some radical improvements in his pole-cable terminals. Mr. Cook states that he has at last evolved what he considers the best cable protection on the market. The type "S. A." terminal is a combination of the tubular line fuse and carbon lightning arrester, mounted upon a galvanized sheet-steel cable box. This is provided with a bracket so that the terminal can be attached either to the cable pole or cross-arm. A sliding galvanized cover protects all connections from the weather. For some time these terminals were made with a heavy cast-iron cable box. The sheet-metal box used at the present time reduces the weight considerably and makes the connections easy of access.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., announces that Mr. W. R. Goodman, secretary of the company, who has been connected with the business since its beginning sixteen years ago, has established an office at 853 Broadway, corner Fourteenth street, New York city, where he will personally look after the interests of the company in the East. The stock in New York is rapidly being increased to meet the demands of the trade in the following lines: fuse wire and fuse strip, fuse links, regular and special enclosed fuses, telephone fuses and blocks, wire joints and paper insulators, switch outlet boxes, etc. The business in the eastern territory has been making large increases, and a full stock will be carried so that all orders may be filled promptly.

W. N. MATTHEWS & BROTHER, 200 Carleton Building, St. Louis, Mo., manufacturers of Stombaugh guy anchors, are making an offer to telephone, electric light and street railway companies which they state is securing many new customers Wherever a doubt exists as to the holding ability of the Stombaugh guy anchor, the offer is made to screw one of these anchors into the ground alongside of a dead-man. The strain is then taken off the dead-man and put on the anchor in such a manner that if the anchor does not hold, the strain will go back to the dead-man, and no damage will result. If the anchor does not hold it may be returned at the company's expense. Thirty days is the time allowed for testing. The company states that this test almost invariably results in a new customer.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., has established a branch office and warehouse at Fort Worth, Tex., in order to meet the urgent demand of its southwestern trade for a nearer supply depot. The warehouse is located on the Texas & Pacific tracks at 319-321 West Fifteenth street, directly opposite the Texas & Pacific freight house and in close proximity to the Union station. It is the intention of the Wesco Supply Company to carry in stock at Fort Worth everything in the way of electrical equipment and supplies. The initial consignment comprises several carloads of rubber-covered wire in all sizes; also a large stock of weather-proof wire in all sizes, iron wire, strand and porcelain material, arc and incandescent lamps, as well as general electric wiring supplies. The company will also carry in stock, ready for immediate shipment, magneto switchboards, of the smaller capacities, and magneto telephones, which are the product of its telephone factory in St. Louis. Two carloads of "Wesco" alternating and Peerless ceiling and desk fans are included in this stock as well as a full line of motors and dynamos.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 5. NEW YORK, SATURDAY, FEBRUARY 4, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

CONTENTS.

EDITORIAL:
Trolley Cars in the Far East . . . 181
A Magnetic Survey of the North Pacific Ocean . . . 181
The Acyclic Dynamo . . . 182
High-Speed Railroad in Germany . . . 182
Electrification of Railroads . . . 183
Refuse Destructors . . . 183
Storage Batteries for Block Signal Work . . . 184
The Institute Annual Dinner . . . 184
Electrically Propelled Gyroscope . . . 184
The New Canal Exchange at Cincinnati, Ohio, by J. E. Peavey . . . 185
Acyclic (Homopolar) Dynamos, by J. E. Noeggerath . . . 188
Electricity and Bread . . . 192
South Dakota Telephone Association Officers . . . 192
The Internal Combustion Engine . . . 193
The Amsterdam-Haarlem Tramway System . . . 196
American Institute of Electrical Engineers' Regular Meeting . . . 197
The Sixth Annual Convention of the Independent Telephone Association of Wisconsin . . . 199
Extraction of Nitrogen from the Air . . . 200
Eliminating Isolation and Distance from Farm Life . . . 200
A Contemplated Magnetic Survey of the North Pacific Ocean by the Carnegie Institution, by Dr. L. A. Bauer . . . 201
The Personnel of the Allis-Chalmers Company . . . 202
Series Alternating Arc Lighting, by E. P. Warner . . . 203
National Electric Light Association . . . 205
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 206
ELECTRICAL PATENTS . . . 208
INDUSTRIAL SECTION:
The Stanley Rotated Jewel-Bearing Wattmeter . . . 210
Standard Wiring for Electric Light and Power . . . 211
German Electrical Industries . . . 211
Switch Type of the Queen Decade Portable Testing Set . . . 212
Switchboard Ammeters and Voltmeters . . . 212
A New Vertical Engine . . . 213
New Alternating-Current Solenoid Brake . . . 213
Transformer Outfits for Thawing Pipes . . . 214
Small Dynamos and Motors . . . 214
A Device for Measuring the Wear of Trolley Wires . . . 214
CURRENT ELECTRICAL NEWS . . . 215

TROLLEY CARS IN THE FAR EAST.

An electric trolley system has been put into service in Hongkong, China. The construction of the road differs but little from the usual practice, only slight changes being made to conform to local conditions. The principal object of this road is to afford transportation facilities to the European residents of Hongkong, for the latter, being a British naval station and an important commercial centre, has a large number of English residents. It is said, however, that the native Chinese are now using the road a great deal, although they first viewed it with suspicion, believing it to be a contrivance of the devil's. They saw, however, that the cars would run, and that passengers were not spirited away, so they finally came, first to tolerate the road, and then to use it as a convenience. Until this road was started the principal means of transportation in Hongkong was the rickshaw, drawn by Chinese coolies. While slow, these are said to be reliable, as the coolies manage to get them around somehow or other. Now that the electric road is running, there is a fierce competition between it and the rickshaw, to which there can be but one ending.

The introduction of electrical apparatus in China and in other countries of the Far East can not but have some effect upon the lives of the natives. The people there change slowly, but probably nothing could have a greater effect than the trolley in bringing about this change, unless we except the telephone. Is it not possible that these two agents will play an important part in bringing about a better understanding between the Chinese empire and the western nations?

A MAGNETIC SURVEY OF THE NORTH PACIFIC OCEAN.

The undertaking of an important magnetic survey is contemplated by the Carnegie Institution, Washington, D. C. It is proposed to begin work this year on the North Pacific ocean, and an initial allotment of $20,000 has been made to cover the expenses for the year. This work will be carried out under the direction of Dr. L. A. Bauer, chief of the division of terrestrial magnetism.

The knowledge of distribution of the magnetic forces of the greater portion of this earth is unsatisfactory. This is particularly true of the oceans—those portions of the earth's surface where accurate knowledge of the magnetic conditions is most important. The conditions with regard to the Pacific ocean are more unsatisfactory than those of the Atlantic, for there has been but one magnetic survey of the former—that made during the famous Challenger voyage.

The Pacific ocean is becoming yearly more and more important as a highway of commerce, and an accurate magnetic survey such as that outlined in the article by Dr. Bauer, appearing on another page of this issue, will be of much value to vessels sailing the Pacific, besides being of great scientific interest and importance. The plan outlined for conducting this survey shows that the northern part of the ocean will be covered completely, and there is little doubt that very valuable results will be secured. The total length of the course outlined is about 70,000 knots. This will be sailed in sections, three years being the estimated time for conducting the work and reducing the observations.

This survey will give an opportunity for an instructive study of the magnetic distribution on land and water, for a magnetic survey is now being made by the United States Coast and Geodetic Survey in Alaska and in the United States. The first circuit of the Pacific survey passes along the American and Asiatic coasts, and the results of this, taken in connection with the land survey, should be especially interesting.

Digitized by Google

THE ACYCLIC DYNAMO.

The exceedingly interesting paper read by Mr. J. E. Noeggerath at the meeting of the American Institute of Electrical Engineers on Friday evening, January 27, takes us back to the earliest type of dynamo—the Faraday disc. This was a continuous-current dynamo, pure and simple, and not an alternator fitted with a commutator, as the continuous-current machine of to-day is. Since Faraday's time there has been a good deal of progress in the design of the so-called unipolar or homopolar dynamo, but all designers have failed to produce a commercial machine, because of the limitations of size, speed and magnetic qualities of our iron.

The step forward which has been made by Mr. Noeggerath is interesting, and has been the result of several factors. In the first place, the original limit of speed has been changed by the production of a commercial steam turbine. As the construction of the revolving part of the machine is simple, it can be made strong enough mechanically to take advantage of the high speeds available, and we may expect our acyclic dynamos of the future to run at peripheral speeds of from 12,000 to even 20,000 feet per minute. But even this terrific speed would not give a commercial voltage in a single disc or conductor unless it were too long to be practical; therefore Mr. Noeggerath has had to compromise by using a number of conductors connected in series by means of slip rings. In the particular machine described—which, by the way, is remarkable for its size and voltage, it being a 300-kilowatt, 500-volt machine—there are twelve conductors connected in series by means of twenty-four slip rings and brushes.

The high speed which it utilized in this machine would, under the usual conditions of brush friction, cut away the brushes and make collecting difficult, if not impossible; but it was found that at these high speeds there is a tendency to throw the brushes off the collector rings. This reduces the pressure, and consequently the brush friction. It does, however, increase the contact resistance, and in this way lowers the efficiency, but it does not appear that this effect is serious. Indeed, the efficiency given by the first machine constructed was about ninety-one per cent at full load, which is certainly a remarkable performance.

The acyclic dynamo offers some very decided advantages for the construction of direct-current machines. In the first place, there seems to be no necessity for laminating either the rotating or stationary parts, for by virtue of its peculiar magnetic distribution there is little tendency for eddy currents to be set up, and but little hysteresis loss. Perhaps "peculiar magnetic distribution" is hardly the proper way to describe the magnetization of this type of machine, for it is peculiar only by comparison with machines of to-day. The aim is to produce as uniform a distribution of flux as possible through the entire air-gap. Another advantage of this type is the perfectly uniform voltage given. There is no irregularity due to commutation, and the only variation which could be detected would be due either to an irregularity in rotation, or to some inequalities in the machine itself. The machine, too, offers some unexpected and valuable features: it can be made to compound itself by the simple process of shifting the collecting brushes, and it can even be made self-exciting. The regulation may be excellent, since the effect of the armature reaction when a good type is adopted tends merely to lengthen the magnetic path. In other words, it acts as a cross-magnetizing, and not as a demagnetizing, force. Since there is no commutator, and as it is said there is no difficulty in collecting current at the high speed of rotation, there should be no trouble from this source due to overloads or rapid changes in load. The machine requires in construction about half the copper necessary for the ordinary type of direct-current machine, and the fact that lamination need not be resorted to will reduce considerably the cost of the iron parts. Moreover, the air-gap need be only wide enough for mechanical clearance, thus reducing the magnetizing force to a minimum. It is, in fact, a cheap type of construction, and one which, from the results published, promises much. One can not doubt that newer machines of this type will show improvements; and since it is intended to be operated by a steam turbine it will share in the advantages of high efficiency and small floor space required, going with that class of equipment for central station work. Heretofore it has been the alternating systems which benefited chiefly by the development of the steam turbine, but now the direct-current systems may share equally from this late advance in steam engineering.

HIGH-SPEED RAILROAD IN GERMANY.

To Germany belongs the honor of having conducted the first successful experiments with running electric cars at very high speeds. Somewhat similar tests had been made previously on a small scale; but the German work was done with cars of standard size carrying persons. The results were satisfactory so far as they were carried, and they proved that speeds much higher than those now used could be attained safely if the necessary stability of track were secured. The tests further gave data of great value, covering the power required to move cars at these excessive speeds, and did much to clear up the erroneous views previously held.

Having carried this work to a successful issue, the question now receiving consideration in Germany is, shall a high-speed road be built between Berlin and Hamburg? Two propositions have been received by the German government from companies offering to construct a high-speed road between the two cities. One contemplates a single-track road, on which a speed of about ninety miles an hour would be maintained. The road would cost nearly $17,000,000. The distance is 177 miles, which can be shortened by a new route. The other proposition is for a double-track road. If the government is content with a speed of 100 miles an hour, the road would cost about $30,000,000. If a speed of 125 miles must be maintained, the cost would be nearly $36,000,000.

This shows that high-speed roads will be enormously expensive, and raises a doubt whether such roads would be profitable, since they must depend for their income upon the passenger traffic alone. The greater part of this cost will necessarily be in the roadbed, for not many cars will be required. There is some doubt

Digitized by Google

whether either of these offers will be accepted, for there is already a fair service between the German capital and Germany's chief seaport, and what traffic the new road would gain would be drawn principally from the older roads. The higher speed, however, would undoubtedly increase traffic between the two cities. The fare proposed is moderate, being only that which is now asked on the other roads. It would seem to be only just, however, to ask an increased rate on a high-speed road, because of the saving in time effected.

ELECTRIFICATION OF RAILROADS.

The electrification of steam railroads is progressing fairly satisfactorily, for it is now a topic for papers and frequent discussion before the engineering societies and those devoted to railway interests. At a recent meeting of the New York Railroad Club, a paper was read by Mr. W. B. Potter, which discussed developments in electric traction, and which brought out some interesting statements from prominent railway men present.

It is interesting to note that the cost of electrical equipment for the New York Central & Hudson River Railroad Company's terminal is, according to Mr. W. J. Wilgus, only about one-quarter of the total cost. But conditions in New York are peculiar, since the other work there is enormously expensive. Electrification, however, brings advantages which at first were not anticipated. It enables a road to go underground or above ground or along the ground, thus increasing three times the space available for tracks.

The method of collecting the current naturally came up for discussion, and there seemed to be a general leaning toward the overhead trolley wire and a collecting wheel. Mr. B. J. Arnold made the interesting generalization that in this country not one road in a thousand would pay if electrified with a direct-current system, but that nearly every road would pay if operated with an alternating-current system. Mr. Arnold believes the roads will be forced to electrify their systems for passenger service, and when this is done the freight service will naturally follow. He thinks that when the roads are run electrically the passenger service will be the principal part of the road's business. This will be a reversal of the present condition. It is hard to see how it can occur, unless we take to traveling a great deal more than we do now. There will surely be no diminution in the freight business.

The discussion of the electrification of steam roads seems to have entered into a sensible stage. The railway man is naturally interested in anything which can benefit his road, either by reducing expenses or increasing its business. The advocate of electrification is willing to explain the drawbacks of an electrical system, as well as to dwell upon the advantages which it would bring. This is an eminently satisfactory state of affairs, and will result in a thorough understanding. It is safe to say that there will not be a heedless rush to electrify, but where conditions seem favorable the prospect for electrification is exceedingly good.

REFUSE DESTRUCTORS.

The suggestion was made not long since by one of the New York papers that, by combining a garbage destructor with an electric light plant, sufficient electrical energy could be generated for all municipal buildings and city streets, without putting the city to any expense for fuel. On the face of it this seems to be a promising scheme, particularly as it would appear from obtainable statistics, that the fuel value of the city refuse would be more than enough to raise all the steam required for municipal lighting.

A little examination, however, shows that the conditions are not so favorable for such an undertaking as would at first appear. In a paper read recently before the Institution of Electrical Engineers, of Great Britain, by Mr. W. P. Adams, which was reported in the ELECTRICAL REVIEW recently, a complete study of the refuse destructors run in connection with the electric generating stations in England was given. There are in England seventeen such stations, which burn refuse and use the steam for generating electrical energy. Certain of these stations make other uses of the steam as well. It appears from this paper that the average performance of these seventeen stations for a year was less than twenty-five kilowatt-hours per ton of refuse. All of these stations require, in addition, a great deal of coal, the proportion of coal to refuse being sometimes as great as twenty-five per cent. It will be seen from this that it is out of the question to run an electric lighting plant by means of refuse alone, and not use some coal.

Moreover, the conditions obtaining in an electric lighting plant are such that it must be possible to meet sudden and great demands on the station quickly, and for this purpose city refuse is about as bad a fuel as can be imagined. If it were possible to run along at a uniform load for twenty-four hours, and store up energy in an accumulator during periods of light load to help over periods of heavy load, it might be done, but this would require an outlay for a storage battery so great as to make the undertaking impractical. Then, too, some means would have to be provided for destroying the excess refuse which could not be used for raising steam. It would hardly seem to be wise to attempt to burn this in destructors used for raising steam.

It is, of course, a wise policy to save, wherever possible, and not throw away anything that can be used, and as city refuse has a certain fuel value it would seem to be desirable to use it for fuel. If this were done in connection with a municipal lighting plant it would be desirable—and probably necessary—to have the plant located within New York city, and this would bring about a condition which would probably not be tolerated, for refuse destructors are undoubtedly a great nuisance to a large tract of surrounding territory. They not only give off obnoxious odors, but they scatter smoke and dust and are an annoyance generally. On the other hand, if the plant could be installed some distance outside of the city, this objectionable feature would be eliminated, but others would be incurred. The expense for transporting refuse to the destructor—which, in the plan proposed was to be avoided, it being delivered at the destructor by the collecting carts—would still be necessary, and the trouble and expense of getting the current to the city would have to be considered. There are, no doubt, a great many localities in this country where a destructor and an electric lighting plant could be combined with benefit, but New York does not seem to be at all suited to such an undertaking.

Digitized by Google

Storage Batteries for Block Signal Work.[1]

The method of electric supply for the operating of railway interlocking and signaling apparatus is reaching a point of the greatest refinement. Within the past few years the attention of signaling engineers has been turning with greater and greater concentration toward the best method of supplying signaling and interlocking devices with electric current, and the result is indicated by the rapid increase in the use of storage cells for this purpose. With storage batteries it is necessary to provide a charging source, and provision must be made either for carrying the charging current to the batteries over a transmission line (the batteries being placed permanently at the working points), or the batteries must be of portable form and transported to and from the charging station. Which method shall be adopted in any given case is dependent upon the geographical distribution of the devices to be served. In the case of transmitting current to the battery points for recharging, we have the additional investment in transmission line, extra power required to compensate for the line loss, the greater number of cells than is required for portable work, and the somewhat larger generator. In a portable plant, on the other hand, we have a somewhat more expensive form of battery, due to the fact that it is necessary to install a larger size of cell and to use rubber jars instead of glass. In addition to this we have, in some cases, the extra expense of transporting cells. In deciding, therefore, which method shall be used, a careful comparison of these various items should be made.

The Southern Pacific Company has been using storage batteries in signaling work for several years, and on that portion of the road between Truckee, Cal., and Sparks, Nev., there are sixty-six signals operated from forty-one battery locations, each battery set consisting of four cells of type 5-PV Exide, having a capacity of fifty-five ampere-hours at eight volts. These four cells are mounted in two wood cases, two cells to each case, handles being provided so that they can be readily transported. Each case of cells weighs approximately twenty-five pounds. These four cells, connected in series, are used for one signal or for a pair of signals, provided they are not a greater distance apart than 500 feet. Once a month the cells are placed on a car and returned to the charging station to be inspected and recharged. It is customary to charge these cells in sets of seven, four cells to each set, making twenty-eight cells in all. The batteries, when recharged, are distributed to new locations and exchanged for other cells which have been in use for a month.

A total of 164 cells supply sixty-six signals, or approximately two and one-half cells in operation per signal. Ordinarily fifty-six extra cells are kept in the charging station and exchanged for others which become discharged, so that the total number of cells for the normal operation of this section of the road would be 220, or three and one-third cells per signal. This is approximately six cells per mile of track. It is estimated that it costs ten cents per kilowatt-hour for charging the batteries, which is less than $1 for each set of four cells per year, or $55 per year for the total number of sets. The cost of the charging station is approximately $300. This figure is exclusive of the building. A gas engine is used to drive the generator.

With these sixty-six signals, if primary cells were used, it would be necessary to have sixteen cells for each signal, because it is not practicable to connect two signals to one set of primary cells; consequently, for the sixty-six signals 1,056 primary cells would be required. The cost of these cells is in the neighborhood of $2.50 each delivered on the coast, and the cost of material for maintaining the same is reported as $1 per cell per year, or a total fixed maintenance expense of $1,056 per year. The maintenance of the storage battery plates for this entire section is estimated at $200 per year. The first cost of the 220 Exide cells will be approximately $1,200. A comparison of the first cost and the operating cost will appear as follows:

FIRST COST.	
1,056 primary cells at $2.50	$2,640.00
Cost per mile of single track	69.50
220 storage cells	1,200.00
Charging plant	300.00
Total	$1,500.00
Cost per mile	39.50
Increase in first cost of primaries over storage	75%
MAINTENANCE.	
Maintenance on 1,056 primaries for one year	$1,056.00
Maintenance per mile	27.80
Maintenance on 220 storage cells for one year	200.00
Charging current for one year	55.00
Total	$255.00
Maintenance per mile	6.70
Increase in maintenance cost of primaries over storage	317%

The question of first cost and operating expense having been settled in this instance to the marked advantage of the storage battery, it remains to be determined whether the storage battery system possesses any points of advantage in actual operation. One point that impresses the engineer immediately is the fact that four cells of storage battery replace sixteen primary cells, and there is a corresponding reduction in the number of connections and units requiring attention. The chances of failure due to broken or bad connections are very much reduced by the use of the storage cells. With the old primary cell system fully half the signal failures were due to the primary cells. Another point of great advantage for the storage cell is the difference in available capacity. It may happen that one semaphore, for some reason or other, is working a great number of times within a short period. In a case like this a signal, after a number of movements, will work very slowly, or possibly not at all. This is due to the polarization of the primary cells, and this effect is not perceptible in a storage cell. In consequence, with the storage cell operation is always sure.

[1] Abstract of a paper, by Mr. Edward L. Reynolds, read before the Railway Signal Association, New York, January 10, 1905.

The Institute Annual Dinner.

Preparations for the annual dinner of the American Institute of Electrical Engineers, which will be held in the grand ballroom of the Waldorf-Astoria, New York city, February 8, are being pushed actively. As already announced, the dinner will be devoted to signalizing the triumphs of electric traction. It is understood that some original and novel features will be included. Messrs. Frank J. Sprague and Leo Daft will speak for the Institute pioneers in electric traction. There will be exhibited for the first time the oil painting recently presented by the Institution of Electrical Engineers, of Great Britain, as a souvenir of last year's visit. This represents Dr. Gilbert making magnetic experiments before Queen Elizabeth. The bust of Professor Ferraris, presented to the Institution last year, will be exhibited in the Astor Gallery reception room.

Electrically Propelled Gyroscope.

At a meeting of the New York section of the American Electrochemical Society, held January 24, 1905, Mr. Edward Durant described an electrically propelled gyroscope. The revolving part of the wheel forms the armature of an electric motor, and the inner gimbals form the magnetic field. Current is conveyed to the motor by way of the trunnions and gimbals, and the revolving part may thus be kept in motion indefinitely.

Digitized by Google

The New Canal Telephone Exchange at Cincinnati, Ohio.

By J. E. Peavey.

THE completion and cutting into service on the afternoon of November 19 last of the new telephone exchange known as the "Canal" marked an era in the successful history of the Cincinnati & Suburban Bell Telephone Company.

The present management has endeavored by the best methods known in the art to place at the disposal of the appreciative public the very best of service. The success of its efforts can be best attested by the subscription list, which has doubled its numbers in the short period of three years, necessitating an addition of eight new exchanges and five new exchange buildings within the city of Cincinnati exchange district. The "Canal" exchange, located at the southeast corner of Race and Canal streets, is the latest addition.

The building is three stories high with a deep, well-lighted and well-ventilated basement. The outside walls are of Kittanning and iron clay brick with freestone trimmings; all inner walls and partitions are of hollow fireproof tile. The supporting framework is of steel and all staircases are of steel and white Italian marble. On the sides of the building, in close proximity to other buildings, metal casings and window frames have been used with wired glass. Loricated iron conduit is used throughout the building for all power and light wires—each floor having a steel and slate junction box and outlet, and also electric light switches have been conveniently arranged throughout the building in a manner that will ensure economical use of the light. Every precaution has been taken against damage by fire and it would hardly be possible for fire to originate or be maintained within this building, which is one of the most important items in modern exchange construction.

In designing this exchange careful consideration was given to the present demands and as near as possible to what the future development may be. The building has an ultimate capacity of 9,600 subscribers and 2,000 trunk lines; full equipment to accommodate this number of lines can be installed without making any changes in apparatus or building. A careful study was also made of the relation of the operators' quarters to the operating room; inspectors' quarters to the wire chief, also isolation of employés in the maintenance department from the operating department.

Fig. 1 is the third floor which is used exclusively as an operating room. There are no columns or anything that would obstruct the view. Switchboards already installed are shown in full lines and those provided for in the future are shown in dotted lines. It will be seen from the drawing that there are two entrances to this room by staircases from the floor below, one landing directly in front of the chief operator's desk is used by the operators; the other shown in lower right-hand corner of drawing being used exclusively by the maintenance department when they have occasion to enter the operating room. It will be seen from this plan that there will be a minimum

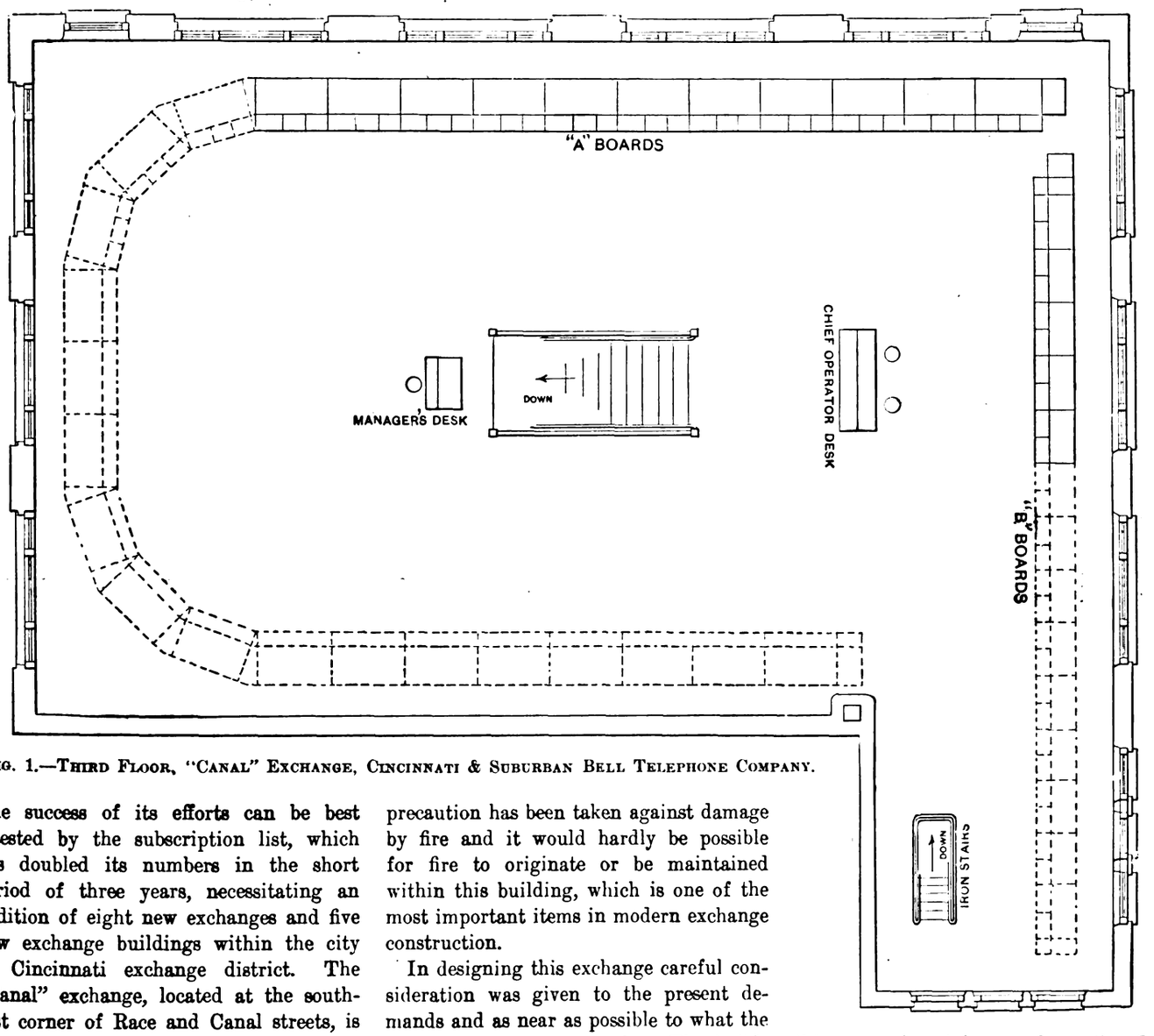


FIG. 1.—THIRD FLOOR, "CANAL" EXCHANGE, CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

Digitized by Google

amount of stir and confusion when making shifts, also all operators are brought directly in contact with the chief operator upon entering or leaving the room.

The second floor contains the operators' quarters and apparatus room—the latter being separated from the operators' quarters by a fireproof wall. The operators' quarters consist of restroom, lunchroom, locker room, kitchen, refrigerator room, janitor's closet and toilet room. The toilet room is finished in white Italian marble with neat mosaic floor; a double row of washbasins have been placed in the centre of the room with a large plate-glass mirror between them. Expanded iron lockers are used in the locker room, and by putting two to a locker there is capacity for 176 operators. The kitchen is equipped with lockers for china and silverware, also an elevator for hoisting provisions and removing garbage. The operators' quarters are in charge of

FIG. 2.—NEW "CANAL" EXCHANGE OF THE CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

a matron, who looks after the welfare of the operators while off duty; the company furnishes coffee, tea and sugar free of charge. The apparatus room contains main and intermediate frames, relay rack and repeating coil rack. Entrance to this room is by way of steel staircase, shown in lower right-hand corner of drawing.

The rear section of the ground floor contains the wire chief's and inspectors' quarters. Entrance to this department is on the Canal street side of the building. In the front are two storerooms—one of which is being equipped as a telephone school and lecture room where all new applicants for positions will be examined as to qualification, and taught the best methods of operating before being placed at the regular switchboard. Lectures on operating will also be given here at stated intervals to the regular operators in order to keep them thoroughly posted and ensure the best possible service. There is a double vestibule entrance to the exchange proper. Between the outer and inner vestibule there is a double plate-glass door controlled by speaking tube and electric lock from the chief operator's desk on the third floor in operating room. The outer doors to the street are double plate glass and left unlocked night and day so the public may have access to the automatic pay-station shown in the outer vestibule. Should any one desire to enter the operating department, it is only necessary to press the push-button and communicate with the chief operator through the speaking tube; if the chief operator considers it a proper individual to have admittance, she presses the button upon the desk and unlocks the door which automatically closes behind him on entering. These vestibules are very neat; the walls and ceiling are of white Italian marble and the floors are finished in very neat mosaic designs.

The power room is located in the rear of the basement. The centre of this floor contains the heating apparatus, in the front are two large cellars that are arranged to go with the storerooms on the ground floor above. The building is heated by direct indirect system of hot water heaters; a ventilating system has also been provided for in order to have a perfect circulation of fresh air and ensure comfort and good health to those confined within the building.

Fig. 2 is an exterior view of the building.

FIG. 3.—SUBSCRIBERS' SWITCHBOARD AND CHIEF OPERATOR'S DESK, "CANAL" EXCHANGE, CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

FIG. 4.—CHIEF OPERATOR'S DESK, "CANAL" EXCHANGE, CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

Fig. 3 is a view of the subscribers' switchboards and chief operator's desk. By the side of the staircase will be seen a Dey time clock, used by the operators

Digitized by Google

to record their arrival and departure. Fig. 4 gives a clear idea of the equipment and arrangement of the chief operator's desk. This desk contains a card system with sufficient capacity to accommodate 14,000 subscribers. Every device has been supplied that would contribute to giving speedy attention to all of the various duties that devolve upon the chief operator. The cabinet on the floor at the right of the desk contains the electric light and fan switches, which can also be controlled by the chief operator without having to leave the desk. This desk was manufactured in the shops of the Cincinnati & Suburban Bell Telephone Company and in service has proven to be the most practicable device so far used by the company.

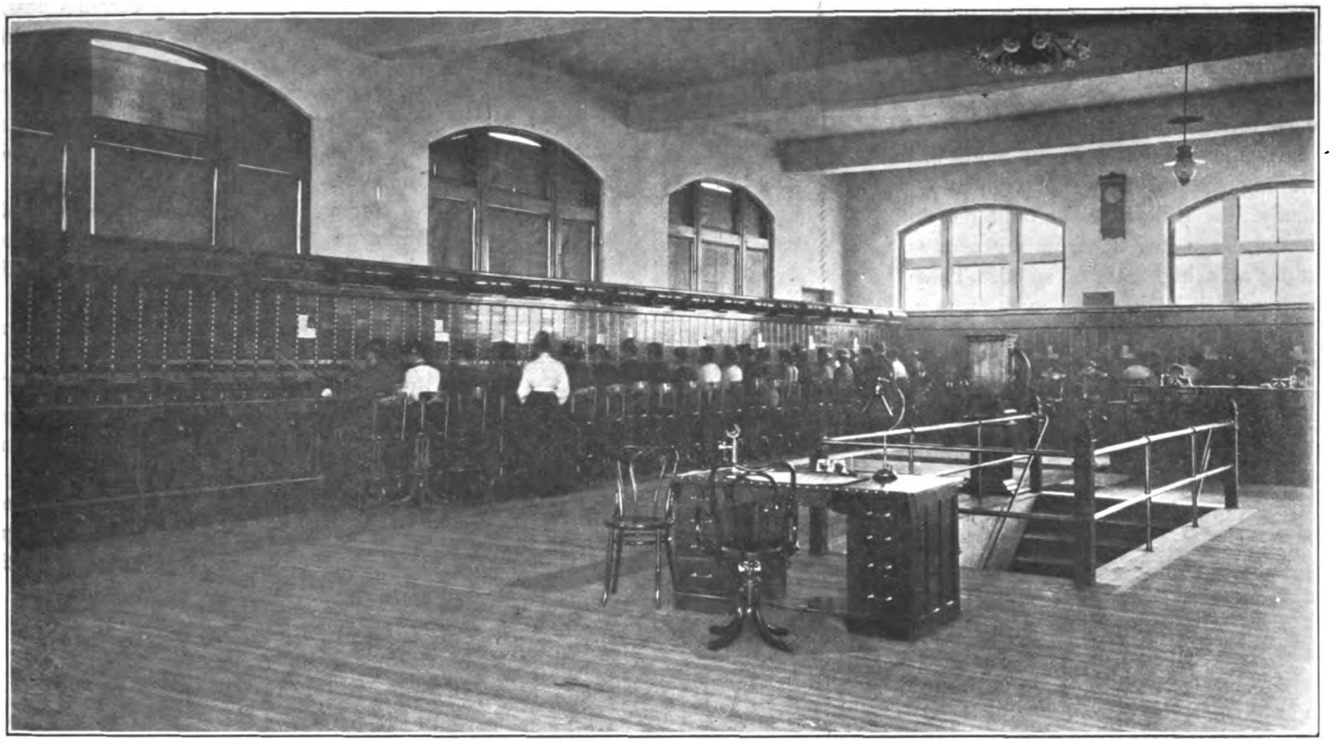


FIG. 5.—OPERATING ROOM, "CANAL" EXCHANGE, CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

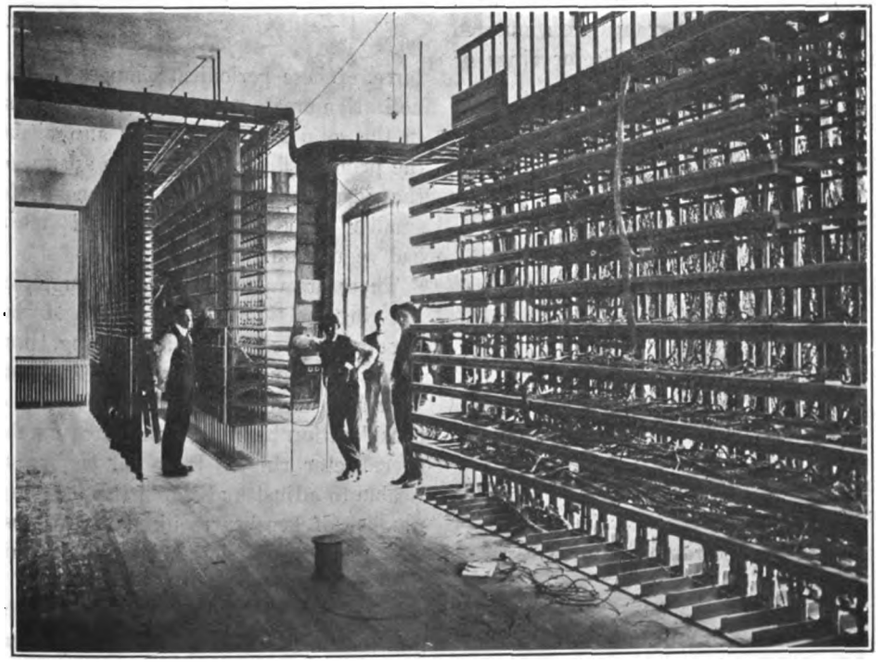


FIG. 6.—APPARATUS ROOM, "CANAL" EXCHANGE, CINCINNATI & SUBURBAN BELL TELEPHONE COMPANY.

Fig. 5 is another view of the operating room, showing the manager's desk and the staircase entering the operating room.

Fig. 6 is a partial view of the apparatus room showing the main and intermediate frames, also relay rack.

All of the equipment used is of the standard Western Electric type. The power for operating the exchange is supplied by chloride accumulators; to ensure against a possible failure in the battery-charging machine, the company has adopted the system of using one motor-generator set and one duplicate generator belted direct to a gas engine. The gas engines have proven as satisfactory as the motor-generator sets for charging the batteries. The ringing machines are in duplicate and are operated from the storage battery. Every device and arrangement of apparatus has been provided that would ensure against interruption to the service from any source.

Cutting this exchange into service was a very interesting undertaking, from the fact that it was a division of the territory being served by the west and main exchanges. A new exchange centre being established, it required considerable skill and caution to cut the line over without interrupting the service, but the transfer was very successfully executed in a short time. The Cincinnati & Suburban Bell Telephone Company has not been hampered by competition and has done itself proud in giving to Cincinnati and vicinity a very high-grade system of exchanges. While the subscription is increasing at the rate of about five hundred per month, it is in a position to promptly meet any and all demands. The officials of the company are: John Kilgour, president; B. L. Kilgour, general manager; R. T. McComas, assistant general manager; W. A. Blanchard, secretary and treasurer.

Digitized by Google

ACYCLIC (HOMOPOLAR) DYNAMOS.[1]

BY J. E. NOEGGERATH.

Except for very low pressures, the so-called homopolar dynamo has so far been a failure from a commercial point of view. This failure is principally due to two conditions: first, the uncertainty as to the magnetic and electrical conditions prevailing in this type of generator; secondly, the difficulties encountered in collecting large currents from a generator running at a high rate of speed. These conditions will be discussed in this paper, and in order that their import may be grasped there will be described in outline the design of, and some results obtained with, a 300-kilowatt, 500-volt, turbine-driven acyclic (homopolar) generator built in the shops of one of the large electrical manufacturing companies. The

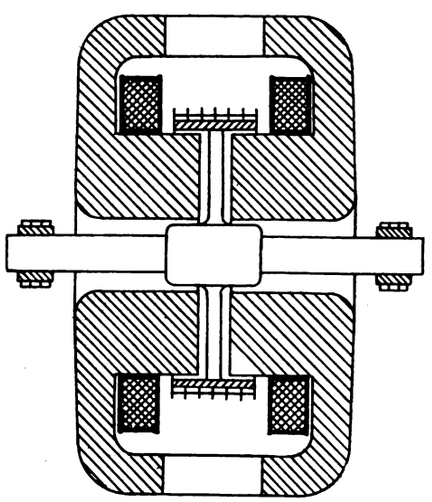


FIG. 1.—RADIAL TYPE; SINGLE DISC.

question dealt with is a broad one, too broad to be discussed at length in this paper; the main points only will be taken up and a more thorough discussion left for a later date.

Classifying acyclic generators according to the position of the armature conductors, we find two prevailing types:

1. The radial type; single disc, Fig. 1; double disc, Fig. 2.

2. The axial type; single cylinder, Fig. 3; double cylinder, Fig. 5.

(The cylinders being solid or hollow—Fig. 4). Combinations of these types are, of course, also practicable.

The armature of the cylinder-type acyclic dynamo here under consideration, Fig. 5, consists chiefly of a solid cast-steel cylinder carrying a small number of straight conductors on its surface; these conductors are connected at both ends to sets of collector rings.

The field, Fig. 5, consists chiefly of a cast-steel structure extending toward the shaft in three polar projections that enclose the armature in complete cylinders. Field coils, F 1 and F 2, are wound concentrically around the shaft.

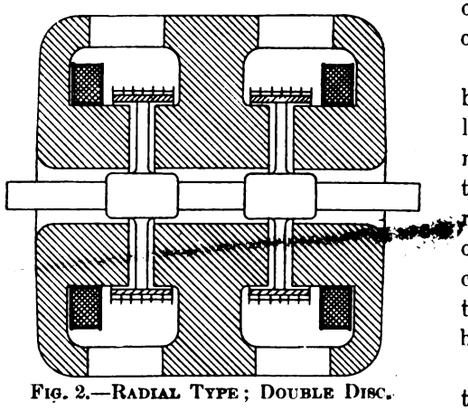


FIG. 2.—RADIAL TYPE; DOUBLE DISC.

There are also mounted two sets of brushes and a number of stationary conductors (frame conductors). Eight openings give access to the brushes and field-spools.

The field-spools set up two primary fluxes shown in Fig. 5 as dotted lines and in Fig. 6 as dotted lines, diverging radially.

As the armature revolves in this uniform field, electromotive forces are generated in the armature conductors, Figs. 5 and 6c; these electromotive forces are constant as to magnitude and direction. Single conductors or groups are connected in series by means of collector rings or

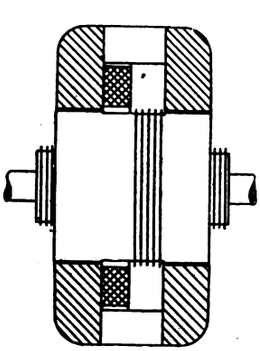


FIG. 3.—AXIAL TYPE; SINGLE CYLINDER.

commutator segments and the frame conductors.

The induced electromotive force

$$= \frac{\phi \, N \, n \, 10^{-8}}{60}$$

$$= 1.66 \, \phi \, N \, n \, 10^{-10}$$

Where ϕ = total flux

N = revolutions per minute

n = armature conductors in series.

Fig. 7 shows diagrammatically the simplest form of an electric circuit in a cylinder type of generator, C and R representing armature and frame conductors, C r and B representing collector rings and brushes respectively. The currents passing through this system set up secondary fields which affect the primary flux. Of these, the ones created by the currents flowing in the collector rings (ring reactions) are of great interest from a practical point of view.

For a given time the connection point between armature conductors and collector ring passes through P_1. At this moment currents flow from P_1 to B_1 through both sections of the ring, the currents being inversely proportional to the ohmic resistance of the ring-sections. The currents set up fields in the magnetic material in which they are completely embedded.

As the armature revolves, the connection point P_1 moves on, changing magnitude and direction of the magnetomotive

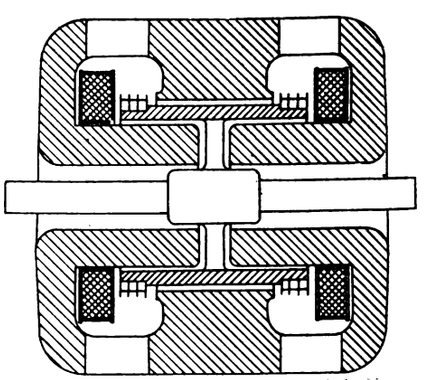


FIG. 4.—AXIAL TYPE; DOUBLE CYLINDER.

force. These periodical changes of magnetization create hysteresis and eddy losses in the solid material. They also weaken the primary flux, since, due to saturation, the increase in density is considerably smaller than the decrease. This means bad regulation.

There are various means of counteracting ring reactions. One consists of placing brushes all around the ring, practically covering its surface. For commercial pressures this method is out of consideration because of the great number of collector rings. It would be impracticable to adjust and watch the very large number of brushes required in this case. The question of friction losses also limits the number of contacts.

Satisfactory results were obtained with a method which is diagrammatically shown in Fig. 8. R_1, R_2, etc., B_1, B_2, etc., and P_1, P_2, etc., represent rings, brushes, and connection points of the collecting system on one side of the armature of one collector. The connection points form

[1] Presented at the 193d meeting of the American Institute of Electrical Engineers, New York, January 27, 1905.

Digitized by Google

a spiral of one complete turn, while the contact points of the brushes form one or more turns of a spiral running in the opposite direction. The brushes are arranged in groups that can be inspected from the openings in the frame. In this case Σ magnetomotive force $= 0$ for each section of the collector periphery and for any position of the armature.

As to the armature reaction, reference is made to Figs. 5 and 6. The currents flowing in the armature conductors C set up secondary fluxes as indicated by the curved lines. These secondary fluxes cut the frame as the armature revolves, causing hysteresis and eddy losses. They also increase the primary flux at α and decrease it at β. On account of saturation, the weakening effect will again be considerably augmented, affecting the regulation. When the conductors are placed

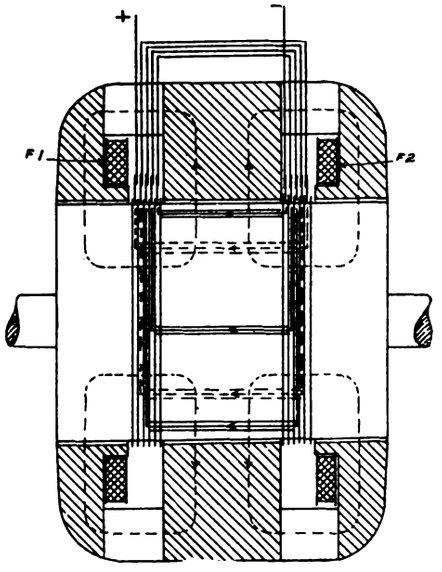


FIG. 5.—ARMATURE OF CYLINDER TYPE, ACYCLIC DYNAMO.

close together, that is, in approaching the equation

$$\frac{d\,i}{d\,l} = C$$

where i = amperes, l = unit length of armature periphery. The radial components of these secondary fluxes at α and β are neutralized. Similar considerations are valid for the stationary conductors.

The most efficient means of conforming to this equation consists of using flat conductors mounted close together. They may be assembled inside of the armature body or on its surface, Fig. 6B. The remaining components of all the local fluxes form one circular field that intersects at right angles with the primary flux, Fig. 6. Considering the influence of these magnetizations upon each other, two conditions are of importance,

1. The medium between armature and frame conductors consists of non-magnetic material, air; that is, the conductors are mounted on the surface of armature and frame respectively, Fig. 9A.

If in Fig. 10, M 1 and B 1 represent magnetomotive force and density of the primary, M_2 B_2 the magnetomotive force

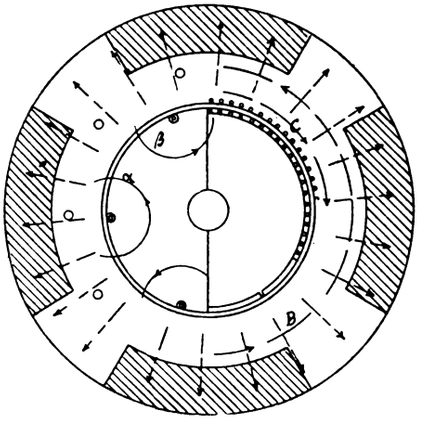


FIG. 6.—FIELD SPOOL FLUXES.

and density of the secondary flux produced by the armature turns, then M_3 B_3 will designate the resulting flux, provided the reluctance is the same in all directions. It is evident that the component of the flux in direction of the primary magnetization remains unchanged.

In an air-gap the length of the path of the resulting flux will actually be somewhat greater than that of the primary flux. But on account of the very high reluctance in the path of the armature reaction, the secondary flux is so small that direction and magnitude of the resulting field do not differ appreciably from the primary.

2. The magnetic medium between the stationary and revolving parts of the winding consists of iron, Fig. 9, B, C; Fig. 11. Principally due to saturation,

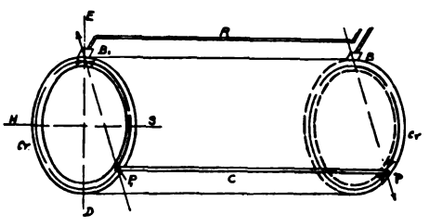


FIG. 7.—ELECTRIC CIRCUIT IN CYLINDER TYPE GENERATOR.

the density of the resulting flux will be considerably smaller than $\sqrt{B_1^2 + B_2^2}$, and its component in direction of the primary magnetization appreciably weaker than B_1. But to restore the flux to its original value only so many ampere-turns have to be added as are required for the increase in density along that part of its path that is affected by the secondary magnetization. The influence of a given armature reaction or regulation is therefore determined by the relation between the reluctance of the primary magnetic circuit in that area and the total primary reluctance. It can be kept very low.

While for the circuits B and C, Fig. 9, the main secondary magnetizations are practically of the same order, the local fluxes produced by the part of circuit C that runs parallel to the shaft are much smaller than in B, because of the high reluctance. They are, in fact, negligible. The neutralization of the ring and armature reactions as discussed above is very complete.

Tests on the 300-kilowatt generator show that the difference in pressure between full load and no load is only slightly higher than the drop, due to the total resistance of the armature circuit; that is, regulation is good.

While the armature windings of acyclic dynamos will not be discussed in detail, yet the points that have to be considered

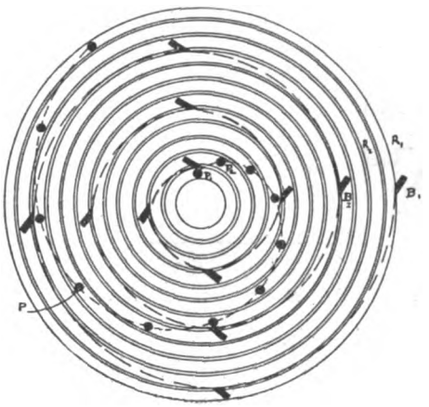


FIG. 8.—COUNTERACTING RING REACTIONS.

in laying out these windings would better be indicated here; they are:

1. Neutralization of ring reactions.
2. Magnetizing effect of end connections.
3. Minimum pressure between rings.
4. Assembling of brushes in groups for accessibility.
5. Equal resistance of armature circuits.
6. Minimum pressure between adjoining conductors.

Point 5 is to be considered if it is desired to run the machines at different pressures, Fig. 16.

Accumulative or differential compounding of acyclic motors or generators can be effected either by means of a series coil, or by giving an angular displacement either between the contacts and the frame conductors or between the connection points and the armature conductors, Fig.

Digitized by Google

13. For instance, Fig. 12, the currents flowing in the leads that connect the frame conductors and brushes partly or totally enclose the armature. The circular com-

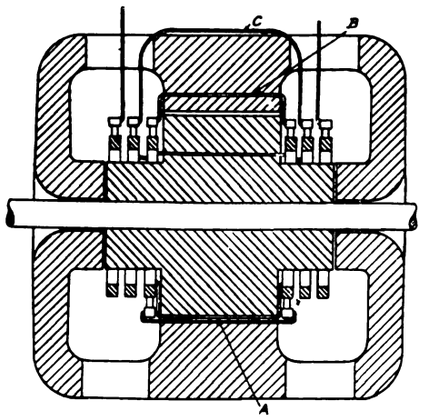


FIG. 9.—MOUNTING OF CONDUCTORS.

ponent of the magnetomotive force of these currents acts in the same or opposite directions as the magnetomotive force of

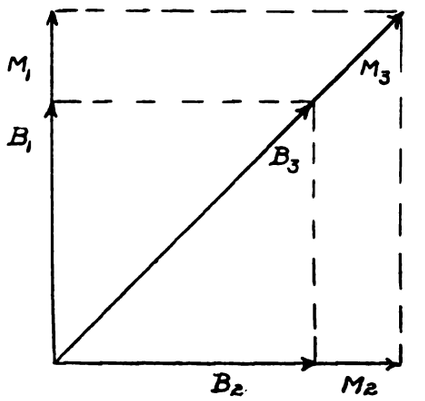


FIG. 10.—DIAGRAM ANALYSIS.

the field-coils. By shifting the brushes it is possible to adjust the compounding. By moving them against the direction of rotation accumulative compounding is

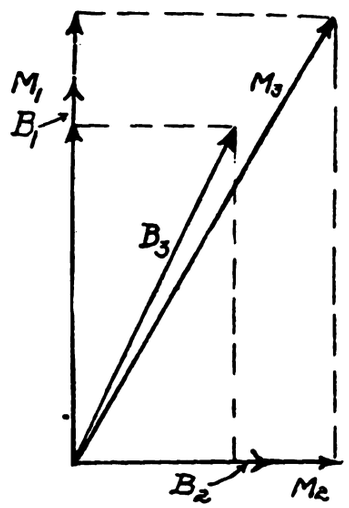


FIG. 11.—DIAGRAM ANALYSIS.

effected in generators; for motors, the result is the reverse.

It is obvious that series generators and motors can be built without field-coils. In such generators the intensity and direction of magnetization can be changed by shifting the brushes and, consequently, the electromotive force of generators as to direction and magnitude can be influenced as well as the speed, torque, and

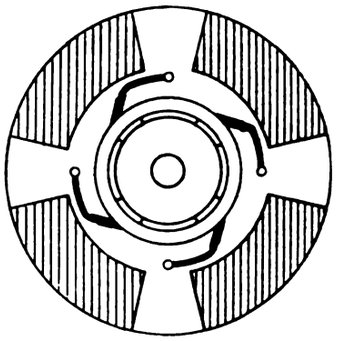


FIG. 12.—CIRCUIT CONDITIONS.

direction of rotation of motors. Acyclic generators are self-exciting.

The considerations of the electrical and magnetic quantities discussed above for an axial type acyclic generator hold good also for the radial type, with the exception of a modification in regard to the

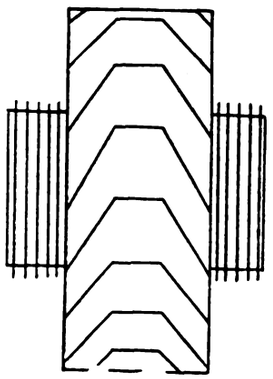


FIG. 13.—CIRCUIT CONDITIONS.

armature reactions. The currents flowing in the armature of the radial type set up fields that enclose the conductors. These secondary magnetizations disturb the primary flux in a way similar to that discussed for the axial type, resulting in core loss and affecting regulation. By placing the conductors close together, that is, in conforming with the equation,

$$\frac{di}{dl} = C$$

the components at α and β are neutralized, leaving a resultant magnetization which may consist of two circular fluxes, F 2, Figs. 14 and 15.

In this case i = current, l^1 = unit length of a circular section taken concentrically around the axis.

The secondary flux F 2 intersects at right angles with the primary. Their influence upon each other can be modified as was discussed for the axial type.

The efficiency of a high-speed acyclic generator about equals that of a turbine-driven commutator generator, but the distribution of the losses is very different.

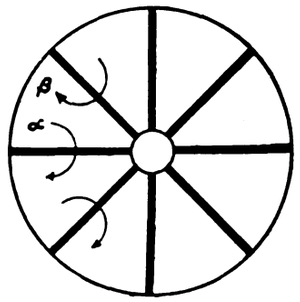


FIG. 14.—CIRCUIT CONDITIONS.

As windage and bearing friction depend on the mechanical design only and not on the type, they can be made to have the same value for both machines.

The I^2R field loss is somewhat smaller in acyclic machines, principally because the length of the air-gap is limited by mechanical requirements and not by the armature reaction.

The I^2R armature loss is almost negligible on account of the small number of turns. In the generator under consideration, there are twelve armature conductors and twelve frame conductors in series.

It is obvious that in a field of uniform and constant density there should be no hysteretic loss. As to eddy currents, reference is made to Fig. 17 where uniform distribution without stray fields is assumed. No electromotive forces are induced in the field. The arrows represent value and direction of the electromotive forces induced in the armature body. It

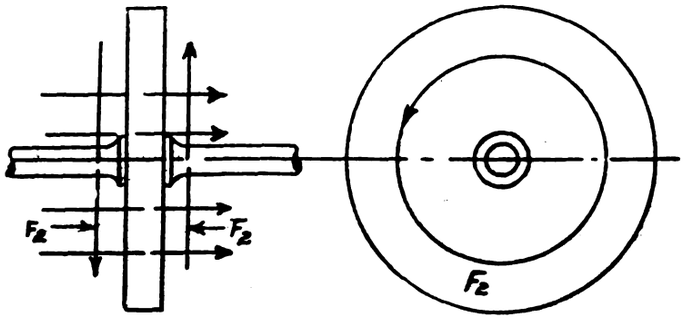


FIG. 15.—CIRCUIT CONDITIONS.

Digitized by Google

is evident that Σ electromotive force = 0 for any closed circuit inside the armature, as well as in any circuit including armature, bearings and field. From Fig. 18 it will be seen that this is true even if there is a stray field, provided it is uniform.

In general, the distribution of the flux

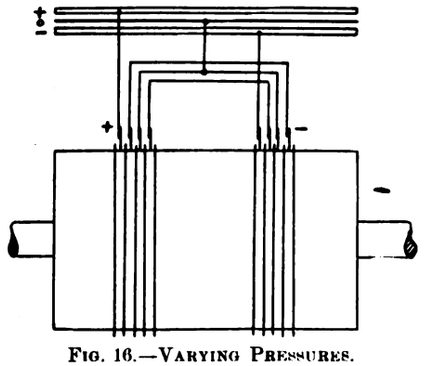


FIG. 16.—VARYING PRESSURES.

in acyclic dynamos that eliminates core loss is expressed by the equation $\frac{d\,B}{d\,L} = C$, where L = unit length of any circle concentric with the axis; that is, the flux

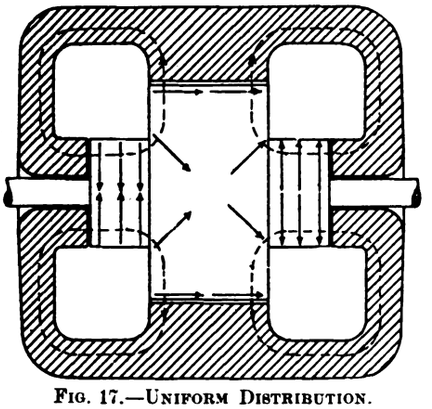


FIG. 17.—UNIFORM DISTRIBUTION.

must have a constant specific linear distribution in the direction of rotation.

The variation of the air-gap length and of permeability, the openings in frame and armature, as well as the secondary fields, disturb this ideal condition. In other words, the flux densities in symmetrical points are not actually equal.

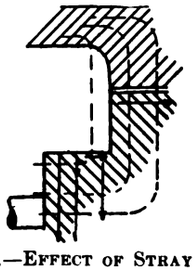


FIG. 18.—EFFECT OF STRAY FIELD.

One-half of this difference in density B *d* represents the B in the hysteresis and eddy current formulas. Its value depends, except on the magnitude of the disturbing elements mentioned above, on the relation of the reluctance in and close to the air-gap to the total reluctance. It is possible to keep this B *d* and, consequently, the core loss very low. The main losses are encountered in the brush contacts.

From a series of investigations the following conclusions are drawn:

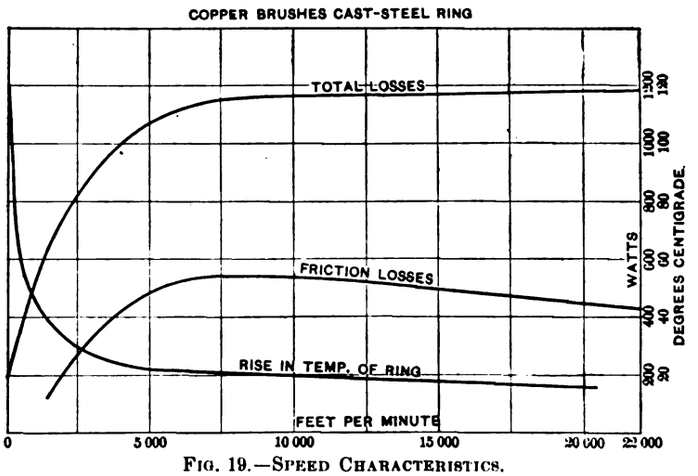


FIG. 19.—SPEED CHARACTERISTICS.

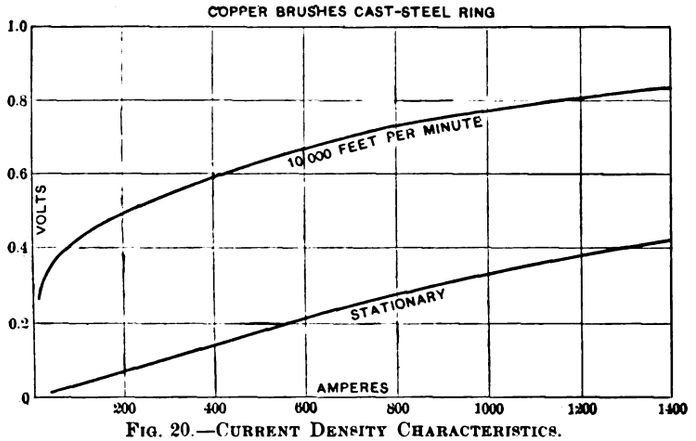


FIG. 20.—CURRENT DENSITY CHARACTERISTICS.

1. As to Speed. Fig. 19—There is a steady but small increase of pressure drop at the brush-contacts with increasing speed. The friction loss, declining somewhat, practically remains constant for high velocity. The total losses also remain practically constant above these speeds. The improved ventilation inherent to greater velocity allows a higher current capacity to be used in the collecting system.

2. Current Density—While the relation between current and pressure drop in stationary contacts of metal brushes and metal rings is similar to that in a solid resistance, the conditions in moving contacts are of the character of those prevailing in an electric arc, the apparent resistance falling off rapidly with increasing densities, Fig. 20. The similarity is furthermore illustrated by the fact that in frequent instances, pressures ten to twenty times higher than normal were required to start the flow of current.

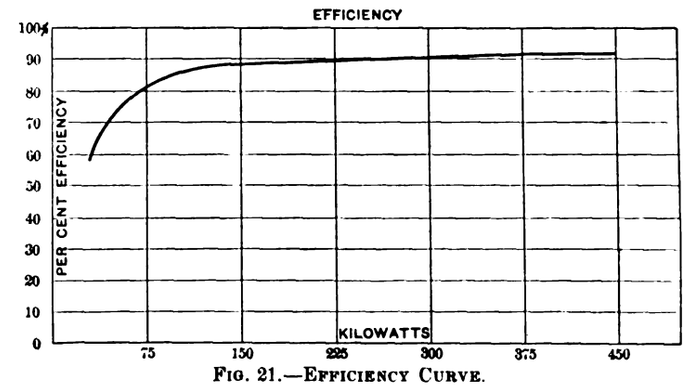


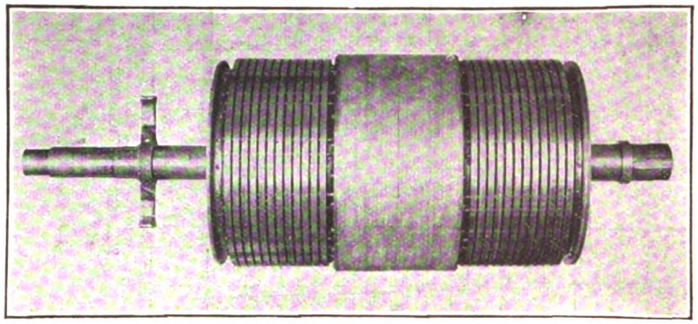
FIG. 21.—EFFICIENCY CURVE.

3. Brush Pressure—The increase of brush pressure does not decrease the drop

Digitized by Google

considerably, but the sparking tendency at high speeds and densities necessitates high pressures.

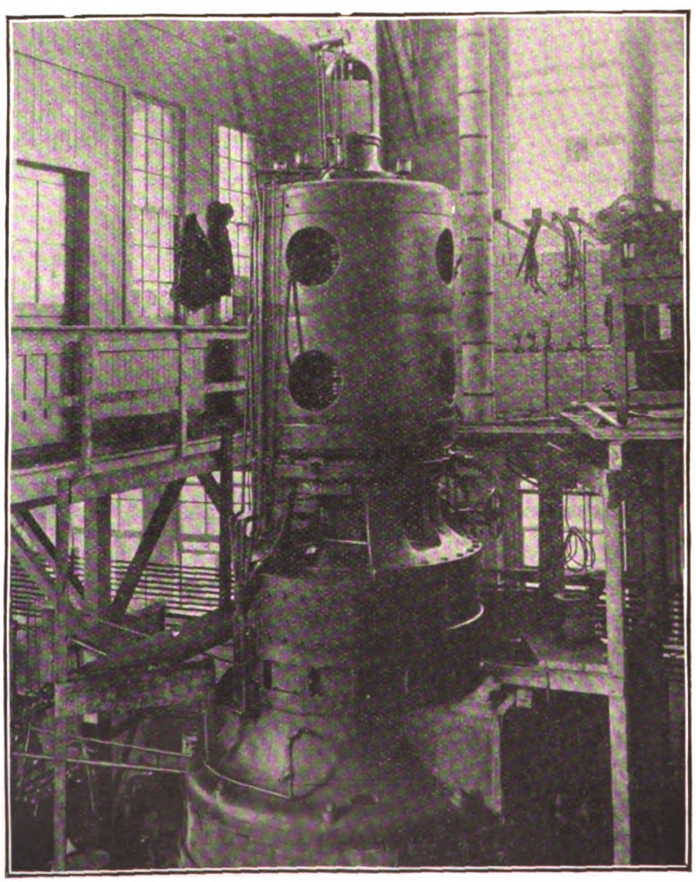
In the 300-kilowatt, 500-volt turbo-generator, the full-load losses equaled twenty-eight kilowatts without windage and bearing friction. The efficiency curve, Fig. 21, is flat, due to the small core and brush friction loss. Regulation equals six to twelve per cent.



Armature and Collector Rings of Acyclic Dynamo.

Considering now the mechanical design, as mentioned above, the generator consists chiefly of a cast-steel armature and a cast-steel frame. On the smooth armature surface twenty-four conductors are mounted, flat sheets bent on the radius of the periphery. The torque is taken up by lugs projecting axially from the armature body and the centrifugal stress by means of steel binding wire.

The twelve collector rings on either side of the armature are assembled close together and mounted on a shell. Eight large-size openings in the frame give access to three brushes each, making a total of twenty-four contacts. The main objection raised against a large number of rings in series is based on the assumption that, consequently many brushes are required, rendering inspection difficult. It seems that twenty-four contacts would be a moderate figure even for a commutator machine of that rating. The stationary circuit consists of twelve cables. Without interfering with other parts, the armature or the stationary winding and either set of collector rings may be removed.



Acyclic Dynamo, Turbine Type, Under Construction.

In comparing commutator and acyclic direct-current machines as to inherent conditions from a commercial point of view, the latter is essentially a high-speed machine, its field being limited in general to large turbo generators, high-speed motors, direct-connected to rotary pumps and blowers and motor-generators.

While the total weights of both types are about equal, even for moderate turbine speeds, the very low copper weight, simple construction—less labor and smaller total cost—combined with the elimination of commutating problems, should speak favorably for the new type.

Electricity and Bread.

The following appeared in the *Kölnische Zeitung* on November 29, 1904, and was transmitted by United States Consul Bartleman from Seville, Spain:

"The power of the electric current to decompose certain substances in a singular way has led to an important development of electrochemistry. In this connection experiments have recently been made in Paris, seeking an improvement in bread-making.

"Laboring under the mistaken impression that the whiteness of wheat bread determines its quality—that the whiter the bread the better—the Parisian public has for years been growing more and more exacting on this score, consequently the fineness of grain flour has been gradually approaching a limit. The public has, as a consequence, received a less nutritive food, it being a known fact that the core of the wheat grain, which is the chief constituent of bread, while producing the whitest flour, at the same time contains the smallest amount of albumen and is thus least nutritious.

"There has recently been raised the hope of obtaining a whiter bread by aid of electricity, for which purpose the flour was brought in contact with electrified air, whose ozone possesses efficacious bleaching properties. A report to the Academy of Science at Paris on the result of an experiment with flour treated in both the ordinary way and by electricity, under similar conditions, explains that the flour subjected to electric influence was much whiter in color, but that its taste and odor were far inferior to those of flour treated by the ordinary method. The amount of phosphorus was the same in both, but the quantities of fatty and acid substances varied largely. Thus, in flour treated by electricity the fatty substances proved rancid, glutinous, and of a less yellowish color, and instead of retaining their usual aromatic yellow state, became oxidized and partly converted into white sebacic acid, which could be dissolved in alcohol. The glutinous substances were discolored and changed.

"The bread made from this flour was whiter than usual, but of inferior taste, and the experiment serves to demonstrate that electric treatment, while successfully turning flour whiter, injures it."

South Dakota Telephone Association Officers.

The South Dakota Telephone Association has elected the following officers: president, C. B. Kennedy, Canton; vice-president, J. A. Steninger, Parker; secretary, H. B. Hartwell, Irene. It has been decided to hold the next annual convention in Sioux Falls, S. D., on the second Wednesday in January, 1906.

Digitized by Google

THE INTERNAL COMBUSTION ENGINE.[1]

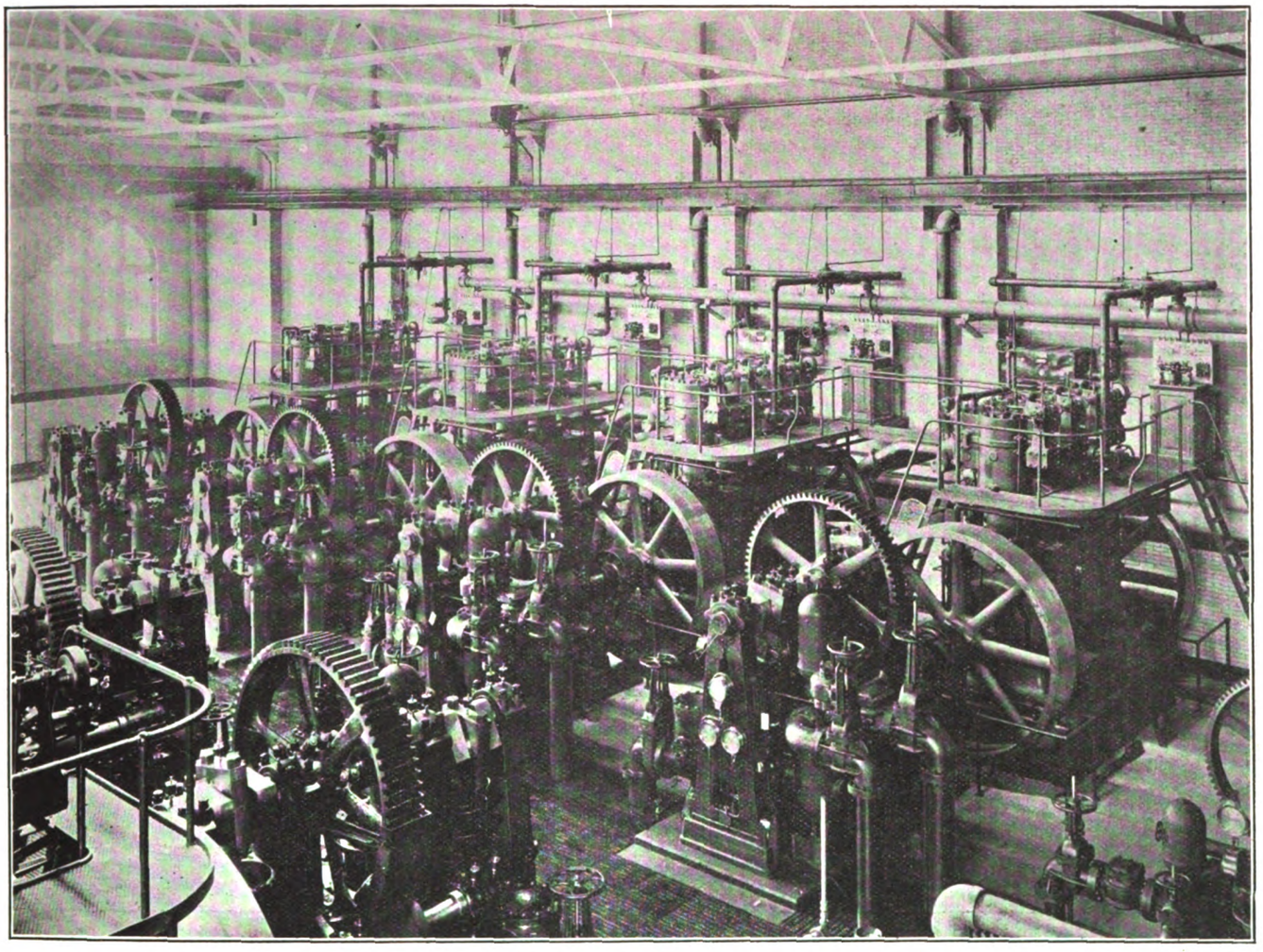
BY J. R. BIBBINS.

ITS PRINCIPLES AND USES.

Of the several prime movers available for general power purposes, which has the highest practical efficiency?

This question is a very pertinent one at the present time; what answer shall we make to it? We search through our stock of information regarding the hydraulic turbine, the impulse type waterwheel, the steam engine, the steam turbine, the gas engine and other motors of specialized character such as the hot-air engine, the sulphur-dioxide engine, the aermotor, the wave motor and the solar engine. At the outset, however, we find it necessary to define clearly the term "practical" efficiency, and we arrive at the conclusion that the true efficiency is represented by the ratio $\frac{\text{useful work done}}{\text{energy input.}}$ Upon this basis, our finding is that the hydraulic turbine motor occupies the most prominent position in the scale of efficiency, approximating eighty-five per cent for either pressure of impulse types. But as the application of the hydraulic motor is entirely restricted by local conditions of water supply, it is practically debarred from general consideration; likewise wind and wave motors. There now remain the heat motors and out of these we find but three which bear the stamp of unquestionable practical success—the steam engine, the steam turbine, and the internal combustion engine.

Recent reports of steam-engine tests show that an indicated-horse-power can be delivered to the piston with an energy consumption of 220 to 250 heat units per minute or 13,200 to 15,000 per hour. By the first law of thermodynamics, which teaches us that heat energy and mechanical energy are mutually convertible, we may reduce the work done by the engine to a heat basis. Joule, and later Rowland, found that one heat unit is equivalent to about 778 foot-pounds. Therefore, the equivalent of one horse-power of work is $\frac{60 \times 33{,}000}{778} = 2{,}545$ heat units per hour. The indicated efficiency of the steam engine is therefore $\frac{2{,}545}{13{,}200} = 19.3$ per cent. Even this efficiency is high and can only be attained by engines of several hundred horse-power capacity working under steam of at least 150 pounds pressure and a good vacuum (twenty-six inches of mercury). In a few highly economical pumping plants a slightly greater efficiency has been reached. Twenty per cent may be considered the limit, and this only with an engine of extreme complexity, great bulk and costly construction. The steam turbine has exceeded this efficiency by a few per cent and its average efficiency may be taken as twenty per cent, based upon useful power delivered to the shaft. But the heat consumption of the ordinary power plant engine may be considered to approximate nearer ten per cent than



HIGH-PRESSURE FIRE-PUMPING STATION, PHILADELPHIA, PA. WESTINGHOUSE VERTICAL GAS ENGINE, DIRECT-CONNECTED TO DEANE PUMPS, SUPPLYING WATER TO UNDERGROUND MAINS AT A PRESSURE OF 300 POUNDS PER SQUARE INCH.

[1] Abstract of a paper read before the Modern Science Club, Brooklyn, N. Y., January 10, 1905

Digitized by Google

twenty per cent. Hence, in the case of the average engine, eighty to ninety per cent of the heat delivered is lost during conversion into work.

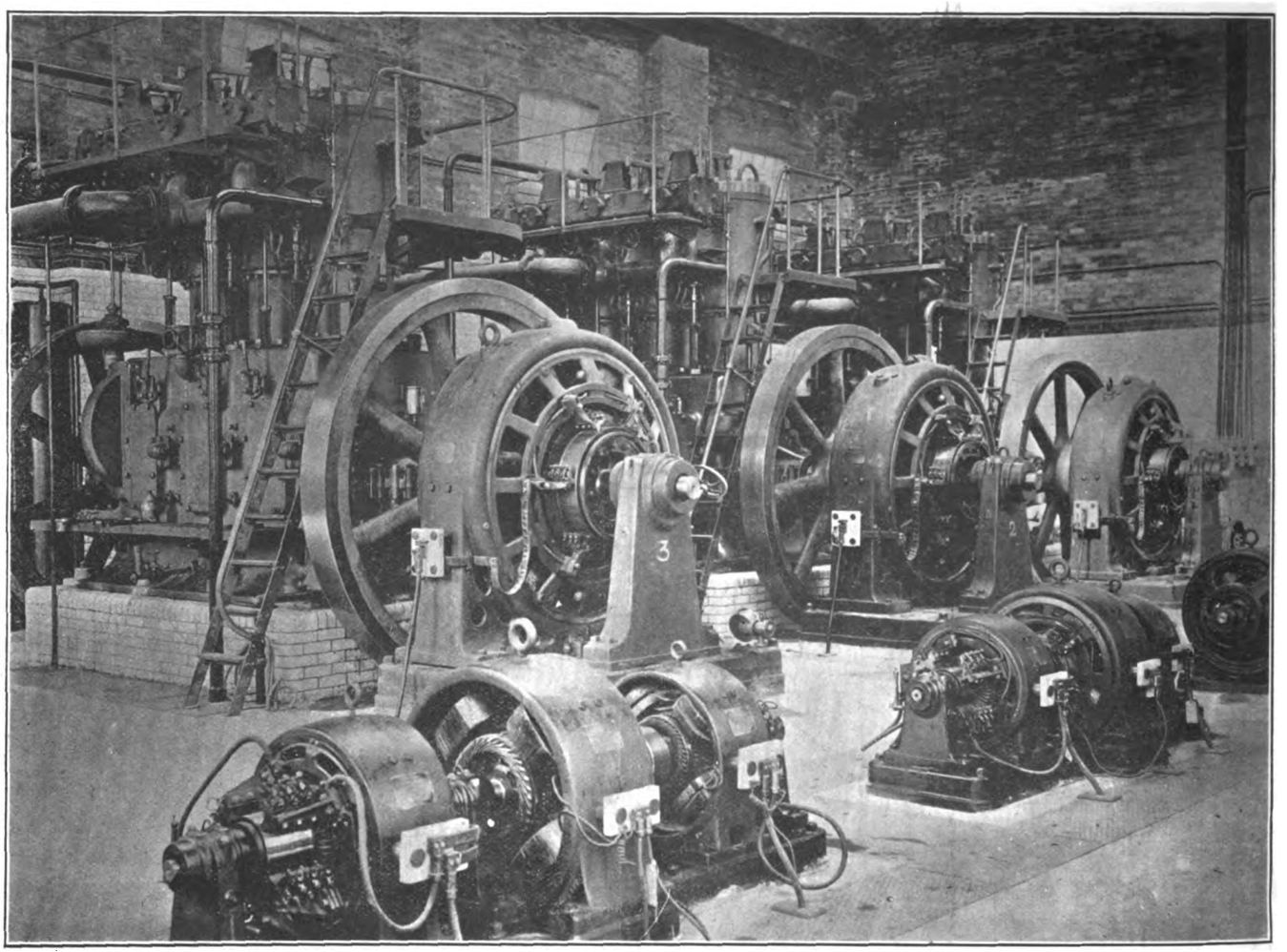
On the other hand, what has the internal combustion engine done to reduce this great loss in heat? Fortunately we are in possession of much data which prove conclusively that a horse-power can be delivered to the shaft of a well built gas engine with an expenditure of 167 heat units per minute or 10,000 per hour. If indicated-horse-power were taken as the basis of comparison, the heat consumption is still less, perhaps 9,000 heat units per hour, and the efficiency is thus $\frac{2,545}{9,000}$ or 28.25 per cent, which is forty per cent higher than the best steam engine. Moreover, this is a very average efficiency of high-grade engines and tests are on record where thirty-four per cent has been obtained.

But, you will ask, if the combustion engine is so highly efficient why has it not entirely displaced the steam engine. There are two reasons, neither of which can be laid at its door as a functionary shortcoming:

First, on account of its high efficiency its early applications have been logically centered in those sections where the cost of fuel was high. Some of the more conspicuous installations in domestic territory are therefore to be found in remote sections such as Southwest Mexico and South America, where coal costs from six to twelve dollars a ton. In Europe, where this type of engine is now used to an extent unappreciated in this country, the extremely high cost of fuel has furnished the main incentive toward its development. Further, by reason of the smaller earning capacity of European properties and the consequent necessity of utmost curtailment of expenses, its high economy has been an important factor in bringing about its general introduction. In America, the general industrial conditions have been distinctly reversed; coal has been abundant and cheap, labor the opposite. And it is thus that the merits of the combustion engine have not been brought home to us with such direct forcefulness. With plentiful stores of energy at hand, previously bottled up by nature for our uses, we have not been in need, until recent years, of the more efficient prime mover.

Secondly, after the introduction of the gas engine had been begun by a handful of enterprising American manufacturers, serious difficulty arose in the provision of a proper fuel. In sections where natural gas was plentiful the difficulty was solved, and the numerous power plants are now running upon natural gas drawn from private wells or from those of a distributing company. In other districts, however, illuminating gas or producer gas has been the only alternative. The former is far too expensive for general power use; the latter has been generally successful only when produced from anthracite coal. Up to the present time a simple and satisfactory bituminous producer has not been put on the market, and this constitutes a serious problem in present and future application of gas power.

As an exception to the above may be mentioned the Mond ammonia recovery



A Model Gas Power Plant, Using Producer Gas. Midland Railway, Hegshaw Harbor. Westinghouse Vertical, Three-Cylinder Engine and Mond Producers.

Digitized by Google

process, in which bituminous coal is used successfully, large quantities of ammonia being reclaimed in the form of ammonium sulphate. The chemical process, however, adds complication to an otherwise simple system, and is hardly applicable to general development of small powers. There is now under construction in England a large gas distribution system which will supply Mond gas in great quantities to all towns in the south Staffordshire district within a limiting area of 123 miles.

There are several builders in this country and numerous ones abroad who are ready to construct engines up to several thousand horse-power capacity, but they must be supplied with producer gas and this gas must be made from bituminous coal by a process embodying the essential requirements of extreme simplicity and economy. When such a process is available, another revolution in choice of prime movers is certain.

NEW FIELDS.

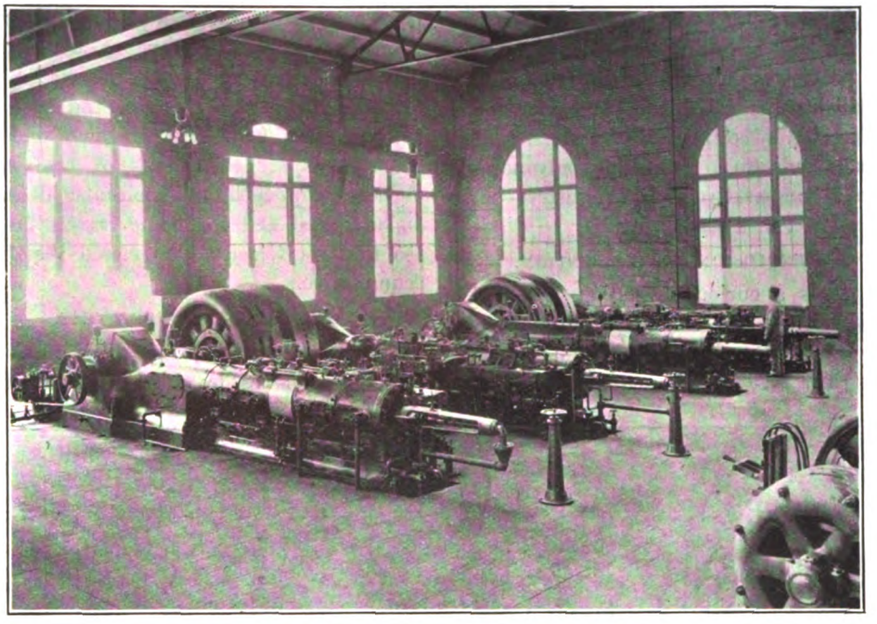
Probably the most important development and achievement in recent gas power engineering has been the conservation of waste gaseous products from blast furnaces, coke ovens, etc. The gas engine is now being rapidly applied with much success to the generation of power from blast-furnace gas. The practice was started in Germany and has now been adopted in America. The money value of this waste gas which is now discharged in the atmosphere as a waste product runs up into fabulous figures. The last United States census on manufacture states that the use of this gas for power "returns a profit" of $1.25 per ton of pig iron produced; or about $150,000 per year for every furnace in the country.

Another and practically undeveloped field for the gas engine is the generation of power from the rich gases given off in the process of coke-making. These gases, like blast-furnace gas, have heretofore been discharged into the atmosphere, transforming the neighboring districts into a state of semi-volcanic desolation. A number of by-product coke processes is now in use including the Semet-Solvay, Otto Hoffman, Lowe and others, in which the coke-making process is so controlled and modified that the rich volatile hydrocarbon gases may be conserved for the generation of power, metallurgical or other purposes.

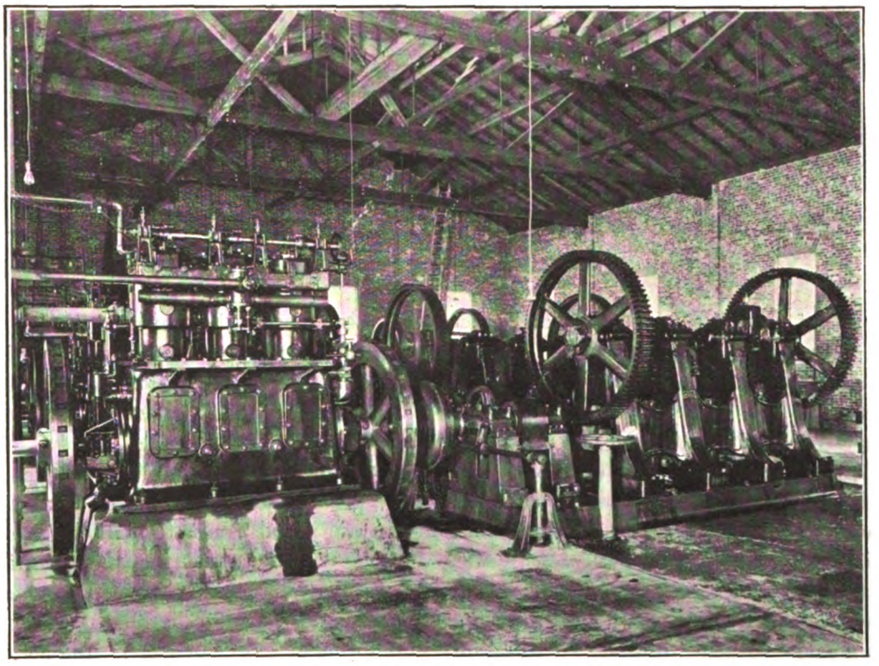
In one notable instance of a large American oil refinery, the rich gases given off during the refinement of crude petroleum are similarly conserved for use in gas engines to generate electricity for light and power throughout the works.

An even more noteworthy development of recent years in the utilization of waste products is the reclamation, or, more properly, destruction of city refuse. Several large plants in Europe generate steam for municipal lighting by burning the combustible refuse under boilers. In Glasgow sufficient heat is thus available to furnish 9,000 horse-power per ten-hour day for manufacturing purposes. It has lately been proposed to modify this process by cremating within specially constructed destructor cells, which are virtually gas producers and operated as such. The resulting gases, after being fixed and enriched if too impure, are then available for conversion into electric power by gas engines.

Outside of these special applications, however, the gas engine has rapidly increased its foothold in all branches of power work, particularly in the generation of electricity for light and power in central stations, isolated plants and industrial works. An eminent English authority, Mr. H. A. Humphrey, estimated at the close of 1902 that there were in operation or had been built engines aggregat-



TYPICAL MODERN GAS POWER PLANT, ATLANTIC REFINING COMPANY, PHILADELPHIA, PA. WESTINGHOUSE TWIN-TANDEM, DOUBLE-ACTING GAS ENGINE, DRIVING ALTERNATORS IN PARALLEL. OPERATE ON WASTE OIL GAS FROM THE REFINERY.



PUMPING PLANT, FORD CITY, PA., PLATE GLASS COMPANY. OPERATE EXCLUSIVELY ON NATURAL GAS, FURNISHING ENTIRE WATER SUPPLY FOR PLATE GLASS WORKS.

Digitized by Google

ing 182,000-horse-power capacity. This estimate excluded all engines under 200 horse-power, and the average was about 550 horse-power per engine. Conservative estimates would now nearly double these figures. A number of engines of 1,000 to 1,500 horse-power had then been built; to-day engine capacities up to 4,000 horse-power are under construction and still larger sizes will be contracted for on demand by responsible builders. These facts indicate a tremendous advancement in a comparatively new industry—barely a quarter of a century old.

EXPLOSION VS. COMBUSTION.

It is a curious fact that in spite of evidence to the contrary the gas engine is generally considered as an explosion engine. We are all acquainted with the power of dynamite, gun-cotton, and other explosives to instantaneously resolve themselves into gas when ignited by a detonator; yet these substances will burn rapidly but without explosion when ignited in the ordinary manner. With best mixture the period of the so-called explosion was one-thirtieth of a second, but with poorer mixture the full pressure was not reached until nearly one-half second had elapsed. Further, the highest pressure obtainable without previous compression was ninety-six pounds per square inch. Does this savor of explosive suddenness of violence, as these terms are used in their true sense?

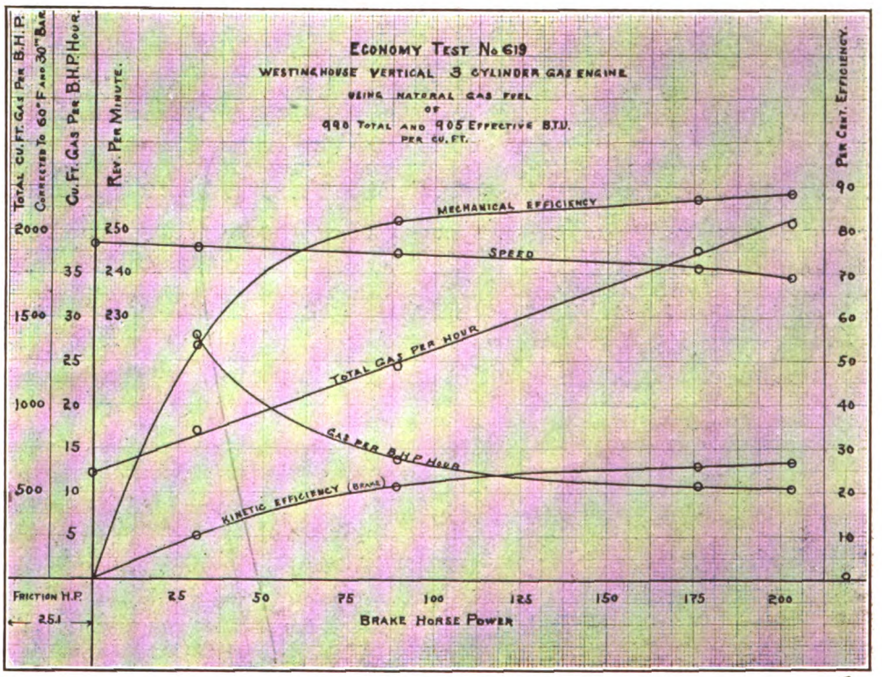
The gas engine is thus not a true explosion engine, although high pressure and rapid combustion take place due to the small volume at ignition and the large quantity of heat energy contained. The rate of flame propagation or flame advance through an unconfined combustible mixture is a perfectly definite quantity—about one metre or three and one-fourth feet per second for coal gas. With true explosion this rate is over 1,000 metres or 9,000 feet per second, as stated by Dugald Clerk, for a perfect mixture of oxygen with hydrogen, which is one of the principal constituents of coal gas. When compressed, the molecular density is increased and the flame travels faster so that its velocity in a closed vessel is cumulative.

PERFORMANCE UNDER TEST.

In accurately determining fuel economy the indicator has, by almost common consent, been discarded in favor of the Prony or friction brake, owing to the difficulties in the calibration and use of the indicator with the sudden and excessive pressures encountered. The brake test involves the actual work delivered by the engine at the shaft. It is therefore free from the uncertainties attached to indicated performances. By measuring the quantity of gas delivered to the engine by meter, and its calorific value by one of the several forms of gas calorimeters, the actual heat consumption of the engine is readily determined.

A typical test is shown, taken at random from nearly a thousand tests on individual engines that have been constructed at East Pittsburg. The curve of total gas consumption is very nearly a straight line throughout the range of normal engine capacity. This furnishes ample evidence that the engine consumes heat in gaseous form with the same inherent efficiency at all loads. This characteristic ensures a continually decreasing gas consumption per horse-power as the load increases, reaching the maximum at about full load, as shown by the curve. At this point this engine consumed ten and three-fourths cubic feet of natural gas per horse-power, equivalent to 9,800 effective British thermal units per brake-horse-power-hour, or 163 British thermal units per minute. This corresponds to a thermal efficiency of nearly twenty-six per cent.

The efficiency of a gas engine is but very slightly affected by the kind of gas used, provided that the mixture of gas and air is of the proper proportion, and it is found that the gas consumption in cubic feet varies in practically inverse proportion to the heat units obtained. Thus, if an engine consumes ten cubic feet of natural gas containing 1,000 British thermal units per cubic foot, it will consume about thirty cubic feet of coal gas containing 350 British thermal units, eighty cubic feet of producer gas of 125 British thermal unit heat value, and 105 cubic feet of blast-furnace gas containing ninety British thermal units per cubic foot. With the lesser gases a higher compression may be carried without risk of spontaneous ignition or back-firing, thus conducing to higher economy which is, of course, due to the increase in pressure and temperature head thus made possible.



VERTICAL THREE-CYLINDER GAS ENGINE UNDER TEST, USING NATURAL GAS.

The Amsterdam-Haarlem Tramway System.

The British electrical papers published recently descriptions of the Amsterdam-Haarlem electric tramway system, which has just been completed by J. G. White & Company, Limited, of London. Haarlem and Amsterdam are only ten miles apart, and the plan of connecting them by means of an electric road is not a new one. Some years ago a route was laid out, but it was too roundabout and the scheme was abandoned. In 1901 a concession was granted by the Holland government for the construction of an electric system parallel with the steam railway. The conditions, however, were stringent. The company was required to sheet-pile the sides of the road, which is bordered on one side by a canal, and on the other side by a ditch, in order to secure the necessary width and stability, and to carry out the whole of the work with the least possible interference with the regular use of the road. The concession is for a period of fifty years. It was required that plans for all work be approved by the government, and two years were allowed for carrying out the construction. The secretary of state fixes the maximum speed allowable and the maximum rate

Digitized by Google

which may be charged. At the expiration of the concession the government will take over, without compensation, all property located on government land.

To enter Amsterdam a private right of way was secured for about two miles from the government road to the city limits. Within the city the right to run over the existing system was secured. The strip of land secured was wide enough to permit of a row of building lots being laid out on either side. On this section the track is built in the centre of the road; along the highway it is located on the sides of the road, with a driveway between the tracks.

In addition to the piling, a good deal of other construction and reconstruction was necessary. A large swing bridge was required, and a third rail had to be laid within Amsterdam, since the system there uses the standard gauge, while the new road has a gauge of one metre.

The power-house is located on the canal bank at Halfweg, a village midway between Amsterdam and Haarlem. The location is good, not only for the feeder system, but for securing coal and water. Owing to the nature of the country, the condition of the ground at that point was poor, and an elaborate system of piling was necessary, the entire site being piled with forty-six-foot long, nine and three-quarter-inch diameter piles, placed four feet one inch apart. The building itself is of brick with stone trimmings, and covers an area of something over 9,000 square feet. The main generating plant consists of three Belliss self-lubricating, three-crank, enclosed, triple-expansion engines, each rated at 430 brake-horse-power. The steam consumption is thirteen and one-half pounds per brake-horse-power-hour, superheated, and seventeen pounds with saturated steam, when operating with a twenty-six-inch vacuum. The speed is 375 revolutions per minute. The generators, furnished by the Societe Anonyme Westinghouse, of Le Havre, are direct-connected and rated at 300 kilowatts, 525 to 575 volts. The foundations for the main engine and condensers were built of concrete. Surrounding the engine and condenser foundations are arches of concrete to support the engine-room floor.

There are thirty-four cars, each divided into two compartments, the largest seating twenty-two passengers, and the other twelve. The cars are provided with hand-brakes and air-brakes, and are equipped with fifty-horse-power motors.

On that part of the road from Haarlem to Zandvoort bay, contact is made with two wires simultaneously. The trolley wire is zigzagged in order to equalize the wear on the bow. Through the village of Halfweg there are two sections of single line, which are protected by an automatic electric signaling device. When a car enters either of these sections the collecting bow makes contact, closing an electric circuit and lighting the signal lamp.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

READING AND DISCUSSION OF TWO INTERESTING PAPERS.

The 193d meeting of the American Institute of Electrical Engineers was held on Friday evening, January 27, at Carnegie Hall, New York city. The meeting was opened by President J. W. Lieb, Jr., who spoke of the sudden death of Mr. E. H. Mullin, and the loss to the Institute in consequence. The death of Mr. C. M. Wilkes, of Chicago, was also announced.

The first paper of the evening was then read by Mr. J. E. Noeggerath, of Schenectady, N. Y. It was entitled "Acyclic (Homopolar) Dynamos," and described a 300-kilowatt, 500-volt, turbine-driven acyclic generator which has been built by the General Electric Company and tested in its shops. This paper will be found on another page of this issue. Mr. Noeggerath first discussed briefly the theory of such machines, classified them according relatively to the direction of rotation and that of the electromotive force produced. He explained the armature reactions, showing how they could be controlled and how the machine might be compounded. The results of tests which were given show that the friction losses are the most important. The efficiency was found to be high, being over ninety per cent at full load. The regulation is between six and twelve per cent, according to the density of the magnetic flux and the arrangement of the conductors. The weights of this machine are about the same as those of turbine-driven, direct-current dynamos. They, cost, however, much less, and only fifty per cent of the copper is required. These conditions obtain only at and above 300 kilowatts; for smaller machines the type is not favorable.

The discussion was opened by Professor F. B. Crocker, of New York, who referred to the paper read by himself before the Institute in 1894, describing unipolar dynamos, as they were then called. The machine is really a Faraday disc machine, and, in fact, Faraday had proposed increasing the electromotive force by multiplying the number of discs. Professor Crocker objected to the designation of the different types of machine as "radial" and "axial," holding that the terms in general use, "disc" and "cylinder," were more appropriate. He called attention to the high electromotive force per foot of conductor, which, assuming the speed to be 12,000 feet per minute, and the magnetic flux 90,000 lines per square inch, was twenty-six volts per foot. The armature reaction corresponds to that of a direct-current machine with no brush lead—that is to say, it is a cross-flux. One of the interesting points in the construction was the compounding effect which could be brought about by simply shifting the brushes. Professor Crocker thought that blow-holes in the magnetic parts would be the cause of eddy currents.

Dr. W. E. Goldsborough, New York city, dwelt upon the importance of machines of this type in certain classes of work. He said that many engineers had tried to develop a satisfactory homopolar machine, but so far this seems to have been the only successful one.

Dr. A. E. Kennelly, Cambridge, Mass., said that this was one field in which the direct-current machine has an advantage over the alternating-current. As there is no need to laminate any part of the iron-work, the field and armature cores can be cast. The enormous speeds give high electromotive forces, and should reduce the weight of the active part after all allowance had been made for material used simply for mechanical strength. An interesting point was the size of the collector rings or commutators, this being practically twice that of the armature surface.

Mr. Crellin Cartwright, of Schenectady, N. Y., pointed out the advantages of this class of machine for carrying overload. There is no trouble with the collecting brushes, due to overloading, and the insulating material is designed more particularly for mechanical than dielectric strength—hence the machine should be very important for railway work.

Replying to this discussion, Mr. Noeggerath held that classifying machines as "cylindrical" and "discs" is not satisfactory, since a cylindrical machine may have an electromotive force developed in it radially. He pointed out the difference between the armature reaction of the acyclic dynamo and that of a direct-current machine. In the latter the cross-magnetization causes crowding of the flux at one pole tip, and a weakening at the other. In the acyclic machine there is no such crowding, but a true composition of flux takes place. He did not think that blow-holes would produce the losses anticipated. In fact, he had drilled holes through a machine to secure better ventilation without any perceptible increase in the iron losses. The collector rings used are ordinary hard cast steel, not hardened. Of course, nickel steel would

Digitized by Google

be better. So far the brush-wear on this machine had not proved to be excessive.

President Lieb then introduced the second paper of the evening, which was by Mr. J. E. Moultrop, entitled "Modern Central Station Design as Exemplified in the New Turbo-Generator Station of the Edison Electric Illuminating Company of Boston." It consisted of a discussion of this station, which has already been fully described in the ELECTRICAL REVIEW of May 21, 1904, and was read by the author. In calling attention to the importance of design, President Lieb quoted figures from the United States census for 1902. He pointed out that in one of the largest New York central stations ten per cent of the power equipment is in use only twenty-five hours during the year, and all of this occurs within one month; twenty-five per cent of the station equipment is used only seventy-five hours during the year, all occurring within two months, and fifty per cent of the equipment is in use only 500 hours, all within seven months. These features have a great influence on the design of the station, and should always be borne in mind.

The discussion was opened by Mr. H. G. Stott, New York city, who spoke of the relation of the cost of generating plants to the operating cost. He showed that an extra investment of $12.50 increased the cost per kilowatt-hour one-half cent. Many plants cost too much to be economical, as the interest and depreciation equal the operating cost. It would be better in many cases to put in a less economical, but cheaper plant. He thought that the steam turbine is a move in the right direction, in that it reduces the first cost of the station.

As has been pointed out, a good part of the machinery is needed to carry the peaks of the load, but as these exist for a short time only, there is no need that the machines should be operated with high economy when carrying them. What should be done would be to demand generators with a great overload capacity, but they need not be efficient at these loads. This would bring down the interest and depreciation. Mr. Stott did not think it was safe to have no cross-connections in a station, as is true in Boston. He thought this applied particularly to the steam piping. He pointed out that banking boilers when using mechanical stokers requires almost as much coal as running the plant during the lighting hours, and if there were cross-connections in the steam piping, a new generating unit could be started, using the boiler equipment intended for the one which was being taken out of service; hence banking one set of boilers would be avoided. Mr. Stott would not admit that a steam turbine could be put into service more quickly than a reciprocating engine. He said that barometric condensers could be introduced in a station, giving equally high vacuum, and yet costing six cents per kilowatt less, which was equivalent to one-quarter of a cent less per kilowatt-hour.

Mr. F. C. Bates, quoting some figures given by Mr. W. L. Emmet, said that a 5,000-kilowatt generator, located in a city plant, would, during a year, use $6,000 worth of city water. Using surface condensers ninety per cent of this could be saved. Capitalizing the $5,400 thus saved at ten per cent showed that the surface condensers were equivalent to a saving of $54,000. Putting it another way, the saving would be equivalent to two pounds of steam per kilowatt-hour.

Mr. Philip Torchio, New York city, agreed with Mr. Stott in regard to the drawbacks of complete separation of the operating machinery. He did not think it advisable to remove the switchboard operator from the engine room. An experienced operator depends almost as much upon his ears as his eyes for detecting trouble. Placing him in a separate room deprived him of any audible warning. He thought that a reciprocating engine could be thrown into service more quickly than a turbine. As the high economy of the steam turbine is due to the high ratio of expansion of the steam, it is essential that a high vacuum should be maintained; hence surface condensers are necessary. He called attention to the fact that European engineers have had a good deal more experience with turbine performance than we have had in this country. This experience has so far been satisfactory. In one particular case a turbine case had been sealed up and then run for 17,000 hours without examination. At the end of this period it was opened in the presence of a delegation, and showed no corrosion whatever, either of wheel, blades or nozzles. He thought that if a station were well designed it was fair to assume that it should produce one kilowatt-hour per sixteen pounds of steam, using 150 degrees superheat.

Mr. C. O. Mailloux, New York city, also compared European station design with that of this country. He was pleased to see more attention being given to the finish of the station, as this was undoubtedly a move in the right direction. He held that a surface condenser would give a better vacuum than a jet condenser, and said that in Europe vacua are not as high as in this country, twenty-six or twenty-seven inches being considered good practice there.

Mr. W. F. White, of New York, said that surface condensers enable boilers to be run a longer time without being cleaned. He thought that too little attention is being paid to carrying a suitable coal reserve. It is impossible to store a satisfactory reserve in overhead bunkers, as these would become so large as to make the cost of the building excessive. This being the case, a storage yard is necessary; and, having a storage yard, it becomes unnecessary to install large bunkers in the building.

Mr. Stott, taking up again the subject of jet condensers, said that there are now in operation in New York sixteen barometric condensers, which, without the use of dry air-pumps, give eighteen inches vacuum. When a dry air-pump is employed, they give twenty-nine and one-quarter inches; within one inch of the absolute vacuum. He called attention to the losses taking place when coal is stored outside. Twenty-five per cent of the heat value is lost very quickly. Mr. Stott said that it is incorrect to assume that the use of surface condensers enabled water to be used over and over again in boilers, as distilled water has a corrosive effect upon the boiler tubes and on the superheaters. He mentioned a particular case in which a reciprocating engine had been started up and thrown into synchronism in one minute and thirty-seven seconds.

Replying to the discussion, Mr. Moultrop said that it is very true that many large plants to-day are too good. He did not think this applied to the Boston Edison company's plant, because this is the result of the growth of a large system. Everything being considered, the tile finish will be cheaper in the end. The new plant will carry a steady load, and hence an expenditure with a view to obtaining economy is proper. The peaks of the Boston loads will be carried by the older stations, which contain the less efficient machinery. It would not pay the Boston Edison company to sell this old equipment, because it would bring in very little. In regard to cross-connections, he did not agree with Mr. Stott and Mr. Torchio. Cross-connections had been tried at the Atlantic avenue station, where every conceivable connection had been made. The result was that, within a short time, every one forgot the purpose of the different connections, and when trouble came there was no time to trace out the precautionary piping and wiring. In the Boston plant they had gone to the other extreme, and adopted no cross-connections.

As the hour was late, Mr. Moultrop asked to be allowed to continue the discussion in writing. The meeting then adjourned.

Digitized by Google

The Sixth Annual Convention of the Independent Telephone Association of Wisconsin.

Milwaukee, January 25 and 26, 1905.

THE sixth annual meeting of the Independent Telephone Association of Wisconsin was called to order in the convention hall of the Pfister Hotel at two o'clock, January 25; the president, Richard Valentine, of Janesville, delivered his annual address, showing the continued rapid progress being made by the independent companies throughout the state, that most of the companies had greatly increased their list of subscribers, and that exchanges were being installed in the cities of Green Bay and Depere. He stated that the reason for calling the convention a month earlier than usual was for the purpose of discussing matters of telephone legislation, which were to be brought up at the present session of the legislature. The bill prohibiting discrimination in telephone rates, which the association was advocating and which had passed the House by a vote of three to one at the last session but was defeated in the Senate by one vote, would again be urged for passage at this session, and he asked the active cooperation of all the members in securing its passage.

J. C. Harper, of Madison, discussed in full the bill to prohibit discrimination in telephone rates, showing the benefit it would mean to legitimate telephone interests and what hardship the present discriminations are to many of the cities. The bill was very nearly passed two years ago and with a little more cooperation by the companies throughout the state its passage would be assured at this session.

The bill was further discussed by Richard Valentine, of Janesville, and J. M. Baer, of Appleton.

J. J. Nate, of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, spoke of the conditions in Minnesota, where the independents had built up the local territory but neglected to build toll lines. The Tri-State company of Minnesota was building up a fine system of toll lines and exchanges in Minnesota.

On motion that the chair appoint a committee on telephone legislation the following were appointed:

J. C. Kuoni, of Sauk City; J. C. Harper, of Madison; J. M. Baer, of Appleton; Philip Sheridan, of Green Bay; and E. A. Miller, of Hixton. On further motion the president was made chairman of this committee.

H. H. Davenport, of Green Bay, spoke of the work being done by the Valley Telephone and Telegraph Company, which was installing an exchange in Green Bay for 3,000 subscribers and one in Depere for 1,000, and also expected to develop that section of the state.

J. M. Baer, of Appleton, spoke of the good construction being put in by the company, which was sparing no expense to get the best, and which was putting in five miles of underground work, and the entire system was to be of copper wire.

A committee of three on resolutions was appointed as follows: G. W. Wilder, Chicago; Alfred Slater, Beloit; D. B. Bestor, Mazomanie.

Adjournment was then taken until ten o'clock the next morning.

The meeting reconvened on Thursday morning, January 26, and James B. Hoge, of Cleveland, president of the National Independent Telephone Association and of the United States Toll Line Company, made an address on the growth of the independent telephone business, stating that although the independents had started only ten years ago that they today had 2,500,000 subscribers. The rapid growth of the independents was still continuing and independent securities now had a much better standing than formerly. In most sections of the country independent trunk toll lines were being constructed. He urged that the state association should cooperate with the national, which had recently been consolidated with the interstate. The independent companies should advertise their long-distance business more and ought to adopt a uniform and standard toll sign. On motion of J. C. Harper a resolution was passed that the toll station sign adopted by the national association should be adopted by the independent companies of Wisconsin.

H. A. Nuttall, of Chicago, gave an address on "Ways and Wiles of the Bell Company."

G. W. Wilder, of the Armour Institute of Technology, Chicago, made an address on "Simultaneous Telegraphy and Telephony." He explained the system being successfully used in European cities and predicted that the telegraph service would become an important part of the telephone companies business in the future. The telegraph service could be rendered at a very small additional expense. The apparatus required is very simple and by means of condensers and retardation coils the two different currents are prevented from interfering with each other. A metallic circuit line is capable, by means of duplexers, of transmitting eight telegrams simultaneously.

E. C. Lewis stated that some of the railroad companies were using this combination system on their branch lines and were meeting with much success.

Mr. Hoge stated that the United States Toll Line Company was using these telegraph instruments in combination with their telephone lines quite extensively and was receiving an additional revenue of some $20,000 a year therefrom.

Don Farnsworth, of New York city, spoke on "Telephone Securities," stating that trust companies and the investing public were giving much more attention to telephone stocks and bonds than formerly. He was endeavoring to secure independent telephone statistics to show the vast development of the independent business and this would tend to give independent telephone holdings a firmer and better standing in the financial centres.

The following were appointed a committee to recommend officers for the ensuing year:

Charles Schernecker, of Sun Prairie; William Van Middlesworth, of Racine, and J. C. Harper, of Madison.

J. B. Hoge, president of the National Independent Telephone Association, advised that the state association affiliate with the national association, and a committee of three was appointed to confer with Mr. Hoge, consisting of H. C. Winter, of Madison; John C. Murdoch, of Broad Head; and W. F. Goodrich, of La Crosse.

Adjournment was taken until 2.30 P. M. Upon the meeting reconvening the report of the committee to confer with Mr. Hoge was made, advising that the Wisconsin association join the national association and recommending

Digitized by Google

that Mr. Valentine be elected member of the advisory board of the national association, and that three alternates be elected to attend the convention of the national association, which is to be held in Chicago next June; on motion the following were elected delegates: J. M. Baer, Appleton; W. F. Goodrich, La Crosse; J. C. Harper, Madison; and as alternates Dr. G. W. Wilder, Chicago; Philip Sheridan, Green Bay; and Charles Schernecker, Sun Prairie.

The secretary's report showed that 122 new independent companies were organized in the state the last three years, with $2,000,000 capital; that the increase in the number of companies and the steady growth of those now operating continue without lessening. A copper trunk toll line was now completed between La Crosse and Minneapolis, which gave good long-distance service between the Twin Cities, the important parts in Minnesota, Superior and Ashland in Wisconsin, and the Dakotas on the West. It was expected that this line would be extended into central and southern Wisconsin in the near future. There are to-day 275 independent telephone companies in Wisconsin, with an investment of $4,000,000, with 1,200 toll stations, 350 exchanges and 37,000 subscribers, of which number about 10,000 are farmer subscribers.

The committee to recommend officers, recommended the following officers for the ensuing year, which were elected:

Richard Valentine, Janesville, president; J. C. Kuoni, Sauk City, vice-president; H. C. Winter, Madison, secretary-treasurer.

Members of the executive committee: William Van Middlesworth, Racine; Philip Sheridan, Green Bay; J. C. Harper, Madison; W. F. Goodrich, La Crosse; H. V. Bartlett, Chippewa Falls; John M. Baer, Appleton; E. A. Miller, Hixton; and J. C. Crowley, Superior.

On motion it was decided to hold the next annual meeting at Milwaukee on December 20 and 21, 1905.

EXHIBITORS AT THE CONVENTION.

A number of manufacturers and supply men was represented at the convention, many exhibiting a large variety of telephone apparatus and auxiliaries. Among those present were the following:

American Electric Fuse Company—F. B. Patton.

American Electric Telephone Company—M. W. Zabal, H. A. Nuttall, S. J. Baer.

J. Andrae & Sons Company—H. P. Andrae, J. C. Schmidtbauer.

Automatic Electric Company—C. L. Fisher.

Frank B. Cook Company—F. W. Pardee, H. R. Cook, G. C. Fricke.

Dean Electric Company—R. H. Manson.

Electric Appliance Company—S. A. Densmore.

Electric Supply Company—L. W. Burch.

Eureka Electric Company—R. S. Mitten, C. W. Robbins.

Holtzer-Cabot Electric Company—E. R. Harding.

Independent Telephone Manufacturing Company—A. F. Adams.

International Telephone Supply Company—H. H. Deavenport.

Kellogg Switchboard and Supply Company—F. E. Rotchka.

Kusel & Kusel—H. J. Kusel, I. J. Kusel.

A. Meinema & Company—Albert Meinema.

Milwaukee Telephone Manufacturing Company—F. J. Whitmore.

Monarch Electric Wire Company—C. A. Kuhlman.

Monarch Telephone Manufacturing Company—E. E. Yaxley, W. H. Trimm.

North Electric Company—Charles H. North.

J. A. Roebling's Sons Company—W. H. Slingluff, Bond Wisler.

Signalphone Company—A. D. Weller.

Standard Telephone and Electric Company—M. L. Eldred, H. C. Biester.

Standard Underground Cable Company—E. J. Pietzcker, J. E. O'Neil.

Sterling Electric Company—W. E. Doolittle, C. R. Brown.

Stromberg-Carlson Telephone Manufacturing Company—J. J. Nate, E. C. Lewis.

Vought-Berger Company—J. G. Ball.

Williams-Abbott Company—L. Sand.

Extraction of Nitrogen from the Air.

In the London *Electrician* for January 6 appears a contribution from Siemens & Halske, of Berlin, referring to the calcium cyanamide process for fixation of nitrogen. It is said that the process is no longer merely a laboratory method, but is already at work in Berlin on a fairly large scale. In addition, the Societa Italiana per la Fabbricatione di Prodotti Azotati is building works at Piano d'Orta, in Italy, which will be able to produce 4,000 tons a year.

Calcium cyanamide can be used as a fertilizer instead of nitrate or ammonium sulphate. This fact has been established by experiments extending over three years, conducted by the royal agricultural testing station at Darmstadt and Posen. Experiments in this line have also been carried out at other places by well-known experts.

It is said in this communication that a new process of fixing atmospheric nitrogen has been devised, which is better than the cyanamide process, in that it eliminates one of the steps of the latter. For this method the nitrogen is fixed by heating lime and carbon and a stream of air in the resistance furnace, under determined conditions. This direct process of fixation dispenses with the previous formation of calcium carbide.

Eliminating Isolation and Distance from Farm Life.

At the recent annual meeting of the Kansas State Board of Agriculture, held at Topeka, Kan., Mr. Fred DeLand, treasurer of the Federal Telephone Company, Pittsburg, Pa., delivered an address on the topic of "Eliminating Isolation and Distance from Farm Life." Mr. De Land rehearsed the developments which had been made in improving the condition of rural communities. He called attention to the remarkable advance made since the invention of a practical reaper, and suggested that the only other invention which had brought to rural communities the same advantages was the electric speaking telephone. He sketched the development of the telephone from the crude apparatus of Reis to the present-day perfected apparatus. He described the first telephone line, and considered that this was not only the first line, but the first farmers' line and the first fence line ever built. It was erected thirty years ago, and was the forerunner of the 400,000 farm telephones now in use. In many ways the telephone was a great boon to the farmer. It helped him to market his produce and brought him in touch with many conditions that heretofore were impossible. It increases the earning value of many farms through helping to lessen the cost of operating and maintaining the farm property. He emphasized the necessity of a good understanding of the elements of telephone construction, and cautioned the farmer against using anything but first-class material; the best of construction being the cheapest in the end.

Digitized by Google

A CONTEMPLATED MAGNETIC SURVEY OF THE NORTH PACIFIC OCEAN BY THE CARNEGIE INSTITUTION.

BY DR. L. A. BAUER.[1]

A project for a magnetic survey of the North Pacific ocean by the department of international research in terrestrial magnetism has been favorably acted upon by the executive committee of the Carnegie Institution of Washington and authorization has been given to begin the work this year. An initial allotment of $20,000 has been made to cover the expenses for the current year.

As is well known, the state of our knowledge of the distribution of the magnetic forces over the greater portion of the earth—the oceanic areas—owing to the paucity of precise data, is exceedingly unsatisfactory. This fact is especially true for that great body of water, the Pacific ocean, rapidly developing in great commercial importance.

Captain Creak, for many years superintendent of the compass department of the British admiralty, now retired, says: "the North Pacific ocean is, with the exception of the voyage of the Challenger, nearly a blank as regards magnetic observations, and I, therefore, think the magnetic survey proposed will be of great value."

Hence, except for data from occasional expeditions and such as were acquired in wooden vessels a long time ago, the present magnetic charts used by the navigator over this region depend largely upon the observations on islands and along the coasts. Such land observations, however, are rarely representative of the true values because of prevalent local disturbances. It is, therefore, impossible to make any statement as to the correctness of the present charts. The demands of science, as well as those of commerce and navigation, require a systematic survey of this region under the most favorable conditions possible, and that the work be done under the auspices of some recognized research institution in order to ensure that the scientific aspects of the work receive their adequate recognition.

The eminent physicist and magnetician, Professor Arthur Schuster, states as his opinion: "I believe that no material progress of terrestrial magnetism is possible until the magnetic constants of the great ocean basins, especially the Pacific, have been determined more accurately than they are at present. There is reason to believe that these constants may be affected by considerable systematic errors. It is possible that these errors have crept in by paying too much attention to measurements made on islands and along the seacoast. What is wanted, is more numerous and more accurate observations on the sea itself." Furthermore, the superintendent of the United States Coast and Geodetic Survey, Mr. C. H. Tittmann, says: "there is no doubt in my mind that a survey for that purpose would result in obtaining data of great and permanent value and that it should be undertaken."

Additional quotations could be given; the above, however, are representative and show sufficiently the great importance of the proposed work and the fruitful results that may confidently be expected. It is the hope that upon completion of the magnetic survey of the North Pacific, the means will be forthcoming for extending the survey so as to include other oceanic areas. An effort will furthermore be made to secure the interest and cooperation of all civilized countries, so that we may look forward to the completion of a general magnetic survey of the accessible portions of the globe within about fifteen years. Thanks to the awakening and renewed interest in magnetic work shown on all sides, I fully believe that this hope will be realized.

The matter of prime consideration in magnetic work at sea is the elimination of the effects resulting from the ship's own magnetism as due to her construction and equipment. Such effects are especially troublesome to eliminate when it is proposed to obtain not only the magnetic declinations at sea, but also the other magnetic elements (the dip and the intensity of the magnetic force). The plan, therefore, to be attempted this year, as worked out by Mr. G. W. Littlehales, hydrographic engineer of the United States hydrographic office and consulting hydrographer of the department terrestrial magnetism of the Carnegie Institution, is in brief as follows: "to charter a wood-built, non-magnetic, sailing vessel of about six hundred tons displacement, which starting out in summer from San Francisco shall pursue a clockwise spiral course embracing the entire North Pacific ocean. The object of planning such a course is to gain continuous advantage throughout the survey of the dynamical agencies of the atmosphere and the ocean, in passing in succession into each of the five-degree quadrangles into which the chart[1] is divided and in which observed values of the three magnetic elements need to be obtained.

"The seasonal shifting of the permanent centres of barometric pressure will cause a variation from month to month of the conditions of wind and current that are represented on this particular chart, but if the departure from San Francisco be taken in the summer, the chain of meteorological events will contribute toward the maximum progress over the course, passing thence along the west coast of America to the vicinity of the Calapages Islands, thence across the Pacific in latitude between two and three degrees north, thence along the eastern side of the Philippine archipelago and the empire of Japan, thence eastward in about latitude fifty-two degrees north, thence to the latitude of San Francisco, and thence continuing through the series of areas, bounded by parallels of latitude and meridians of longitude each five degrees apart, lying next on the mid-ocean side of the circuit last made, and proceeding gradually and by successive circuits into the central region of the North Pacific."

The total length of the course marked out is about 70,000 knots; however, each of the first circuits practically closes at San Francisco, so that if it is found that the method pursued is not the best, the work can readily be terminated or modified. From enquiries made, it would appear that the entire work of observation and reduction can be accomplished in three years. The cost per month of the field work, inclusive of all expenses and services, will approximate fifteen hundred dollars ($1,500). Counting eight months of continuous service per annum, the total annual outlay is estimated at about twelve thousand dollars ($12,000).

This project as result of careful consideration and solicitation of expert opinion is believed to be thoroughly feasible. It permits of useful comprehensive results being immediately obtained, and is one which can be interrupted without any important waste of antecedent expense, whenever circumstances may render a discontinuance or a modification of the original plan advisable.

The region it is proposed at present to survey fortunately contains magnetic observatories in requisite number and proper distribution for furnishing the necessary corrections to be applied to the observed magnetic elements in order to reduce them to a common epoch. Thus continuous records of the magnetic variations required for this purpose will be available

[1] Director, Department of Terrestrial Magnetism, Carnegie Institution, Washington, D. C.

[1] The course to be followed was shown in red ink on a U. S. hydrographic office pilot chart of the North Pacific.

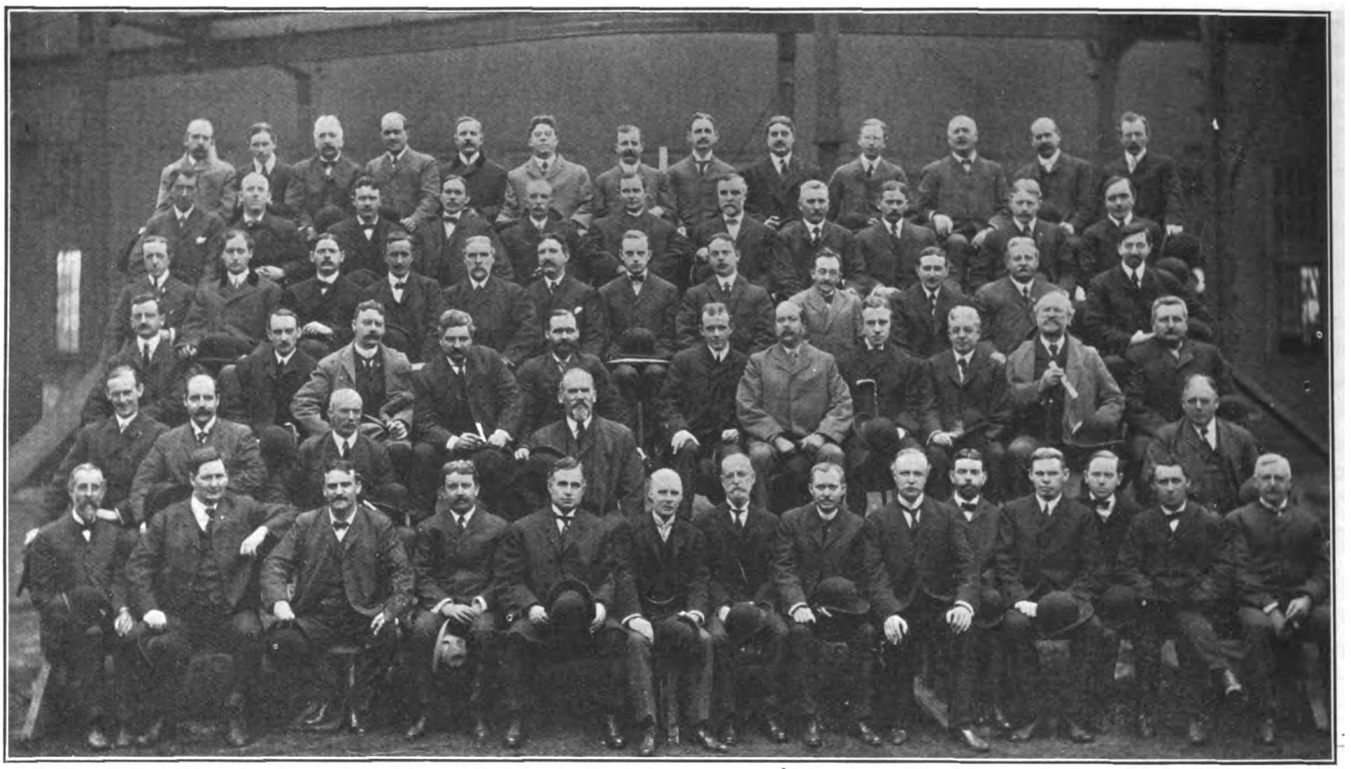
Digitized by Google

from the following stations: Sitka, Mexico, Honolulu, Manila, Shanghai, Tokio. In addition, it is hoped that there may be soon a magnetic observatory in California or vicinity for lending effective cooperation, and that the German government will continue its magnetic observatory at Apia throughout the period of the survey. Also excellent opportunities for controlling instrumental constants and obtaining required additional data will be afforded by stations on the coasts and on islands.

It should also be pointed out that the plan of the courses as mapped permits ready adjustment of the observed quantities for closed areas, in accordance with the potential hypothesis, and it may even permit to a certain degree the testing of the accuracy of this assumption, though as regards the latter more can be said at the end of a year's work.

While it is not anticipated that any marked irregularities in the distribution of the earth's magnetism will manifest themselves over the deep waters of the Pacific, it may confidently be expected that in the neighborhood of the islands and along the coasts distortions and irregularities will be revealed. With the aid of the results of the detailed magnetic survey of the United States and Alaska, opportunity will therefore be afforded of studying the effect of the configuration of land and water upon the distribution of the magnetic forces. The first circuit, passing as it does along the American and Asiatic coasts, will yield especially interesting results in this respect. Thus, for example, along the Aleutian Islands marked local disturbances will be disclosed. Reports are received frequently from mariners in this region regarding the unsatisfactory behavior of the compass; it is, therefore, greatly to be desired that a systematic magnetic survey of the waters in this region be made.

Additional information regarding the expedition will be given later.



SALESMEN AND HEADS OF DEPARTMENTS, ALLIS-CHALMERS COMPANY, MILWAUKEE, WIS.

The Personnel of the Allis-Chalmers Company.

The large group photograph herewith shows some of the members of the sales force of the Allis-Chalmers Company, as well as some of the officers and heads of departments who attended the meeting of the Allis-Chalmers salesmen recently held at the Reliance works of the company at Milwaukee, Wis.

The accompanying key will lead to the ready identification of each member of this group. A number of the men present have been the subject of personal reference in these columns from time to time. All are very prominently identified with contemporary progress in engineering and are well known throughout the engineering fraternity.

1—James Tribe. 2—G. C. Forgeot. 3—A. Niedermeyer. 4—W. J. Sando, manager pumping engine department. 5—W. H. Whiteside, general manager of sales. 6—W. J. Chalmers vice-president and treasurer. 7—B. H. Warren, president. 8—A. M. Mattice, chief engineer. 9—Arthur Warren, manager of publicity. 10—B. A. Behrend, chief engineer of electrical department. 11—C. C. Tyler, general superintendent. 12—W. M. S. Miller. 13—Ervin Dryer. 14—F. F. Coleman. 15—James Ashworth. 16—H. A. Allen. 17—W. W. Nichols, vice-president and secretary. 18—J. F. Harrison, manager flour mill machinery department. 19—Almon Emrie, superintendent Milwaukee works. 20—W. G. Starkweather. 21—J. R. Jeffrey. 22—C. J. Printz. 23—H. S. Mitchell. 24—I. L. Skeith. 25—G. C. Henry. 26—Robert Mulford. 27—J. C. Buckbee. 28—H. Woodland, assistant treasurer. 29—Clemens Herschel, manager hydraulic turbine department. 30—C. A. Burns. 31—H. L. Wells. 32—Franklin Wharton. 33—H. V. Croll. 34—G. L. Tifft. 35—J. D Millar. 36—W. C. Trout. 37—M. C. Millar. 38—W. A. Wood. 39—H. Schifflin. 40—J. A. Milne, comptroller. 41—H. S. Pell. 42—G. S. DeWein. 43—H. J. Holden. 44—M. J. Furlong. 45—George T. Thomas. 46—W. E. Dodds, superintendent of construction. 47—Richard Hoppin. 48—H. C. Helvey. 49—Albert Hoppin. 50—A. J. Gates, superintendent of Chicago works No. 1. 51—George L. Fisher. 52—W. N. Tanner. 53—Richard Barnard. 54—F. W. Greenleaf. 55—H. S. Mallalieu. 56—H. I. Keen. 57—J. O. Watkins. 58—R. J. Glendenning. 59—G. F. Collins. 60—R. D. Tomlinson. 61—C. A. Derby. 62—G. A. Berg. 63—J. C. M. Lucas. 64—W. O. Everett. 65—H. A. Hammil. 66—D. T. Jones.

Digitized by Google

SERIES ALTERNATING ARC LIGHTING.[1]

BY E. P. WARNER.

During the past three or four years the very extensive introduction of series alternating arc lighting in the United States and Canada for the illumination of streets and public places has called for studious consideration of conditions and results. Valuable experience has been gained and it is gratifying to find that substantial advance has been made in both the reliability and cost of operation. Looking back at the old direct-current arc generators of a few years ago, with their very limited capacity and high cost for maintenance, and comparing them with the large direct-connected generators of the present day with their high efficiency, practically unlimited capacity, compactness and simplicity, the station engineer, and indeed all financially interested, can not fail to appreciate that in the series alternating system of arc lighting we have the practical solution of a number of problems, since, first, we may build our generators to any desired capacity; second, we may greatly reduce the floor-space required; and third, we may cut down cost for attendance and repairs.

REQUIREMENTS OF A MODERN SYSTEM.

The conditions which confront the engineers and others responsible for the welfare of large municipalities are such as to call for most earnest and careful study, and not the least exacting to meet are those pertaining to the lighting. What system shall we install and how shall we install it, are the questions for which answers must be found. The engineer or station superintendent is called on to consider the different system and plans of installation from the standpoints of reliability of operation, cost to install and cost to operate—in doing this he is sometimes hampered by local conditions, but, as a rule, is free to carry out his own ideas and make his own selection of a system.

In many of our large cities the lighting systems at present in use, a number of which has been installed within the last ten years, are so far from filling the demands of economy and certainty of operation that it will not be long before the increased service and reduced cost demanded will bring about their replacement by systems more fully filling all requirements.

In the series alternating arc lighting system of to-day we have a most practical, I may say beautiful, means by which the necessary electrical energy can be supplied to the different sections of a large city. Instead of a large number of small lighting stations scattered about the city, with their attendant nuisance of smoke, noise and dirt, their high cost to maintain and operate and many other objectionable features, we can have large stations located at a considerable distance from the city, where land would be comparatively cheap; also condensing water and fuel. From this station supply mains at high pressure can be run to any desired number of distributing stations equipped with transformers and regulators. Such a station would be practically noiseless, smokeless and, in fact, free from nearly all the objections that can be made to the present direct-current lighting station. Again, the cost of installation can be brought below that of the small separate stations and the cost to operate very considerably reduced. There is suggested by this system a practical solution of the problem of the smoke nuisance; we may some day have large stations located some distance from the city equipped with smokeless furnaces from which the city will receive its supply of light, heat and power.

PRACTICAL ARC LIGHTING.

In the past we have heard much regarding the relative lighting efficiency of different classes of arc lamps; the change from an open arc system to the alternating enclosed arc system often brings up the question of comparative intensity of light. Lighting committees and station managers must be satisfied regarding that point before they can make an intelligent selection of a system. The old commercial standard open arc lamp of 450 watts or 2,000 nominal candle-power, as adopted by the National Electric Light Association, has been an accepted standard for many years. Lamps of lower wattage have been used extensively, but the 450-watt lamp has come to be pretty generally recognized as best adapted for street lighting.

A 450-watt alternating enclosed arc lamp is fully equal to the old open arc direct current for street illumination in respect to the amount of light given, and far superior to it in the matter of lighting effect as demonstrated by the increased field of vision. The bright ring of light on the street and the dark spot under the open arc lamp are familiar to us all, but with the enclosed arc both are absent and a good average illumination of this field is obtained, which for the purpose of vision is much to be preferred. At a distance of 150 feet the light from the alternating arc fully equals that of the open arc and beyond that distance the difference is distinctly in favor of the former. I am here proceeding on the assumption that lamps are hung at the same height. We find, however, that the alternating lamp may be hung three or four feet lower than the open arc with a still further improvement in the effective illumination.

In the substitution of series alternating arc lamps for the open arc in tower lighting the results have been exceedingly gratifying. Lamps were used of about 420 watts at the arc with eighteen-inch metal shades, white enameled on lower surface. It was found that the light at and near the base of the tower was very much greater, while the general average lighting at a distance from the tower was fully equal to that given by the open arc. No adverse criticism of the conditions after the change was offered by the people living in the neighborhood, and a number of favorable comments were volunteered touching upon the increased steadiness and more uniform distribution of the light.

Central Station Equipment—In the equipment of a station for the operation of series alternating arc lamps, the choice of suitable switching and controlling devices becomes an important matter; not that these details are extraordinary in number or complication, but for the reason, as often happens, that there are several good ways of doing the same thing.

A switchboard should have a system of stab-switches, one for each of the two terminals of a circuit, so arranged that it may be transferred from one system of supply to another, and so that any circuit can be readily disconnected from its source of supply. The first provision is made with a view to permanency of operation of a circuit. Failure of a transformer or regulator should not compel the shutdown of a circuit for more than a very short length of time, and a simple means should be provided for bringing into service a new source of supply. This is ordinarily an extra regulator and transformer properly installed and connected to the switchboard, held ready for use in emergency. In very large installations it is necessary to have a number of such extra transformers and regulators, with connection buses running the entire length of the board, thus permitting the connection to any arc circuit by means of stab-switches. Transfer buses for interchanging the circuits are not used in the present practice to any great extent, it being found unnecessary to make trans-

[1] Paper read at thirteenth annual convention of the Northwestern Electrical Association, Milwaukee, Wis., January 18, 19, 20, 1905.

Digitized by Google

fers very frequently or to any very great extent. A good reliable ammeter should be installed in each of the arc circuits. This need not be an expensive instrument, but should be one reasonably accurate and allowed to always remain in circuit while same is in use. Where very high potentials are used, it is customary to use a current transformer to actuate the ammeter in order to insulate it from the circuit and thus render it safer to handle, and to reduce the liability of crossing to other instruments on the board. Where aerial lines are used, a good system of lightning arresters should be installed at a point on the circuits immediately after entering the station. It has been found desirable to disassociate the lightning-arrester installation entirely from the switchboard proper, making it a special feature of the installation.

Transformers and regulators can be installed in a separate room or building, if desired, and generally speaking this is a good plan for the reason that it more or less isolates different portions, thus reducing the risk of injury or loss from fire. The transformers used in many of the systems, where inductive regulators are employed, are of the ordinary constant potential type and may be either oil insulation or air cooled. Generally speaking, the efficiency of these transformers can be as high as that of ordinary constant potential transformers used with non-inductive load, and the combined efficiency of a transformer and inductive regulator supplying an arc circuit is fully equal to that of the best form of tub-transformer under any stage of load.

The usual practice to-day in the matter of regulators is to have all regulators of full-load capacity so that they not only serve as current regulators for small changes of load and voltage, but act also as safeguards in case of a complete short-circuit of an arc-circuit. Arguments have been advanced against this practice, claiming that it was unnecessary to provide such an extreme range of regulation and that safety from short-circuits could be provided by more inexpensive means. Whether this is true or not has not been demonstrated by any very extended practice. Of all automatically operating regulating devices known in the engineering world to-day, the inductive regulator stands forth as one of the most perfect pieces of electrical mechanism known in the art. It has been found so perfectly reliable in its operation that the average station manager will question the accuracy of his ammeter before he will that of the regulator. It is not an uncommon thing to hear the remark made when the current reads wrong, that "the ammeter must be off." A regulation of current to within one-tenth of an ampere, under quite extreme fluctuations of load and voltage, is easily accomplished and this so quickly that there is scarcely a noticeable fluctuation of the lighting power of an arc lamp in series, even when ten or fifteen per cent of the lights are extinguished at once. It is not a good plan to have regulators retarded by the action of the dash-pots or other retarding devices. Perfect reliability of action is best secured by leaving the coil free to move, and relying on the magnetic conditions to bring about stability in action and position.

In the mechanical construction of regulators it should be observed that they are strong, accessible, free from excessive friction in all moving parts, readily adjustable to load conditions and capable of operation at high efficiency and power-factor, and operate with little if any noise. Electrically they should be well insulated, sufficient ventilation should be provided in all portions of the windings to prevent accumulation of heat and excessive high temperature in any part.

Outside Construction Details—One of the most prolific sources of trouble on outside construction work lies in the lamp suspensions. Where lamps are suspended from span wires crossing the street, it is not uncommon to find a very poor insulator interposed between the lamp and the span wire. This often puts the full strain of the extreme voltage of the system between a lamp and the suspension wire to ground. Heavy leakage and general low line insulation are the results of such construction. In many cases the line loop extending from the pole to the lamp is brought to a small wooden cross-arm equipped with small porcelain knob insulators at each end, and from there extends downward to the terminals of the lamp, which is in turn insulated from the small wooden cross-arm by a single porcelain insulator, the cross-bar itself being practically uninsulated from the span wire when the lamp is hoisted into position. Under these conditions the line insulation is secured only by the small porcelain knobs at the end of the cross-bar and the surface of the cross-bar itself which in ordinarily stormy weather is entirely insufficient. Under the conditions described above, the lamp itself is also subjected to severe strain by reason of its insufficient insulation from ground. It is all very well to say that a series alternating arc lamp should be able to withstand a breakdown test to ground without damage to the insulation of 7,000 to 8,000 volts alternating current applied for one minute, but it has been demonstrated in practice that lamps which will stand this breakdown test when new and clean will fall very short of it after but a short period of actual service. The only practical way of securing good line insulation is to place a thoroughly good insulator above the lamp and above the cross-arm, if one is used, so that the line itself, as well as the lamp, will be insulated from the span wire. Under such conditions the necessity for any high-voltage test between the live parts of a lamp and the case is done away with and is, in fact, undesirable. No superintendent of a station, who has proper regard for the safety of the lives of his employés, will permit them to handle a live lamp while standing on the ground, and no matter what breakdown test a lamp may be said to stand, the employé should not place reliance on it, but should as thoroughly insulate himself from ground as though the lamp were alive in all parts.

Again, the argument may be raised that there is liability of the lamp coming in contact with some other wire and thus grounding the case. I think there are very few of you who would fail to realize that this is a very remote contingency indeed, and you will also realize that a breakdown test such as that outlined above would fall very short of preventing trouble in such a case, particularly after the lamps have been in service for some time.

Arc Lamps—In the early stages of development of the different series alternating systems, certain manufacturers attempted to make use of arc lamps in which the regulation was controlled entirely by shunt-winding, claiming that by using such a lamp they were enabled to secure very high efficiency with sufficiently good regulation. As time passed on lamps of this type were gradually eliminated from the field, and as an illustration of the survival of the fittest, we have to-day practically only the differential type of lamp, the shunt-controlled being a failure.

Now a few words as to the desirable features in the series alternating arc lamp.

1. It must be one in which the operating parts are few and of such design and construction that stock repair parts can be used in repair with facility and despatch.

2. The parts should be so assembled and attached as to facilitate removal and re-

Digitized by Google

placement, also to give ready access for examination and adjustment.

3. All material used should be of a character to best resist the action of the elements and ordinary wear and tear encountered in actual service. The quality of material used and its application should be a matter of careful scrutiny to the station manager, as therein lies part of the secret of reliable and continuous service. Do not let first cost be the prime factor in your choice of a lamp.

4. Regarding the performance of the lamp and the safeguard provided, I should say that it should be capable of regulating the voltage of the arc to the point adjusted within three volts in either direction, and when operated with a current of seven and one-half amperes, should give a life, with each trimming, of approximately ninety hours.

It is found in practice that variation in the sizes of the carbons, in the character of the core, in the density of the material used in the carbons, will considerably affect the length of life. This means that care should be taken in selecting carbons, though I think no greater amount is necessary than has been found to be the case with the old open arc systems. In all lamp mechanism there is a certain amount of lost energy; in a well-constructed lamp this loss should not greatly exceed twenty watts. The efficiency may vary somewhat with the different makes of carbons and the different stages of the burning, but the figures given above are a fair general average. The power-factor of an arc lamp varies with the quality of the carbons, with the position of the arc in the globe and also with the character of the cored material. It has been found possible in experimental practice to maintain an alternating arc, using two cored carbons of very rich material, at unity power-factor, but such results have not as yet been obtained commercially. With the ordinary carbons obtainable to-day, a general average power-factor of ninety at the arc can be obtained reliably. In estimating this power-factor we find the ratio of the true watts at the arc to the apparent watts. It has not been customary for purchasers to specify any stated performance in respect to the power-factor of the arc; they have contented themselves with the power-factor of the lamp as a whole. This, of course, is somewhat lower than the power-factor of the arc, varying in different makes of lamps. It is, however, a very important feature which must be considered by the purchaser and he should be careful to exact definite performance in this respect.

The durability of a lamp and the adaptability for long continuous service depend to some extent on the parts of the regulating mechanism remaining at a reasonably low temperature. In order to obtain such low temperature parts must be made of sufficient size and superficial area to readily dissipate the heat generated by losses in the mechanism and the heat which may be conducted from the arc. The rise in temperature by such mechanism after a run of twelve hours, should not exceed fifty degrees centigrade above the temperature of the surrounding air.

In the choice of enclosing globes it has been found that ordinary clear glass gives the greater general satisfaction, the distribution of diffusion of the light from the arc effected by the globe being practically as good as from any form of tinted or opalescent globe after one or two hours' operation. Practically the only reflector which can be used in combination with the alternating arc lamp is one placed above the arc and outside of the outer globe. I would say in this connection that certain users are making use of the reflector without employing an outer globe, making use of special tempered glass inner globes, which will stand the action of the elements very well. This is even accomplished in tower lighting, where the force of the wind is very great and rain and snow have full sweep. Reflectors which are very small can not be applied practically to the alternating arc, for the reason that the upper lobe of light is so disposed that it can not reach a reflecting surface which is very close to the central line of the lamp. This is true of the conditions in all positions of the arc in the enclosing globe. Effective reflectors can be and are applied which are so nearly flat discs that they do not offer much surface to the wind and hence do not cause the lamps to swing badly. The point has been raised that owing to the deposit of semi-opaque material upon the inner surface of the globe, the lighting efficiency is very materially reduced after a run of forty or fifty hours and that the deposit of this material is determined to some extent by the character of the gas cap or plate which closes the upper end of the globe. We have found this to be true to a very limited extent and that the lamp which had the metal gas cap conducted away the heat from the inner globe more readily and caused the lamp to run with a lower temperature in the inner globe, and thus to deposit less of the objectionable material upon the surface of the globe. Another result of this lower temperature was the fact that none of the material so deposited was burned into the surface of the glass, as is often the case in lamps where a high temperature is maintained. It follows, therefore, that the general lighting efficiency of a lamp with a metal gas cap is considerably higher than without.

It has come to my attention in a number of cases that the central station men engaged in making preliminary tests of arc lamps have endeavored to compare the different lamps offered on the basis of number of hours' service with one trimming. In this they have apparently lost sight of the fact that the number of hours' service with a trimming is controlled solely by the carbons and the amount of light given, the lamps having, in fact, nothing whatever to do with the result. In order to give a good steady light of sufficient power, it is necessary to admit a certain amount of air to the enclosure, restricting this amount only to the point where high lighting efficiency and reasonable length of life are obtained. We reach a point in this line of research where one line crosses the other; there we must stop, knowing that a displacement in either direction will give unsatisfactory results.

In this connection I should say that nearly all the reputable manufacturers of arc lamps of the present day are practically unanimous as to the most desirable conditions in respect to the above features, and it is only the unprincipled dealer who tries to influence the customers by claims for greater life than can be given with satisfactory lighting power.

In conclusion, I should say the results which have been achieved in series alternating arc lighting during the past three years are of a character to give confidence to the central station engineer that the system has come to stay, and is one which may be safely adopted with all the probable contingencies which may arise in the near future well in view.

The National Electric Light Association.

Considerable progress is being made by the committee in charge of arrangements for the next convention of the National Electric Light Association. This convention will be held in Denver and Colorado Springs, Col., during the week of June 6. The members of the committee in each of these cities are working under considerable strain to make the convention a remarkably successful one. The side trips that will be arranged for the entertainment of the delegates will cover those sections of the state that afford opportunity for inspecting electrical plants and construction in a mountainous country.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Nantes Transfer Bridge.

A transfer bridge has been put into service recently at Nantes, France. There are a number of these transfer bridges in Europe, but this bridge is built on somewhat different lines from those generally followed. The bridge is of cantilever construction, with an intermediate girder, the short end of the cantilever being held down by a counterweight. There are no oblique strains on the tower. The suspension is by hinges at the top of the tower, and therefore the load on the latter is vertical. The main span is 458 feet long, and the ferry is suspended by means of cables a short distance above the water. The height from the water to the bridge is 164 feet. The ferry itself is thirty-six feet in length and thirty-nine feet wide. It has a roadway and two side cabins. The pilot's cabin is built on the roof of one of the others, and from here the motion of the ferry is controlled. The transverse movement is given by a traction cable, which winds around an electrically driven drum. The driving machinery is located at one end of the bridge, all machines being in duplicate. The traffic across this transfer bridge amounts to 100,000 persons per month, and 800 carts and carriages.—*Abstracted from Engineering (London), January* 13.

The Metric System of Weights and Measures.

A general discussion of the advantages of the metric system, and of the advisability of adopting it in this country, is here given by Dr. A. E. Kennelly. The arguments used are already fairly familiar to those who have paid any attention to the proposed change. Some points of interest, however, are not so generally known. The metric system is by no means new in France. It was introduced in 1795, in the third year of the French republic, and its introduction was greatly aided by the upheaval of long-established customs in France at that time. During the first half of the nineteenth century France stood almost alone in the use of this scientific system. In the latter half of the nineteenth century other countries of Europe adopted the system. Spain did this officially in 1849, Italy about 1850, Portugal in 1852, Switzerland virtually in 1851 through the medium of a transition system, and finally in 1877, when the complete system was finally adopted. Germany and Austria-Hungary officially adopted the system in 1871; Russia semi-officially in 1900. Denmark alone in continental Europe declined to make the change, but it is said that the system is much used there, owing to the influence of neighboring countries. The pressure upon the continental European nations to adopt a uniform international system has been considerable, owing to their relatively close geographical association, but beyond this and the advantages claimed for the metric system, no pressure has been brought to bear. It is said that the change was brought about in a few weeks in Germany in the large cities, and in the country districts during the course of a few months. Within a year the metric system was practically universal. The manufacturers continued to use their old tools and standards, but they now graduated their products in the new units. As machines were renewed they were changed so as to produce even metric sizes. From this it is seen that the transition in this country should not require any machine, tool or piece of apparatus to be discarded. The difficulty of transition would not be in expensive new machinery, it would lie in translating the old familiar sizes made by existing machinery into the new units. The trouble would be intellectual rather than material. It is thought that it is only a question of time when the metric system will become universal.—*Abstracted from the Popular Science Monthly (Lancaster), February.*

Direct Wheatstone Working between England and Teheran.

Interest was aroused recently by the announcement that direct working had been established between Liverpool and Manchester, England, and Teheran, Persia. In this article Mr. T. W. Stratford-Andrews describes the workings of this line. Morse working had been employed throughout the company's system until it became inadequate to cope with the increase in traffic, and the Wheatstone system was experimentally introduced on the Odessa-Teheran section in the summer of 1897. It may be well to mention that this line, leaving London, passes through Lowestoft, England, and under the North sea to Emden, Germany; through Berlin, Warsaw, Odessa, Tiflis, Tauris to Teheran. Experiments with the Wheatstone system showed that signals could be transmitted satisfactorily in both directions along this section, but it was soon found that the Odessa office became blocked with messages intended for the west. The next step was to introduce the Wheatstone system between Odessa and Emden. As soon as this section of line was in satisfactory operation the two sections were amalgamated, making the operation between Teheran and Emden direct. This action then blocked the Emden office with westward messages, so that it became necessary to introduce the Wheatstone system on the Emden-London section. Over this section the Morse duplex had been worked, but full advantage of this system could not be taken because of the difference in time, as the bulk of the homeward traffic comes through during the daytime, and the out traffic comes by night. Before the Wheatstone system could be introduced on this section it became necessary to convince the English and German postal authorities that no disturbance would be caused by induction on the through wires in the Norderney and Borkum cables. Experiments were made with the Wheatstone system which satisfied the government officials at both ends, and the system was then introduced, and automatic transmission between Emden and London begun. Experiments were next made to test direct working between London and Teheran, a distance of about 3,800 miles. These were so satisfactory that this method of operation was adopted on January 1, 1903, and has been used since that time. During the last few weeks, as already stated, direct transmission from Teheran to Manchester and Liverpool has been going on. In addition to the general discussion of the system, Mr. Stratford-Andrews describes in detail the equipment of the London station.—*Abstracted from the Electrician (London), January* 13.

An Installation of Electric Power for a Quebec Mine.

The Eustis mine at Capelton, province of Quebec, has been a steady producer for over thirty years of sulphur, copper and precious metals. Recently alterations have been made in this mine, and electric power introduced. Heretofore steam has been used. Now a neighboring water power has been improved by means of a dam fifteen feet high. Two turbines have been installed, each rated at 450 horse-

Digitized by Google

power, which are directly coupled to 200-kilowatt Westinghouse, three-phase, 2,200-volt, twenty-five-cycle, revolving-field generators. Power is transmitted from the power-house to the mine, a distance of about two miles, by three bare copper wires. At the mines all the machinery is driven by means of induction motors. The air-compressor is operated by a 200-horse-power, 2,000-volt, constant-speed induction motor. The hoisting apparatus is placed at the end of an adit tunnel 1,000 feet long, through which power is conveyed by three weatherproof wires, which are protected by being placed in a heavy wooden box bolted to the wall of the tunnel. The hoist has two cast-iron drums, seventy-two inches in diameter and forty-eight inches long, mounted on separate shafts. Both drums are driven by one motor through a double set of gears. The drums are connected to the motor by friction clutches of the Lane type, provided with band brakes and indicators which show the position of the skips in the shafts at all times. The motor for the hoist is a 150-horse-power, three-phase, 2,000-volt, variable-speed induction motor, with a normal speed of 480 revolutions per minute. The controller has seven stops. It operates by introducing resistances in series with the rotating part of the motor. The mine incline varies from forty-five degrees to twenty degrees. At present it has a depth of 2,000 feet. The normal speed of the hoist is 500 feet per minute, but it has been found in actual practice that it takes only from five to six minutes for the skip to come from the bottom of the mine, discharge its load, and return again to the bottom. The crushing plant consists of a twenty-inch by six-inch Farrell crusher, with a set of gear rolls for reducing the hard ore to fine. These two machines are driven by a fifty-horse-power, 200-volt, slow-speed induction motor, supplied through two twenty-five-kilowatt transformers. When in operation these two machines absorb about forty horse-power, and crush eight tons of ore. In case of accident to the electrical machinery the hoisting apparatus may be operated by steam, simply by coupling an engine to each end of the countershaft hoist, an operation which requires very little time. —*Abstracted from the Canadian Electrical News (Toronto), January.*

Electric Tramways in Hongkong.

Since the island of Hongkong (China) became a British possession sixty years ago, its rise in importance as a commercial centre and naval stronghold in the far east has been rapid. The island is some eleven miles long, and from two to five miles broad, and consists mostly of lofty, uncultivated hills. In 1902 an ordinance was passed by the legislative council of Hongkong, authorizing an electric railway to be laid down by the Hongkong Tramway Electric Company. Work was commenced in May, 1903, and completed last July. The total length of track is fourteen and one-half miles, which is laid in nine and one-quarter miles of route. The gauge is three feet six inches. Girder rails are used, weighing eighty-six pounds per yard. The lines within the city of Victoria have, for the most part, centre-pole construction, but the eastern portion of the route, being outside of the city limits, has side-pole construction. With the exception of two short branch lines, the line runs parallel with the seafront. Owing to the varying nature of the ground, three forms of permanent way construction have been adopted. Where the ground was solid the rails were embedded on a concrete beam eighteen inches wide and six inches deep. Where the ground was not so good, a bed of concrete six inches deep, and seven feet three inches in width, extending under the whole track, was adopted; and for doubtful ground, which had been recently reclaimed from the sea, this concrete bed was made eight inches deep. The length of the brackets on the centre-pole construction does not exceed two feet. Where the side poles are used, the arms are about six feet long. The trolley wire is divided into half-mile sections by means of section insulators, and at each of these points the main feeder cables are tapped and current taken to supply the section. This is accomplished by running feeders through a feeder pillar containing the necessary switches and fuses. The feeders themselves are laid on the solid system underground. The generating station is placed on the side of the Bowrington canal, from which water for condensing purposes is obtained. The location is about midway of the system. Coal is delivered in barges. The equipment consists of two water-tube boilers of the Babcock & Wilcox make, and two Yates & Thom horizontal, cross-compound engines with a maximum output of 557 horse-power. These are directly connected to two Dick, Kerr & Company continuous-current railway generators. There are twenty-six single-deck motor cars, ten being of the combination type, and sixteen of the open, cross-bench type. Each car is mounted on a Brill truck, and equipped with two twenty-five-horse-power motors. Before the introduction of electric traction into Hongkong, the rickshaw, drawn by a Chinese coolie, was the principal means of locomotion. Of these nearly 2,000 were licensed for hire, in addition to a large number owned privately. While rather slow, the rickshaw is hard to beat for general convenience. The fight for supremacy between this and the new system will be watched with interest.—*Abstracted from the Electrical Review (London), January* 13.

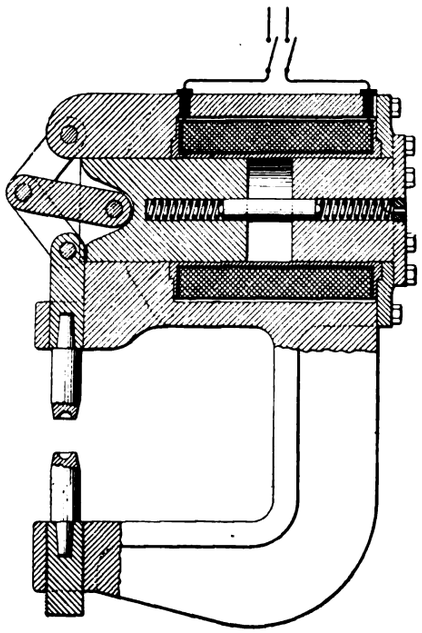
Safety Devices for High-Tension Lines.

Ever since the high voltages have come into use in France efforts have been made to perfect certain safety devices which will prevent accidents from such lines, in case the wires should be broken. One of the most successful devices of this kind has been brought out by M. E. Giraud. This is here described, and an account given of recent government tests of it. The principle of the device is to actuate at the distributing station a cutout which will disconnect the line from the switchboard as soon as the rupture takes place, and before the wire, as it falls, comes within twelve feet of the ground. The device consists of a metal attachment fastened to the top of a porcelain insulator. In the upper part of this attachment is a tube, through which the wire runs loosely. At one end of this metal attachment there is a bracket, to which is hinged a long forked arm. This fork would hang down, but as long as the line remains unbroken it is held up by a hook fastened to the wire. Vertically below the main wire is a second wire, running also to the station, or it may be grounded. Should the line break, the tension on the wire is unbalanced. The latter then tends to slip through the sleeve, being drawn by the neighboring unbroken span. This movement of the wire draws the supporting hook toward the insulator, and thus throws down quickly the forked arm, bringing the latter in contact with the auxiliary wire. As soon as this contact has been established the disconnecting device at the station is opened. A device of the same character, though constructed somewhat differently, is attached to the auxiliary wire, and when the latter breaks a fork is thrown upward, making contact with the upper wire. For protecting trolley wires the trolley ear is mounted on a pin, and just above it are placed two contacts, against which the unbroken spans of wire are drawn should an adjacent span break. These devices have been subjected to somewhat severe tests, which, it is thought, demonstrate that they suppress all danger to persons who come in contact with a fallen wire. They disconnect the broken wire permanently, and this is done before the wire has fallen far enough to come in contact with passersby.—*Translated and abstracted from L'Industrie Electrique (Paris), January* 10.

Digitized by Google

Electrical Patents.

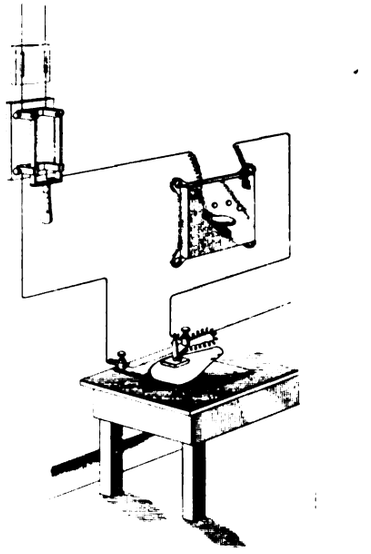
An electromagnetic metal-working machine, which has particular relation to machines in which the metal-working operation is effected by a single stroke, has been devised and patented (779,427, January 10) by Francis W. Jessop, of Cleveland, Ohio. The object of the invention is to enable the application to this purpose of an electromagnet, and consists in combining with the die, punch, shears, hammer, or other tool, an electromagnet and power-multiplying mechanism intermediate thereto, whereby a powerful blow may be imparted to the tool, and also in certain general and specific details of construction relating to the construction and arrangement of the magnet, multiplying mechanism, containing and support frame, and auxiliary mechanism. In carrying out the invention a frame is employed having an angular arm extending below its main body. The body of the frame is cored from end to end and in this cored-out portion is inserted a spool. A solenoid is carried by the spool. An annular cover-plate, secured to the frame, abuts against the spool, and a core extends within the spool and through the cover-plate being secured to the latter. A plunger also extends within the spool and is adapted to be actuated by the solenoid. Springs are seated in orifices in the core and plunger. A bridging-piece, between the core and plunger, extends into the orifices and engages the springs. A guide is located in the overhanging portion of the body, and a ram is movable in this guide. Toggle-links are connected respectively to the frame and ram. A link connects the plunger with the joint of the toggle. A tool is employed secured to the end of the ram and another tool is secured to the angular ram.



ELECTROMAGNETIC METAL-WORKING MACHINE.

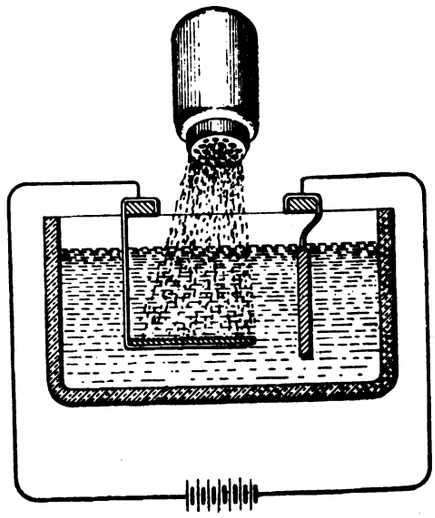
Edgar F. Price, of Niagara Falls, N. Y., has assigned to Union Carbide Company, of the same place, a patent (779,733, January 10) recently obtained by him for an improvement in electrodes. In a process hitherto employed, the chemical compounds are produced by electrolyzing solutions with an electrode of a metallic carbide, which will react chemically on the electrolyte, especially one of calcium carbide. It is, however, difficult to obtain pieces of calcium carbide of sufficient size, regular shape and uniform composition to serve as practical electrodes, and the reaction between the carbide and aqueous solutions is apt to disintegrate and destroy the electrode. The present invention is a composite electrode of the carbide and binder, the preferred binding agent being a coked hydrocarbon or carbonaceous substance, such as bituminous coal. To produce these electrodes, the carbide for example, calcium carbide, is crushed and mixed with the binding agent, for example, five to twenty-five per cent by weight of pulverized bituminous coal and a small amount of water-free tar or pitch. The mixture is then moulded into the desired form by a press or by forcing it through a die and cutting the product into lengths. The moulded pieces are then baked at a temperature sufficiently high to decompose the hydrocarbons and drive off the volatile matter, converting the bituminous coal and tar into coke. This coke not only binds the particles of carbide into a hard coherent body, but increases the electrical conductivity, and is especially useful when electrodes are employed in aqueous solutions, as it retards the action of the water upon the carbide, although its porosity permits the water to finally react on all of the carbide. The porosity may be decreased by saturating it with a liquid hydrocarbon or carbohydrate and again baking it, thereby depositing more carbide in the pores.

David C. Sprecher, of Kansas City, Kan. (779,810, January 10), has patented an improved electric branding apparatus, a one-half interest in which he has assigned to John E. Doran, of Kansas City, Mo. The object of the invention is to produce apparatus of this character whereby a clean and clear cut brand may be made upon hams, bacon, and other meat and substances, without seriously affecting the same and with either a low or high voltage. The apparatus is also portable and of convenient, simple, strong and durable construction. In the embodiment of the apparatus, a pair of conductors are employed and a switch for making and breaking a circuit through these conductors. A rheostat is in circuit with one of the conductors. An electric fuse is also in circuit with one of the conductors. An electrode is located at one end of one of the conductors, and a movable electrode is electrically connected to one end of the other conductor. This movable electrode is in the form of a branding-iron, having its contact-surface of materially less area than the first-named electrode.



ELECTRIC BRANDING APPARATUS.

Edson G. Case, of Niagara Falls, has devised and patented (779,639, January 10) a method of fastening abrasive material to metal bodies. The object of the invention is to produce an abrasive surface which is practically inherent in the

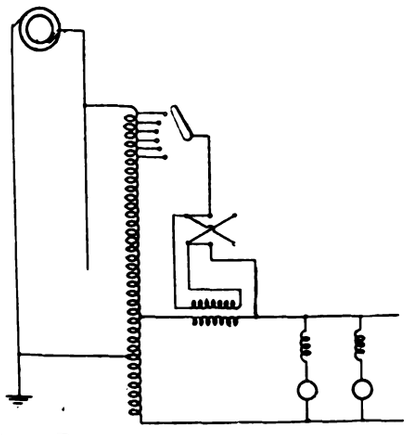


METHOD OF FASTENING ABRASIVE MATERIALS TO METAL BODIES.

Digitized by Google

body to which it is applied, whereby the wearing qualities and permanency of the grinding or polishing surface are materially increased. To this end, the invention consists in the mechanical application of an abrasive substance—such as carborundum, emery or equivalent material to the surface or surfaces of a metal body and at the same time subjecting the body to an electroplating process, whereby as the abrasive is being applied to the body a metal coating is deposited over and around the surfaces of the abrasive deposit and metal body and permanently fixes the abrasive material thereto, it being understood that under this treatment the abrasive particles become embedded into and fastened by the plating.

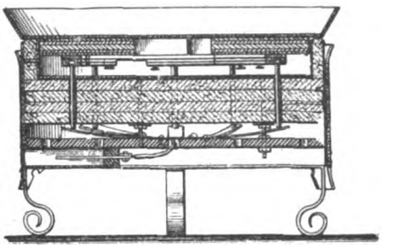
A single-phase alternating-current system of distribution is the subject-matter of a patent (780,048, January 17) recently granted to Paul M. Lincoln, of Pittsburg, Pa., and assigned by him to the Westinghouse Electric and Manufacturing Company. The object of the invention is to provide a system in which energy may be transmitted at high voltages and delivered through voltage-regulating apparatus to translating devices at lower voltages and in which the differences of potential between the grounded conductor from the source of energy and



SINGLE-PHASE ALTERNATING-CURRENT SYSTEM OF DISTRIBUTION.

the respective terminals of the translating devices are reduced to safe and limited values. It has been proposed to operate by means of alternating-current energy motors of the commutator type of construction having series-connected armature and field-magnet windings, and being similar in many respects to ordinary direct-current motors. Various systems have been devised for transmitting energy at high voltages and supplying it at variable low voltages to motors at the points of consumption. In one system for this purpose the difference of potential between one terminal of the motors and the grounded conductor is the same as the potential difference between the motor-terminals, whereas in the system comprising the present invention, the differences of potential between the respective motor-terminals and the grounded conductor are only one-half that between the motor-terminals. With this arrangement the stresses on the insulation and the dangers incident to the operation or repair of the motors are materially reduced.

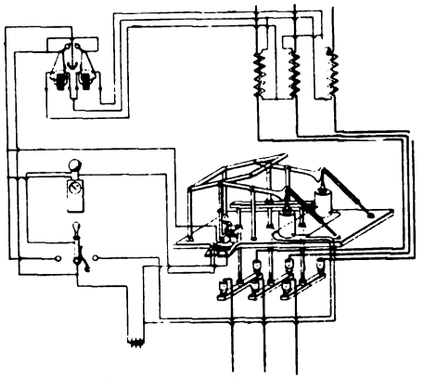
An electric stove in which heat is generated by passing an electric current through resistance wire has been patented



ELECTRIC STOVE.

(780,228, January 17) by Earl H. Richardson, of Ontario, Cal., and he has assigned, by direct and mesne assignments, his entire interest in this invention to the Pacific Electric Heating Company, of the same place. One object of the invention is to provide for flexibility of that part of the stove which supports the dish or other object to be heated, and to employ for this purpose a plurality of contact or heating-blocks which are resiliently supported so that they will accommodate themselves to any unevenness in the bottom of the dish or object. Means are also provided for preventing heat from escaping in any direction except toward the top of the stove. The resiliency of the supporting heat-blocks is such that when the dish or other object to be heated is placed upon the supporting-blocks they are depressed by the weight of the dish, so that it rests upon the rim of the stove which further confines the heat and prevents escape of heat radially from under the bottom of the dish. The heat-block in which the resistance wire is arranged is of novel form, being so constructed as to take heat from both sides of the resistance wire, the top plate of the block receiving its heat directly from the wire, while the heat of the top plate of the heat-block is further augmented by receiving heat indirectly from the bottom plate and core, the ends of the heat-block receiving heat directly from the ends of the core and indirectly from the bottom side of the wire by conduction from the bottom plate, the bottom plate itself receiving heat directly from the bottom faces of the wire. The heat-blocks are so supported that when the weight of the dish or other object being heated is removed from the blocks they will assume a position which will cause them to separate slightly from the edges of the stove and form cracks or spaces which allow air to circulate around and under the heat-blocks to prevent excessive heating of the blocks when the dish is off. This is of special value in cases where the dish has been removed and through negligence the current has not been turned off from the heater. A central hole is formed in the heat-blocks which is adapted to receive a lug on the dish. The lug on the dish serves to hold the dish from displacement on the stove and the weight of the lug causes a close contact between the dish and heat-blocks to be maintained.

A circuit-making and breaking relay, having for its object to provide a simple and effective device of this character which shall be suitable for operation by either single or polyphase alternating currents in order to make and break either direct or alternating-current circuits, has been devised and patented (780,024, January 17) by Frank Conrad, of Edgewood Park, Pa., who has assigned the patent obtained thereon to the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. In the embodiment of the invention a



CIRCUIT-MAKING AND BREAKING RELAY.

polyphase, alternating-current circuit-making and breaking relay is provided, comprising two electromagnets, each of which is provided with an unsymmetrically located closed coil. Two metallic sectors have their upper ends pivotally supported and their lower ends project respectively into the fields of the magnets. The edges of these sectors are provided with contact-pieces, and a stationary contact-terminal is located in the paths of movement of these sectors and their contact-pieces. Adjustable counterweights serve respectively to normally hold the sectors and their contact-pieces in open-circuit positions.

Digitized by Google

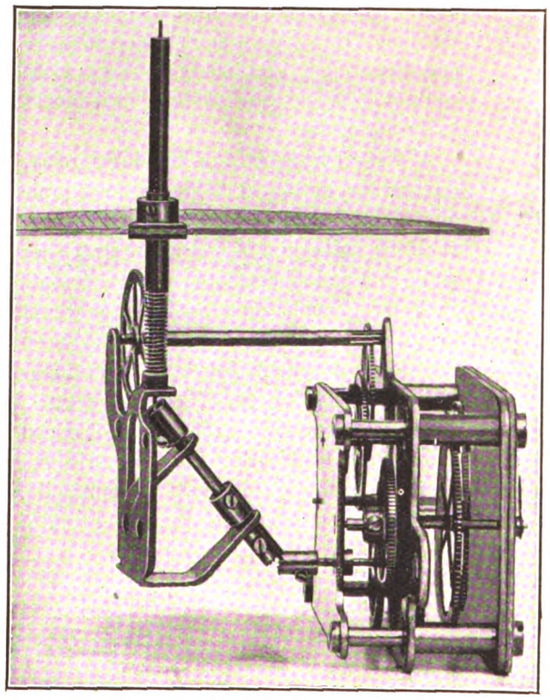
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Stanley Rotated Jewel-Bearing Wattmeter.

The Stanley Instrument Company, Great Barrington, Mass., has just placed upon the market a new recording wattmeter for alternating-current circuits, which contains many novel and remarkable features.

The principal characteristic of the meter, in which it is a radical departure, is that the jewel bearing upon which the disc-shaft pivot rests and turns is itself turned or rotated by the train gearing, so that a new jewel surface is constantly automatically placed under the disc-shaft pivot whenever the disc moves. The meter derives its name of rotated bearing wattmeter from this distinctive device, the details of which can be readily appreciated from the accompanying illustration.



STANLEY ROTATED JEWEL-BEARING WATTMETER.

The jewel-carrier shaft is connected with the train gearing by a bevel gear; whenever the train moves the jewel-bearing shaft must also move. The turning of the jewel bearing is a positive action operated by the system of gears constituting the train-registering mechanism. At every movement, no matter how slight, of the train gearing a new spot or point of highly polished jewel surface is automatically brought under the disc-shaft pivot. Consequently during each and every portion of a revolution of the pivot a new jewel bearing is automatically supplied.

The gear in the train-registering mechanism which rotates the jewel-bearing shaft is so arranged that the disc-shaft pivot can be in contact with the same spot or point of the jewel surface only one time during approximately 1,800,000 revolutions of the disc-shaft pivot; the equivalent of 1,000 kilowatt-hours.

For example, in a ten-ampere, 110-volt meter the disc will make 1,800,000 revolutions while the jewel bearing makes one revolution; and the train will register 1,000 kilowatt-hours.

For whatever period of time a jewel in a stationary-bearing meter will remain uninjured by the wear of contact friction, the same jewel in a rotated bearing must necessarily endure approximately 1,800,000 times longer without effect from friction contact.

In the rotating-bearing meter, no spot or point of the jewel surface can remain in contact with the pivot end long enough at any one time to be roughened in the slightest degree; because the pivot end is constantly moved from contact with any given spot on the jewel surface by every movement, no matter how slight, of the train gearing.

In the Stanley rotated-bearing wattmeter the jewel is so shaped that the disc-shaft is maintained in exact perpendicular alignment when the meter is connected up in service; there is not possible any effect upon the disc-shaft from side thrust.

The jewel is cup-shaped and the jewel-supporting shaft is at an angle of about forty-five degrees to the vertical disc-shaft. This places the jewel in an oblique position under the pivot and the pivot is thereby brought in contact with the junction between the sides and bottom of the cup, this junction being shaped in the proper curve.

The jewel carrier is a separate piece on the upper end of the rotatable bearing shaft and can be quickly and easily removed and replaced by any one, a skilled mechanic and special tools not being required.

The new Stanley rotated bearing wattmeter retains many of the characteristic features of the very popular Stanley meters of previous manufacture.

It is about the same size and of the same general appearance as the Stanley model "H" wattmeter, and retains the balanced thrust principle whereby is obviated the vibration of the disc by the alternating-current fluxes.

In addition to the elimination of hammering by the balanced thrust construction, the new Stanley rotated bearing wattmeter is further provided against the effects of vibration by having its disc-shaft pivot supported by a long spring contained within the disc-shaft, which, for the purpose of containing the spring, is a tube or hollow bore for a large proportion of its length. The upper end of the spring is in contact with the upper end of the hollow bore, the lower end being in contact with the head of the pivot. All the weight of the disc and its shaft rests upon the spring which is of sufficient length to make it impossible for any vibration to be transmitted from the disc to the pivot end. The spring removes from the pivot all vibration, whether of service, transformation, handling or premises.

The meter is shipped ready for connection into service, no clamping or adjustment of staff or pivot end being required for transportation or handling. The spring support of pivot and disc-shaft is so arranged that when the meter is in any position except when connected for service the pivot end is held firmly to the bearing and can not be jarred away or separated from it. When set up in position for service the disc floats smoothly and freely on its bearing. The pivot end is removable and can be taken off and put on again, or replaced by another, within a very few moments; no skilled mechanic or special tools being required.

In the new Stanley rotated bearing wattmeter the disc is 0.035 of an inch thick; five inches in diameter; the torque obtained is fifty millimetre-grammes; the ratio of torque to weight is ten to seven. It is, therefore, possible to obtain most easily extreme accuracy on the smallest loads as well as with the heaviest loads.

The maker cites the following example

Digitized by Google

of the permanence of adjustment of these meters: a rotated bearing wattmeter of ten-ampere, 110-volt capacity has been in circuit constantly, day and night, during more than eight months. It has been operated during this period without any brake magnet; the disc and its shaft rotating, consequently, at the high rate of speed of about 660 revolutions per minute. During this period and under these conditions the disc and its shaft pivot have revolved upon the rotated jewel bearing more than 150,000,000 times; registering the equivalent of 120,000 kilowatt-hours, representing a revenue earning, at the rate of ten cents per kilowatt-hour, of $12,000. At the end of that service, and during every week of the period, it was impossible to discover the slightest change in accuracy on any load from twenty-five watts up to fifty per cent overload.

It is suggested by the manufacturer that these meters be tested by the purchasers for frictional conditions in the following severe method: before beginning the special test ascertain the accuracy of the meter upon any desired load at stipulated rate of disc rotation; or determine the light load accuracy by comparing the full-load rate of disc rotation with the light-load rate which will denote the initial internal friction (if any) in the meters; then remove the brake magnet and let the disc spin around under full load for an hour, or a day, or a week; then replace the brake magnet and without change of pivot end or jewel test the meter again in the same manner to ascertain the difference (if any) between rate of disc rotation at light load or at full load or fifty per cent overload.

Another valuable feature of the new Stanley rotated bearing wattmeter is that it can be adjusted quickly and easily for any frequency from forty cycles to 133 cycles. This is accomplished by the magnetic shunt or bridge principle constituting an important part of the construction of all Stanley meters. The adjustment is of the simplest character, being merely the sliding of a contact on a small rheostat conveniently accessible; the change in resistance of the rheostat changes the reluctance of the magnetic circuit and thereby adapts the shunt system to alternating current of different periodicities.

The new Stanley wattmeter is made with two terminals, one at bottom, the other at top, for connection through the meter of the two wires of a two-wire circuit, or of the two outside wires of a three-wire circuit; the shunt connection being provided within the meter.

Where it may not be convenient or desired to take both wires of a circuit through the meter a shunt connection from one wire can be made with the upper terminal connection.

Another characteristic is the complete magnetic shield separating the shunt and current elements from the brake magnet system. This magnetic shield is the diaphragm or iron plate comprising the entire top or front of the case. Between this cast-iron front plate and the back plate of the case are contained the shunt and current coils which are thus completely enclosed in an iron box.

The brake magnet and brake adjusting screws, the disc-shaft and the train system are mounted on the side of the shield plate opposite from the coils. The excessively strong fields which necessarily result from short-circuits from lightning, or from abnormal voltage, or current overloads of any kind, are confined within the iron box and the brake magnet system is thus effectively shielded.

The cover of the meter is of all glass, one piece, or of metal with glass windows, as may be desired. The method of fastening the cover to case is patented and consists of a sealing band or ring which not only forms part of the means of connecting the case and cover, but also completely covers the joint between them.

The cover can be held to the case through the medium of the encircling band by the sealing wire which passes through a hole at one side of the band down along the side of the case, across behind the back of the meter, thence up the opposite side of the case to a hole in the other side of the band. Besides fastening the cover to the case this wire is a perfect and easily made sealing of the moving parts of the meter while permitting ready access to the terminal boxes to make connections to the circuit wires. The cover is additionally held to the case, through the medium of the sealing band, by the covers of the two terminal boxes. The cover is separately sealed, by wire and lead seal, to and around the case; each terminal box is also separately sealed, by wire and lead seal, through the heads of the screws fastening the terminal box covers to the case. By this method of enclosing and sealing, the meter with the glass cover can not be tampered with without immediate visual evidence of the interference. The meter can be connected with or disconnected from the circuit in the terminal boxes without removal or unsealing of the cover.

Standard Wiring for Electric Light and Power.

Mr. H. C. Cushing, Jr., author of the handbook, "Standard Wiring for Electric Light and Power," as adopted by the fire underwriters of the United States, has brought out the 1905 edition of this book, completely revised up to date. In revising this new edition Mr. Cushing was successful in securing the services of F. E. Cabot, secretary of the Boston Board of Fire Underwriters, and chairman of the electrical committee of the Underwriters' National Electric Association, to assist him with that part of the book which treats of the underwriters' rules and requirements. Mr. George T. Hanchett, consulting electrical engineer, assisted in checking up and revising the many valuable tables and formulæ to aid practical wiremen and contractors in determining the proper sizes of wire for all manner of construction work, for both direct and alternating currents. The new edition is handsomely bound in a flexible leather cover, and makes a complete and accurate pocket companion for the practical electrical engineer, central station man, wireman and contractor. It is also an accurate guide for the architect and builder, who are now called upon to embody not only in their own specifications but in their plans provision for electrical construction in all manner of buildings.

German Electrical Industries.

According to the report of United States Consul-General Guenther, Frankfort, Germany, the published statement of last year's business operations of the General Electric Company, of Berlin, shows a marked improvement. The gross profits were 10,439,000 marks ($2,484,482), against 6,984,000 marks ($1,662,192) in the preceding year. The number of employés was 27,487. The company declared a dividend of nine per cent on its share capital and carried large amounts over to reserve funds and to payments to directors and to benevolent endowment funds for employés. The company has a turbine manufacturing department which works on American designs, and has also established a department for making automobiles which has already turned out a large number of autos for passenger and freight traffic. The business lookout is excellent, as the company has orders for a long time ahead at very remunerative prices. The report of this company may be accepted as an indication of a general improvement of Germany's electrical industries.

Digitized by Google

The Switch Type of the Queen Decade Portable Testing Set.

Queen & Company, Incorporated, Philadelphia, Pa., has made a number of modifications to the switch type of the Queen decade set, which is shown in the accompanying illustration. Some of the valuable features in this instrument are as follows: contacts are made with very thin laminated phosphor-bronze brushes; the handles for moving the switches are double, allowing two decades to be moved without changing the position of the hand. This permits the operator to give his entire attention to the direction taken by the galvanometer needle when the switches are being changed. By the present arrangement of switches the resistance of the main stud does not enter into the circuit. The galvanometer is extremely sensitive, and is provided with a shunt having three shunting values. In one bridge-arm a standard condenser of one-third microfarad is mounted; also a ten milli-henry induction coil. In connection with this standard condenser a telephone receiver of extremely sensitive form is provided with each decade set.

SWITCH TYPE, QUEEN DECADE PORTABLE TESTING SET.

Provision is made in the set allowing the Wheatstone bridge, Murray loop, Varley loop, and all other usual tests to be easily and quickly executed. Switch and binding-posts are provided to permit the use of an outside galvanometer. Ten special dry cells are mounted in the case, and give an electromotive force of fifteen volts. They provide an exceedingly high-current capacity, each cell supplying about eight amperes on a short-circuit for a short time. A special interrupting alternating-current device is mounted in the lid. This makes it possible to test resistance, capacity or inductance in connection with the telephone receiver.

The maker states that these sets are in great favor with the telephone companies on account of the rapid adjustment of the resistance which is obtained. It is only necessary to watch the galvanometer and turn the switches until the galvanometer shows a deflection. This is much more rapid than the old method of changing plugs, and a balance can be obtained in about one-fifth of the time.

The instrument is described in detail in circular No. 403, issued by Queen & Company.

Switchboard Ammeters and Voltmeters.

The Troy Electrical Company, Troy, N. Y., is bringing out a new line of voltmeters and ammeters for switchboard work. In these instruments the working elements consist of a permanent magnet and two stationary coils, together with a pointer and its pivot, provided with a small steel vane. The moving elements in the instruments are made as light as possible. The steel vane is 0.01 inch in thickness, and 0.75 inch in diameter. The material in the vane is of specially selected stock in reference to its magnetic permeability, and its freedom from magnetic lag. No scale or oxide is allowed to remain on its surface. Vigilance in this respect gives an instrument perfectly reliable in its indications under all conditions, whether they be ascending or descending. The indications are caused to be dead-beat by a small aluminum damper.

SWITCHBOARD AMMETER.

SWITCHBOARD VOLTMETER.

The electrical losses are small, a 125-voltmeter having a resistance of over 3,000 ohms. This resistance is formed of an alloy having a very small heat coefficient, and renders the indications very accurate, irrespective of changes in temperature. The insulation of all instruments is subjected to a breakdown test before leaving the factory.

Special tungsten steel is used in the permanent magnet. In magnetizing, the steel blanks are subjected to a magnetic flux of maximum density, with the idea of affecting the molecules most difficult of movement; the theory being that actual movement of the molecules takes place. The direction of magnetic flux is then reversed, and its density is lessened, thus demagnetizing the magnet until but twenty per cent of the original charge remains. This twenty per cent is assumed to be due to the molecules most difficult to move, and therefore most permanent. Final ageing is done by subjecting the magnets to a long series of extreme temperature changes. The length of steel entering into the magnets is over fourteen inches, and the air-gap is very short, being bridged by the steel vane of the moving element.

All conditions necessary for permanent calibration are met. Hundreds of instruments have been made under this plan, and have shown no change whatever, despite constant and severe use. The instruments are extremely sensitive, and the scale is open throughout its length. By a peculiar arrangement, relatively to the poles of the permanent magnet and of the stationary coils, the scale is caused to be more open in the portions most used. This is an important point in a switchboard instrument which has to be read from a distance.

The instrument is on an iron base and has a carefully fitted iron cover. These form a good magnetic shield, and errors due to proximity of bus-bars or other conductors are thus eliminated. The diameter of the base is eight and one-half inches, and the length of scale, six inches.

American Electrical Fuse Company to Build New Factory.

The American Electrical Fuse Company, which now has factories at Chicago, Ill., Milwaukee, Wis., and Adrian, Mich., is to build a new factory at Muskegon, Mich. The other works will all be removed to the new plant. The company will employ 400 men.

Digitized by Google

A New Vertical Engine.

The American Blower Company, Detroit, Mich., is placing on the market a new vertical engine which possesses some unique features of great merit. The engine is shown in Fig. 1. It is fully

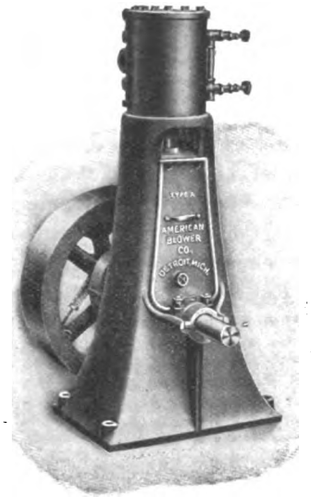


FIG. 1.—NEW VERTICAL ENGINE.

enclosed, preventing foreign matter getting into the working parts, the latter being easily accessible, however, upon the removal of the enclosing plates.

One feature of the engine is its oiling system, which is different from any of the usual methods, and has proved very successful. Every frictional surface runs on oil, there being no positive contact be-

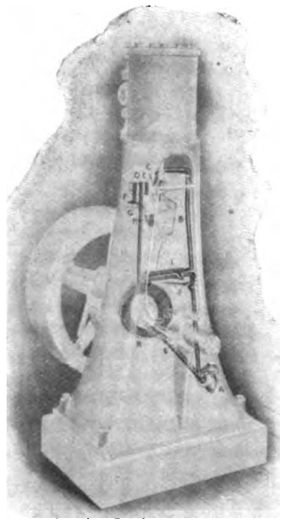


FIG. 2.—THE OILING SYSTEM.

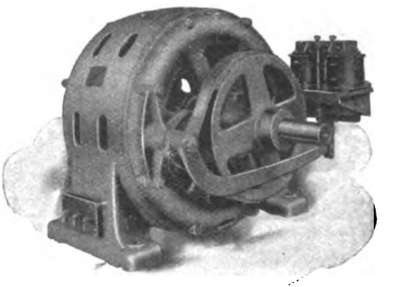
tween metals. This has the effect of almost eliminating wear. The oiling is done by the engine itself, and each bearing has a stream of oil.

The operation of the oiling system is shown in Fig. 2. An eccentric K on the shaft drives the plunger L, the oil pump A forcing the oil up through the tube B into the small strainer C. From C it drips into an oil box, through the bottom of which four tubes project. On one side of each of these tubes there is a slot, so that when the oil box contains only a small amount of oil, each tube can take only its proper proportion. In case the box is full, all the tubes get more oil in proportion to the increased height. One of the tubes F and one on the opposite side, not lettered, apply oil to the guides, the oil dripping into a small oil trough G, from which it runs into the bearing through an oil-hole. The cross-head pin is supplied by the tube marked E, the oil dripping into the cup H, filling the cavity between the bolt and inside of cross-head pin and the oil grooves. The oil dripping from the cross-head is caught in two pans attached to the inside of the cover. From these oil pans it runs down the inside of the cover, dripping into a cup in the top of the main bearing cap. Instead of using oil grooves at the top and bottom of the main bearing, the oil is supplied at the sides where bearing is cut away at the joints. The crank pin is oiled with the tube marked D, which discharges into a crank oil ring inside the eccentric, which, in turn, discharges into the crank-pin oil-tube, the oil flowing across the crank-pin bearing. The crank-pin oil-ring, in addition to its independent supply, catches the drip from one end of the main bearing. The eccentric is oiled by the drip which it catches from the other end of the main bearing. No difficulty has been experienced in catching the oil thrown off the eccentric strap, and splash from the cross-head has also been easily taken care of. A portion of the oil, as it drips back into the bottom of the frame, falls on an oil filter and is thoroughly cleaned and purified. The oil has an opportunity to cool and settle in the large base of the engine.

The manufacturer experimented on this engine in its own shops for some years. An engine was adjusted and filled with oil on March 10. Up to July 15 no adjustments of any character had been made, and no oil added, except to feed the sight-feed lubricators. The engine had been running from fourteen to sixteen hours a day, driving a blower, and after a lapse of over four months needed no adjustment or fresh lubricant. The maker states that the engine is particularly valuable for adaptation where continuous operation is required, or where peculiarly heavy duty is called for, as in operating dynamos, blowers, pumps, etc.

New Alternating-Current Solenoid Brake Applied to Induction Motors.

The accompanying illustration shows a new set for crane or intermittent service, developed by the General Electric Company, Schenectady, N. Y. The apparatus comprises a fifty-horse-power motor for crane service, and a new alternating-current solenoid brake. These sets are now in use in many large plants, among which may be mentioned the following: Great Northern Railroad shops, St. Paul, Minn.; Haggie Brothers' boiler shop, Joliet, Ill.; Edison Illuminating Company, Detroit, Mich.; Canadian Copper



INDUCTION MOTOR EQUIPPED WITH SOLENOID ALTERNATING-CURRENT BRAKE.

Company, Copper Cliff, Ontario; Canadian Pacific Railroad, Winnipeg shops.

For some time the utility of the induction motor has been handicapped for crane service for the reason that no electric brake had been developed for alternating currents which would operate successfully under all working conditions. This new line of brakes has been built for various potentials and frequencies in four sizes, to be used with motors rated from one to seventy-five horse-power.

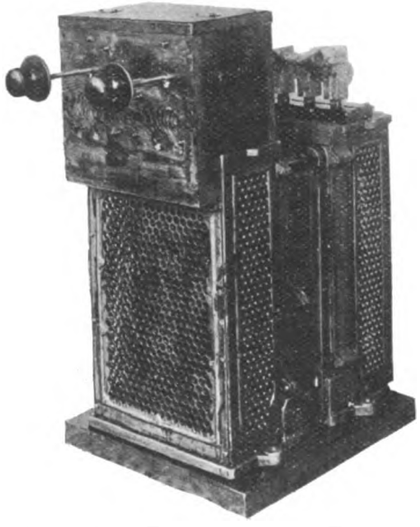
The magnetizing power is small and remains practically the same for all sizes. The momentary input at the full air-gap, which is governed by the type of brake, varies approximately in proportion to the weight of the movable core. The actual power required to operate the magnet is practically negligible. The solenoid works almost instantaneously, and the power consumed is required only for a moment. The power required to operate the brake thus amounts practically to the magnetization only, which is the power consumed by the solenoid when the motor is in operation. In tests made upon nine cranes operated by this General Electric induction motor and solenoid brake set, at the Great Northern Railroad shops, the switchboard ammeters at no time indicated any increase of current when the brake operated, neither was there any noticeable shock on the generators or engines.

The mechanical arrangement of the sets is very compact, the brake lever being placed close to the end of the motor underneath the shaft, with its fulcrum supported on one side and the solenoid on the other side of the motor.

Digitized by Google

Transformer Outfits for Thawing Pipes.

The manifest superiority of electricity as a thermal agent in thawing frozen pipes, and the field for this service that awaits development, has attracted a considerable amount of attention on the part of central station managers, many of whom have improvised outfits for this purpose. There has arisen a very general demand for thawing outfits that shall have a range in capacity to cover all ordinary requirements; shall be portable, easy to connect and moderate in price, and to meet this demand the Westinghouse Elec-



FRONT VIEW, TRANSFORMER FOR THAWING FROZEN WATER PIPES.

tric and Manufacturing Company has designed the two new types of transformers.

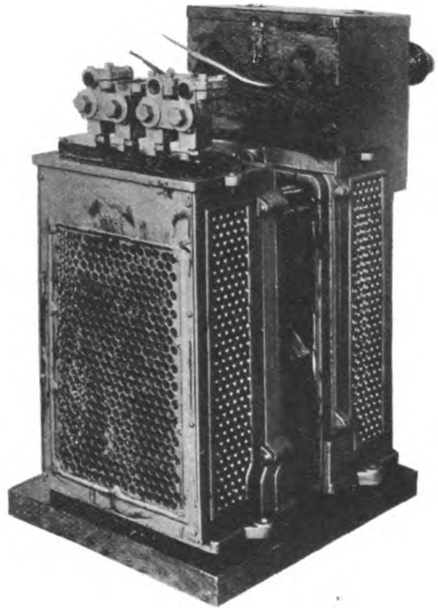
The larger of the two outfits (style No. 40,810, shown in the illustrations) weighs complete with transformer, switchboard and base 750 pounds. It occupies a floor space two feet four inches by one foot ten inches, and is one foot seven inches in height. A link in the top of the transformer case affords a means of lifting the outfit, and if desired truck wheels may be attached to the wooden base.

The transformer may be operated satisfactorily on circuits varying from 1,800 to 2,500 volts. The low tension is arranged to deliver approximately 500 amperes for several hours at an electromotive force from fifteen to fifty volts. By a simple change in connections, the windings may be arranged to deliver about 1,000 amperes at voltages from eight to sixteen, for thawing large mains whose resistance is generally low. It is suitable for thawing anything from a one-half-inch pipe to a one-foot main.

The transformer is generously designed, and will deliver large overloads for short periods of time. The windings are air-cooled. The insulation is not injured by rain, snow or ordinary abrasion. There are no moving parts to get out of order, and the entire outfit is contained in a single unit.

A light but substantial switchboard is mounted upon the high-tension end of the transformer. The switches are of the enclosed plug type, such as are used upon high-tension arc light circuits, and permit a variation of the low-tension voltage, and consequently the current supplied to the pipes. The switches are so arranged that it is impossible to make a wrong connection.

Transformer outfit (style No. 46,811) is smaller and is particularly adapted for thawing service piping about dwelling-houses. It is light, of such proportions as to make it easy to handle, and is mounted in a wooden box provided with a handle and shoulder strap. It has a capacity of 200 amperes at potentials up to twenty-five volts for one hour. It is arranged for operation off a nominal 200-volt circuit, but can be supplied for any other primary voltage to as low as 200



BACK VIEW, TRANSFORMER FOR THAWING FROZEN WATER PIPES.

volts. The voltage regulation and current control are obtained through plug switches in the high-tension circuit.

When desired, these outfits are furnished with a current-measuring device, so that the operator may know the amount of current that is being used.

Small Dynamos and Motors.

The R. M. Cornell Company, Syracuse, N. Y., is placing on the market a line of direct-current dynamos and motors, consisting of experimental machines from the smallest made, up to one kilowatt for commercial purposes. It is expected, that when completed, this line will show the largest variety of small machines on the market, especially in small sizes for experimental purposes.

The accompanying illustration shows the "Wonder" dynamo, which is the smallest generator of its kind on the market. It has an output of about twelve watts and is wound for a number of different voltages. In bringing out this machine it is the aim of the maker to put on the market a small generator following in every detail the construction of a large commercial machine. Among its special features are a laminated armature, adjustable brushes, large and strong com-

NEW TYPE OF SMALL DYNAMO.

mutator, heavy interchangeable bearings. In its construction it is the aim to make the machine complete and efficient; to be used where a small amount of current or power is required and especially desirable in connection with experimental work. As a motor it will operate running light on about two watts of current and with sufficient battery will do considerable work. It is also wound to run in series on a 110-volt lighting circuit. All parts are interchangeable and made of the best material. The company will offer for sale its different size machines as fast as it has them ready for the market.

A Device for Measuring the Wear of Trolley Wires.

A device for measuring the wear of trolley wires has been invented by M. A. Harrich, of Ratisbonn, Germany. It consists of a tube, which may be slipped over the wire, and which is pressed against the latter by a thumb-screw. The tube carries a disc and a system of levers, which, when the device is attached to a wire and then rotated, will trace the outline of the wire, multiplied 100 times, on a sheet of paper attached to the disc. A view of such a diagram is given, showing that the wire is worn away at the lower part, leaving practically a flat surface.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRIFICATION OF SOUTH AMERICAN RAILWAY SYSTEM—The only horse-traction system now operating in Buenos Aires, South America, and owned by the Ciudad de Buenos Aires Traction Company, is to be changed to an electric line. Work is to be commenced at once, and it is expected that the change will be completed by June of the present year.

POWER PLANT FOR THE BLACK HILLS—It is announced that the Black Hills Electric Light Company, at Deadwood, S. D., and the Belt Light and Power Company's plant, at Lead, S. D., will be consolidated. J. J. Henry, a Denver business man and projector of electrical enterprises, is said to be interested in this proposition. The plan contemplates a new installation at Pluma, to generate 5,000 horse-power.

MUNICIPAL LIGHTING PLANT FOR BUFFALO, N. Y.—At the meeting of the board of aldermen of Buffalo, N. Y., January 16, Commissioner of Public Works Ward was instructed to prepare plans giving the estimated cost of a lighting plant for the city of Buffalo, and the cost of maintenance. The time limit which was given for the preparation of this report was thirty days. Mr. Lewis Stockton, president of the Referendum League of the city, stated that the question would be decided by a referendum vote. It is expected that the city would have to be bonded for $6,000,000 in order to carry the idea through.

THE POWER PLANT OF THE CHICAGO DRAINAGE CANAL—Much interest is being manifested in the progress of the work of the sanitary district of Chicago, Ill., which is undertaking a system of electrical supply, the source of power of which lies in the Chicago drainage system. At the present time the channel excavation work is being prosecuted with great vigor. The plans have been prepared for the power-house, and a contract has been entered into for the water-wheels. Specifications are ready for the electrical equipment, but as there are interference proceedings relative to the placing of the contract for the water-wheels, the electrical specifications will not be contracted for until the complication is settled.

NEW ELECTRIC ROAD IN MEXICO—A company known as the Ferrocarril, Jalisco & Michoacan, *via* Chapala, has been organized at Mexico City for the purpose of building an electric road from Guadalajara to lake Chapala. The capital is said to be $1,500,000. The railroad is to be of the latest and best construction. After building the line from Guadalajara to lake Chapala it will run along the shore of the lake, crossing to Zamora, Michoacan. The company will have various branches in the states of Jalisco and Michoacan. The concessions have been secured, and during the past two years about $40,000 has been expended upon the preliminary surveys and other expenses. Among the officers are Carlos L. del Hoys, Zamora, president, and William V. Backus, vice-president and treasurer.

UNITED STATES STEEL CORPORATION TO EMPLOY ELECTRICITY ON ITS ORE-MOVING LINES—It is expected that the United States Steel Corporation will change the motive power on its two principal ore roads from steam to electricity some time this year. The roads to be changed are the Duluth & Iron Range, and the Duluth, Mesaba & Northern. These two systems are the chief transportation elements in getting iron ore from the mines in the Mesaba range to the lake ports. It is understood that the company will get its power from the Great Northern Power Company, which is proceeding with the work of construction on its power installation on the St. Louis river, near Duluth. It is claimed that there is available not less than 200,000 horse-power at this point. The initial installation, however, will be for about 30,000 horse-power.

THE EXTENSIVE PLANS OF THE BROOKLYN RAPID TRANSIT COMPANY—The Brooklyn Rapid Transit Company will make large expenditures within the next two or three years, looking to the improvement and extension of its already large property. Some of the changes are already in progress. The most important of these is the lengthening of all the elevated railway station platforms on the Fifth avenue & Bay Ridge and West End lines. This will permit the running of six-car trains instead of five-car trains during the rush hours. It will enable these two lines to carry back and forth to Manhattan 5,000 more passengers per hour than formerly. Another important improvement is the erection of a $6,000,000 power plant, with a capacity of nearly 100,000 horse-power. This plant will probably be built in the Williamsburg section of the borough of Brooklyn. Two hundred new cars of modern design will replace the cars now running over the new Williamsburg bridge. A considerable expenditure of labor and money is now going on in converting some of the rolling stock which the company owns at present, rendering this absolutely fireproof.

NEW YORK CITY MUNICIPAL PLANT TO USE WASTE FUEL—It has been announced that an experimental plant will be installed by the municipality of New York to furnish current for lighting the new Williamsburg bridge, connecting the boroughs of Brooklyn and New York. The proposition is to run the electrical plant in combination with a refuse destructor. The street cleaning department has operated an incinerator in New York city for over a year with results that appear to be satisfactory. If the plant is built upon the lines already under consideration there will be an excess of current generated. Possibly, some of this may be used in adjacent public buildings. The cost of erecting the plant is placed at $75,000. The Street Cleaning Department has advertised for proposals for the contract to build the incinerator. The incinerator will be located in the block between Tompkins and East streets, Manhattan, under the bridge structure, facing Delancey street, where the terminal of the bridge is. The specifications of the contract for the construction of the incinerator call for a building with a frontage on Delancey street of seventy feet, and with a total depth of 150 feet. No bid in excess of $27,000 will be received. The time allowed for the completion of the work is ninety days. The successful contractor will have to deposit a security of $15,000 to ensure the proper completion of the building. The bids will be opened at noon on February 15.

EDUCATIONAL.

THOMAS S. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY—The Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., in its bulletin for October, 1904, publishes an interesting short article on "The Application of the Temperature-Entropy Diagram to the Analysis of Gas-Engine Tests," by Frederick O. Willhofft, professor of mechanical engineering.

THE ARMOUR INSTITUTE OF TECHNOLOGY has recently been the recipient of a complete line of telephone protection apparatus which was donated to the institution by the Frank B. Cook Company, of Chicago. The institute has been preparing a four years' course in telephone engineering, and the opening of the present winter term found a large class of young men anxious to take up this line of work. The telephone laboratory has been equipped with a complete line of telephone apparatus, the larger manufacturing companies having donated very liberally to this department. The protection apparatus mentioned above consists of a large distributing frame completely equipped with all styles of protective devices manufactured by the Cook Company. A large supply of latest type heat coils, fuses and lightning arresters was included in this apparatus. Special testing devices and other apparatus necessary for experimental purposes accompanied the outfit. The distributing rack has been wired to two experimental switchboards which were given to the institute last year by the Stromberg-Carlson Manufacturing Company.

Digitized by Google

ELECTRIC RAILWAYS.

VINTON, IOWA—A franchise has been voted to the Vinton & Belle Plaine Electric Interurban Railway Company.

CHAMBERSBURG, PA.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company will extend its line from Pen Mar to Gettysburg. This will be one of the three trolley lines that it is promised to enter Gettysburg during the coming summer.

ITHACA, N. Y.—The contract for the immediate construction of the Cayuga Heights extension of the Ithaca street railway system has been let to the Syracuse Contracting Company. That firm has given a bond to complete the grading of the road on or before May 15.

BLOOMINGTON, ILL.—The stockholders of the Springfield & Northwestern Interurban Company have voted to issue $700,000 in bonds to cover the cost of construction and power-house for the line between Springfield and Bloomington, the power-house being in Lincoln.

EUREKA, CAL.—Another electric railroad for Eureka is assured, and the suburban lines to Arcata, ten miles to the north, and Ferndale, twenty miles to the south, will be constructed. J. E. Green and J. M. O'Brien, of San Francisco, have applied for a franchise, and will begin work shortly.

GOSHEN, N. Y.—On Thursday, February 23, at the court house in Goshen, Russell Wiggins, as referee, will sell to the highest bidder the Middletown-Goshen Traction Company's road. At the same time W. J. Groo, as referee, will sell to the highest bidder the Middletown-Bloomingburg electric road.

LAKE CHARLES, LA.—The Lake Charles Street Railway Company has been purchased by the stockholders of the Lake Charles Ice, Light and Waterworks Company for $20,000. The line is about a mile long and operated by mule power. The new purchasers intend to extend the line and equip it with electric power as soon as conditions permit.

NEW HAVEN, CT.—The New York, New Haven & Hartford Railroad has taken over another trolley line, the Berkshire street railway, which runs from Great Barrington, Mass., to Cheshire, about thirty miles. It paid about $800,000 for the road. The bonds are for three per cent for the first few years of their running, and for three and one-half per cent afterward.

NASHVILLE, TENN.—Local capitalists have purchased the rights, privileges and franchises of the Nashville & Columbia and Nashville & Galatin interurban road, and it will be pushed to completion. The road, which will be electric, will extend from Gallatin, Tenn., through Nashville to Mt. Pleasant, Tenn., a distance of about seventy-five miles.

VERSAILLES, KY.—The Woodford County fiscal court has granted to Clifford D. Bebee, of Syracuse, N. Y., a franchise and the right of way for an electric railway from Lexington *via* Versailles to Frankfort. The sum of $2,500 must be deposited in the county treasury in thirty days, to be forfeited to Woodford County if the road is not in operation by April 15, 1906.

CONCORD, N. H.—The men interested in the proposed Derry & Manchester Railroad Company, a bill for the incorporation of which has been presented in the legislature, are Walter M. Parker, W. J. Holt, Noah S. Clark, George H. Chandler, Harry E. Parker and Roswell Annis, all of Manchester; David F. Perkins, of Londonderry; Edwin N. Whitney and C. N. Greenough, of Derry.

DETROIT, MICH.—The Detroit United Railway is enlarging its power-house to accommodate an additional 2,000-horse-power unit with engines, boilers, generators and distributing apparatus. The company has contracted for fifty new double-truck cars, twenty-five of which will be built by the Brill company, and the remainder by the St. Louis Car Company. The total outlay involved is $400,000.

OMAHA, NEB.—A meeting of the directors of the Omaha, Decatur & Northern Interurban Railway Company was held recently at Tekamah, when J. B. Latta was chosen director, *vice* T. B. Gordon, resigned. A contract was entered into with C. B. Pierce and L. F. Wakefield, of Sioux City, for the construction of seventeen miles of road between Decatur and Tekamah. Prospects are reported as being very bright for the completion of this portion of the road by the first of October next.

ANDERSON, S. C.—The first annual meeting of the stockholders of the Anderson Traction Company was held January 10 and it was decided to mortgage the property of the system to the extent of $50,000 to secure funds to continue the work. The system is more than half completed and its affairs are in good shape. The work of construction has been considerably hampered by bad weather during the winter. The wires are now being strung, and it is announced that cars will be running at an early day.

WALLA WALLA, WASH.—E. S. Isaacs, of Walla Walla, has been granted a twenty-five-year franchise by the county commissioners for ten feet of the roadway on county roads near the city for the operation of an interurban motor line in connection with the street railway line which he purposes to operate in this city. It is likely that as soon as electric power can be obtained from the plant on the Walla Walla river Mr. Isaacs and his associates will begin construction of a street car line in Walla Walla.

BALTIMORE, MD.—The management of the United Railways Company contemplates the erection of another generating power-house on Eastern avenue, Baltimore, at the junction of the Back river and Steelton lines, and has sent out plans for a large structure to be built entirely of concrete. The drawings call for a building about fifty feet high, one story and two galleries. The structure will be about thirty by ninety feet, and will have a basement. It will be one of the first buildings in Baltimore to be constructed entirely of concrete.

MEMPHIS, TENN.—The Fort Smith, Ark., Light and Traction Company has filed an amendment to its charter increasing the number of directors from five to nine, and the capital stock from $1,000,000 to $1,600,000. The amendment also specifies that the holders of preferred stock shall be paid a fixed dividend of five per cent, the common shareholders to receive their dividend when the preferred stock has been given the amount due on it. Robert J. Grof, Isaac B. Mikewich and L. W. Jennings, of Chicago, have been named as new directors.

COLDWATER, OHIO—At a meeting held at Coldwater and attended by citizens from Celina, Ft. Recovery and St. Henry, Z. E. Hamburger, of Celina; B. B. Wilson, of Ft. Recovery; H. A. Beckman, of St. Henry; and H. C. Fox, of Coldwater, were selected as a committee to look up the most feasible route for a traction line connecting the towns named. Following is the route proposed by this committee: Celina to Coldwater, on line of right of way secured two years ago by Indiana promoters; from Coldwater to St. Henry, and from St. Henry to Ft. Recovery on one of two routes not yet determined. It is the object of this committee to secure the right of way and then dispose of it without profit to some responsible company that will build a road.

DELTA, COL.—The board of county commissioners has granted an electric road franchise to W. B. Stockham and Charles Pike. The road will consist of two separate lines, one of which will run from Delta to the Grand Mesa lakes, *via* Eckert, Cedar Edge and the four coal banks on Surface creek. The other branch goes from Delta to the Smith's Fork anthracite coal fields. The entire mileage will be about ninety miles. The farmers and fruit-growers have given the right of way along most of the route, in addition to which they are subscribing for five dollars of common stock for each acre of land which they own, and which adjoins the right of way. The new company under the terms of its franchise must construct not less than five miles of road per year. Work will probably commence within ninety days.

GLENDIVE, MONT.—At a special meeting of the commissioners of Dawson County a franchise was granted H. J. Haskell, E. S. Baer, B. S. Adams, J. J. O'Brien and J. R. Widwyer, petitioners for the Glendive & Yellowstone Valley Rapid Transit Company, to build an electric railroad and telephone line from Glendive to a point on the Missouri river opposite Buford, N. D., a distance of eighty miles. The company is to incorporate within sixty days and begin construction within six months after the granting of the petition. The road will traverse the entire length of the lower Yellowstone valley, in which the government will begin the construction of irrigation work in the spring, which will cost approxi-

Digitized by Google

mately $3,000,000 and reclaim 60,000 acres of land. The new road is important, as it will form a connecting link between the Northern Pacific and the Great Northern railroads.

NEW HAVEN, CT.—The directors of the Consolidated Railway Company have voted to double-track the Highland division from Turners to Danbury.

BENICIA, CAL.—F. A. Brand, president of the Benicia Iron Works, has petitioned the board of trustees for a franchise to build and operate an electric railway in the town.

RICHMOND, VA.—The Citizens' Rapid Transit Company, which purposes to build a viaduct from Church Hill to Shockoe Hill and run a trolley line over it, has put up $5,000 of its four per cent. bonds as a guarantee that the work will be done.

OKLAHOMA CITY, O. T.—Oklahoma capitalists, who are interested in real estate on the south side of the Canadian river, in Capitol Hill, are contemplating putting in a line which will connect with the present street railway system.

MARION, IND.—A plan is on foot looking to the building of an electric railway between Hobbs and Greentown, passing through Windfall and connecting the lines of the Union Traction Company, and the Kokomo, Marion & Western traction line. Hobbs is located five miles east of Tipton.

DAYTON, OHIO—L. W. James, receiver of the Dayton & Kenton Traction Company, has been empowered to sell the assets of the concern, consisting of options, rights of way and office fixtures, to Hugo Cook and Michael Chambers, at their bid of $980. They were the only bidders.

WASHINGTON, D. C.—The United States Senate has passed senate bill 3343, authorizing the Anacostia, Surrattsville & Brandywine Electric Railway Company to extend its street railway into the District of Columbia. This authorization allows the railroad to carry passengers, parcels, milk, garden truck and other small freight.

SPRINGFIELD, OHIO—The American Railways Company, which controls the plants of the Springfield Railway Company and the Springfield Light and Power Company, will erect a new electric light plant in connection with the Springfield Railway Company, work to commence immediately. About two miles of electric lines will be built this spring and summer.

CHARLESTON, S. C.—The Charleston-Summerville Electric Railway Company has been organized in this city, and it is expected that work of construction will be started almost immediately. The legislature will be asked to allow the railway to cross Dorchester and Lawson's roads. The route extends over private property with the exceptions named. The company has been given a franchise to run through certain streets of Charleston.

POTTSTOWN, PA.—Under a perpetual lease the Pottstown Passenger Railway trolley line has passed into the control of the Pottstown & Reading Street Railway Company, the officers of which are: president, Samuel H. Ashbridge, former mayor of Philadelphia; general manager, John Blair McAfee, of Philadelphia; acting superintendent, J. P. Pope, also of Philadelphia. It is the intention of the lessees to extend the line, which is six miles in length, to Reading.

CLEVELAND, OHIO—At the annual meeting of the shareholders of the Lake Shore Electric Railway Company the following-named gentlemen were elected directors for the ensuing year: E. V. Hale, J. R. Nutt, H. A. Everett, B. Mahler, Warren Bicknell, H. P. McIntosh, E. W. Moore, E. G. Tillotson, S. F. Haserot, Horace E. Andrews. The annual reports of the president and other officers were submitted, showing a marked improvement in the company's financial affairs.

ELECTRICAL SECURITIES.

The feature of greatest importance in the developments of last week was the very rapid recovery of prices from the decline of the first two days. The only excuse that can be given for the tumble in prices early in the week was the outbreak of civil strife in Russia; but that this condition was merely made use of by some speculators was very much in evidence during the latter part of the week. January and February, it is said, are dull months in the stock market. Nevertheless, it is a fact that for several days last week and the week preceding, speculation reached points which were really highest in a period of twelve months. The sudden fall in prices early in the week gave an opportunity which investors had been waiting for for some time to buy quickly. When the rise set in there was very little selling in sight. The imminence of a final decision on the Northern Securities case, along with the confidence shown by the companies principally involved, has led to a decided interest and activity in railroad securities. It is stated that the profits of the United States Steel Corporation for the December quarter will be in the neighborhood of $20,000,000, and that a very good showing will be made in regard to orders on hand.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 28.

New York:	*Closing.*
Brooklyn Rapid Transit	61
Consolidated Gas	202¾
General Electric	185
Interborough Rapid Transit	200
Kings County Electric	200
Manhattan Elevated	170
Metropolitan Street Railway	116⅜
New York & New Jersey Telephone	170
Westinghouse Manufacturing Company	192

At the annual meeting of the Brooklyn Rapid Transit Company's stockholders no business was transacted beyond the reelection of four directors whose terms had expired, and the adoption of the usual resolution approving and confirming the official acts of the management during the year.

Consolidated Gas directors have declared the regular quarterly dividend of 2½ per cent on the capital stock, payable March 15. Books close February 24 and reopen March 16. After the meeting of the directors the resignation of President H. E. Gawtry was announced. George H. Church has been elected a trustee of the company to succeed William C. Whitney, deceased. Other trustees were reelected. The surplus earnings for 1904 are $2,600,000, compared with $2,500,000 for 1903.

Boston:	*Closing.*
American Telephone and Telegraph	143¾
Edison Electric Illuminating	250
Massachusetts Electric	60
New England Telephone	137
Western Telephone and Telegraph preferred	97½

Philadelphia:	*Closing.*
Electric Company of America	10⅝
Electric Storage Battery common	76
Electric Storage Battery preferred	76
Philadelphia Electric	10
Philadelphia Rapid Transit	25
United Gas Improvement	108¾

Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	150
Metropolitan Elevated preferred	60
National Carbon common	41
National Carbon preferred	114
Union Traction common	12
Union Traction preferred	46½

The Commonwealth Electric Company has increased its capital stock by $750,000, the new issue being taken at par by the Chicago Edison Company, which holds, through trustees, all the stock of the Commonwealth company.

The earnings of the Chicago Telephone Company for 1904 broke all records. The gross revenue was $6,373,116, against $5,534,590 for 1903, or a gain of $838,525. Net earnings were at the rate of nearly 11.7 per cent on the $14,000,000 of capital stock, compared with about 10.15 per cent last year. In this report to the stockholders, President Arthur D. Wheeler announced that at the end of 1904 there were 3,600 unfilled requests for telephones. At the close of 1900 there were 36,414 subscribers' stations. In the succeeding four years the number increased to 117,893, an average of over 20,000 stations a year, distributed as follows: 1901, 17,097; 1902, 25,532; 1903, 22,144; 1904, 16,706.

The annual report of the South Side Elevated Railroad for the year ended December 31, 1904, is as follows: gross, $1,574,829; expenses and taxes, $969,975; net, $604,854; interest and dividends, $442,899, leaving a surplus of $161,955, as compared with $242,051 for 1903, and $178,631 for 1902. At the annual meeting of the company, C. J. Blair retired as a director, and was succeeded by C. H. Hubbard. Other retiring directors and officers were reelected.

Digitized by Google

NEW INCORPORATIONS.

ROME, OHIO—Rome Telephone Company. $2,000.

CASSOPOLIS, MICH.—Home Telephone Company. $25,000.

BROOKVILLE, KAN.—Brookville Telephone Company. $5,000.

FRANKFORT, KY.—Jobez & Bart Telephone Company. $500.

SAN JOSE, CAL.—National Park Electric Power Company. $25,000.

STATE COLLEGE, PA.—Nittanny Light, Heat and Power Company. $10,000.

HARRISBURG, PA.—Columbia Electric Light, Heat and Power Company. $10,000.

MILWAUKEE, WIS.—Iron River Water, Light and Power Company. $100,000.

ROANOKE, IND.—Roanoke Telephone Company. Increased from $2,500 to $10,000.

RALEIGH, N. C.—Asheboro Electric Company. $50,000. Incorporators: W. C. Hammer, A. M. Rankins and others.

PORTLAND, ME.—National Light, Heat and Power Company. $5,000,000. Incorporators: M. W. Baldwin and J. J. Hernan.

LITTLE ROCK, ARK.—Clarksville Telegraph Company. $5,000. Incorporators: C. E. Robinson, W. H. Harris and L. C. Robinson.

KIRKSVILLE, ILL.—Kirksville Mutual Telephone Company. $2,400. Incorporators: O. M. Hale, E. R. Boggs and T. J. Williams.

BURKEVILLE, TEX.—Texas & Louisiana Telephone Company. $5,000. Incorporators: E. F. Montgomery, J. C. Townsend and others.

PORTLAND, ME.—Northwestern Power Company. $10,000,000. President, J. C. Rice, Boston, Mass.; treasurer, C. M. Drummond, Portland.

AURORA, IND.—Farmers' Cooperative Telephone Association. $1,000. Incorporators: Nelson Grimsley, Herbert N. Christy and David E. Clements.

BATAVIA, N. Y.—Batavia Light and Power Company. $100,000. Directors: Seth W. Warren, George R. Howard, Buffalo; Barber B. Conable, Warsaw.

HAMILTON, OHIO—Hamilton Gas Light and Coke Company. Changed to Hamilton Gas and Electric Company, and capital increased to $1,000,000.

TOWER HILL, ILL.—South Tower Hill Mutual Telephone Company. $1,500. Incorporators: John W. Jones, Sweer S. Hertell, Charles J. Simmons.

AUSTIN, TEX.—Northwest Texas Telephone Company, of Canyon City. $10,000. Incorporators: J. N. Donohoo, R. W. O'Keefe, L. T. Lester, all of Canyon City.

TERRE HAUTE, IND.—Terre Haute & Indiana Southern Railway Company. $1,500,000. Incorporators: James R. Riggs, Charles L. Davis, Joseph Moss, of Sullivan.

HARRISBURG, PA.—Fleetwood Electric Light Company. $5,000. Directors: George B. Schaeffer, of Reading; H. E. Ahrens, of Reading, and S. K. Hoffman, of Hamburg.

ROYSE, TEX.—Royse Milling and Light Company; to operate an electric light plant and grist mill. $20,000. Incorporators: J. E. Poynter, C. E. Poynter and J. N. Miller.

WILSON, ARK.—The Wilson Northern Railway Company. To construct a railway from Wilson to Keiser, a distance of ten miles. $100,000. Directors: Robert E. L. Wilson, of Memphis, Tenn., and others.

SPRINGFIELD, ILL.—Springfield & Western Railway Company; to construct an interurban railway from Springfield through the counties of Sangamon, Schuyler, Morgan, Cass, Brown, Pike and Adams to Quincy.

EAST ST. LOUIS, ILL.—Troy & Suburban Railway Company. $50,000. Incorporators: L. C. Haynes, J. M. Bramlette and T. W. Gregory, of East St. Louis, Ill.; M. W. Schaefer and James A. Farmer, of Belleville, Ill.

COLUMBUS, OHIO—Lima, Findlay & Toledo Railway, of Lima; to construct and operate an electric line from Lima to Findlay. $700,000. Incorporators: E. Sanburn, Frank Butler, J. H. Griswald, C. L. Stocker and N. S. Harris.

GUTHRIE, OKLA.—Guthrie Railroad Company; to construct a line from Guthrie to Edmond. $600,000. Incorporators: George H. Brauer, W. J. Faulkner, of Oklahoma City; J. R. Coltingham, G. M. Green and L. N. Beadles, of Guthrie.

COLUMBIA, S. C.—Sumter Electric Light and Railway Company, of Sumter. $200,000. Incorporators: W. C. Brister, Albert DeHaven, both of Philadelphia; E. M. Beale, of Lewisburg, and J. L. Almett and H. F. Wilson, of Sumter.

SILOAM SPRINGS, ARK.—Northwest Arkansas Electric Company. To build a line of electric railroad from Siloam Springs to adjacent cities and towns. $960,000. Incorporators: L. D. Moore, of St. Louis, A. W. Perry, John P. Logan, Tom Williams and D. J. Godbold.

CHARLESTON, W. VA.—The Grafton Railway and Light Company. To construct an electric railway and an electric light plant in the city of Grafton, W. Va. $400,000. Incorporators: W. E. Horton, George W. Powell, T. B. Bradshaw, Thomas F. Job and W. E. Hildebrand, of Pittsburg.

VAN BUREN, TENN.—The Van Buren Electric Railway and Bridge Company. To construct a street railway in Van Buren and an interurban line between Van Buren, Alma and Mulberry, in Crawford County. $500,000. Philip D. Scott, president; directors: Charles H. Drennen, C. L. Scott, J. S. Dunham and L. H. Southmayd.

ENGINEERING SOCIETIES.

NEW YORK ELECTRICAL SOCIETY—An important meeting of the New York Electrical Society will be held on February 15. Mr. H. H. Vreeland, president of the New York City Railway Company, will address the members on the subject of the development of street railway systems.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION—The next annual meeting of the American Electrotherapeutic Association will be held at the New York Academy of Medicine, 17-21 West Forty-third street, New York city, on Tuesday, Wednesday and Thursday, September 19, 20 and 21, 1905. The secretary, Clarence E. Skinner, 67 Grove street, New Haven, Ct., requests the members to notify him of any change of address.

PHILADELPHIA SECTION OF THE AMERICAN ELECTROCHEMICAL SOCIETY—A regular meeting of the Philadelphia section of the American Electrochemical Society was held on Friday evening, February 3, at 22 South Fifth street, Philadelphia. A paper by Dr. G. P. Scholl, on "Modern Types of Electroplating Machines," was read and discussed. The change of meeting place was necessitated by the growing attendance at the meetings.

MADISON BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—At the last meeting of the Madison branch of the American Institute of Electrical Engineers held on Thursday evening, January 26, the subject of "The Maximum Distance to Which Power May Be Transmitted Economically" was discussed. Mr. O. O. Wagle, student, abstracted Mr. Mershon's paper, and Mr. G. A. Rodenbaeck reviewed the New York discussion. The meeting was well attended, and a great deal of interest was shown in the general discussion.

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The thirteenth regular meeting of the Toronto branch of the American Institute of Electrical Engineers was held at the Engineers' Club, 96 King street West, on January 13. A paper entitled "The Relative Advantages of a 250-500-Volt, Three-Wire, Continuous Distribution for the Business Districts of Large Cities" was prepared by Mr. R. G. Black, opening a discussion upon this subject. An ideal condition was assumed by Mr. Black, and the different alternating-current systems briefly referred to. The direct-current systems were discussed, and Mr. Black concluded by advocating the use of a 250-500-volt direct-current system. Mr. C. H. Wright questioned the efficiency of such a system. While the increase of voltage would cut down the cost of copper it might not satisfy the customer. The supplying of motors from lighting mains would cause excessive fluctuation in the lamp voltage.

Digitized by Google

PERSONAL MENTION.

MR. W. W. VAUGHAN has been appointed superintendent of the Austin, Tex., division of the Southwestern Telephone and Telegraph Company.

MR. FRED L. BLENDINGER has been appointed purchasing agent and superintendent of telegraphs of the Lehigh Valley Railroad Company. He will have offices at 228 South Third street, Philadelphia, and at 143 Liberty street, New York city.

MR. JAY PARSONS, of Maumee, Ohio, formerly district manager of the American District Telephone and Telegraph Company, at Maumee, has been appointed manager of the South Bend, Ind., exchange of the Central Union Telephone Company.

MR. FRED G. CHENEY, chief operator in the Clinton, Mass., office of the New England Telephone and Telegraph Company, has been appointed manager of the company's office at Lawrence, Mass. Mr. Cheney has been associated with the company since 1889.

MR. AUGUST BELMONT, president of the Interborough Rapid Transit Company, was the principal speaker at the annual banquet of the Chicago Real Estate Board, at the Auditorium Hotel, Chicago, Ill., January 19. Mr. Belmont spoke on municipal transportation facilities, particularly in their relation to a subway system.

PROFESSOR F. A. FISH, of the State University of Ohio, has been elected by the board of trustees of the Iowa State College, at Ames, Iowa, to succeed Professor B. S. Lanphear, deceased, in the electrical engineering department. Professor Fish was educated in the University of Ohio and the University of Wisconsin, and for a number of years has been engaged in electrical work.

MR. WALTER S. TIMMIS has established an office for the conduct of a consulting engineering practice at 150 Nassau street, New York city. Mr. Timmis is making a specialty of equipping printing plants with the electrical drive. He has had a very wide experience in this class of work, having recently equipped the large plant of the Sackett & Wilhelms Lithographing and Printing Company, Brooklyn, N. Y.

MR. CHARLES L. MICHOD, of Colorado Springs, Col., has been appointed general manager of the Interstate Electric Company's business for the island of Cuba. Mr. Michod has been making an extensive trip over the island, and has come in contact with many officials of the various industries. He is of the opinion that a large business can be built up in the supply line and contracting. His permanent address is at Empedrado, Cuba.

MR. ERNEST H. DAVIS, president of the National Electric Light Association, in an able letter to the Brooklyn Daily *Eagle* of January 20, calls attention to discrepancies in the report on the Chicago, Ill., municipal lighting plant. Mr. Davis points out wherein, in a municipal bookkeeping system, a great many charges are omitted which should properly be charged against the plant. A conservative estimate of these expenses per annum places the charge at $283,434.88. This, placed against the record which the municipal plant has made, would show a loss to the city of nearly $50,000.

MR. WILLIAM H. BLOOD, JR., has been appointed chairman of the committee on district heating of the National Electric Light Association. He expects to present a very full and important report on this branch of central station industry. The other members of the committee are C. R. Maunsell, Topeka, Kan., and R. S. Wallace, Peoria, Ill. Both of these men have had personal experience with steam and hot-water heating plants, and have also given the subject extensive study and observation. The association has made a liberal appropriation for carrying on investigations coincident with this work.

PROFESSOR REGINALD A. FESSENDEN, the distinguished inventor, has been appointed to the municipal power commission of Ontario, Canada. Mr. Fessenden was born in Milton, Quebec, was educated at Trinity College School, Port Hope, and has held many important positions in the world of electrical engineering. He has been entrusted with special expert investigations by the United States government, and has held prominent positions with the Westinghouse Electric and Manufacturing Company, the General Electric Company and the New York Edison Company. For the past fourteen years he has been connected with a number of important American power development projects. His work in wireless telegraphy has won him wide fame, and his system is one of those which the United States navy has under consideration.

MR. W. F. DAVIDSON has tendered his resignation as secretary and treasurer of the Port Huron, Mich., Light and Power Company. Mr. Davidson was one of the organizers of this company, and has been manager of the business ever since its inception. Some time ago Mr. Davidson was injured in a railroad accident at the Hyde Park station, Chicago, Ill., and has been in ill health ever since.

MR. M. T. THOMPSON has resigned as superintendent of construction work of the Mexican Light and Power Company, Limited. The company is undertaking considerable construction at Necaxa, Mexico. The engineering staff of the company is now being reorganized, and Mr. F. S. Pearson, vice-president and consulting engineer of the company, will probably appoint Mr. Thompson's successor. Mr. Thompson will establish an office in the city of Mexico.

MR. W. N. STEVENS, who has for some filled the position of assistant mechanical engineer of the Rapid Transit Subway Construction Company, has accepted a position with J. G. White & Company, of 43 Exchange place, New York city. Mr. Stevens has had a wide experience as a constructing engineer in the designing and active construction of important power plants. He had much to do with the design and construction of the Twelfth street power-house of New York Edison Company. He also has had charge of the design and construction of the mechanical equipment of the Seventy-fourth street power-house, and has lately been engaged on the work of designing and building the Fifty-ninth street power-house, nine transformer stations, car barns, shops, and other adjuncts, to the construction and equipment of the Interborough rapid transit in New York city. During his professional career, Mr. Stevens has also been engaged in engineering undertakings in other parts of this country and abroad, he having made both the preliminary and afterward the final plans for the machinery of the power-house for the tramways of Sydney, Australia. J. G. White & Company are to be congratulated in having secured the able service of Mr. Stevens in their mechanical engineering department.

NEW PUBLICATIONS.

TRANSACTIONS OF THE AMERICAN CERAMIC SOCIETY—Vol. vi of the Transactions of the American Ceramic Society has been published. This book contains the papers and discussions of the sixth annual meeting, held at Cincinnati, Ohio, February 1 to 3, 1904.

ANNUAIRE POUR L'AN 1905—This is the annual publication of the bureau of longitudes of Paris. It contains a complete astronomical calendar, a good deal of geographical information, and some statistics of general interest. There are, in addition, a number of valuable tables of weights and measures, interest, computation, etc.

TERRESTRIAL MAGNETISM—The results of the magnetic observations made by the United States Coast and Geodetic Survey, department of commerce and labor, Washington, D. C., between July 1, 1903, and June 30, 1904, are contained in a pamphlet issued as an appendix to report No. 3, for 1904, on terrestrial magnetism. It is edited by Dr. L. A. Bauer. It describes the new type of instrument which is in use, and discusses the methods of observing and the general accuracy of the results. Stations located in twenty-four states are described.

TRANSACTIONS OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION—The report of the second annual convention of the American Railway Mechanical and Electrical Association, held at St. Louis, Mo., October 10, 11 and 14, 1904, has been issued. The frontispiece is an excellent photogravure of the president of the association for 1903-1904, Mr. Edwin W. Olds. This volume includes all of the papers read at this second annual convention, with the discussion in full. There is also a list of the active and associate members of the association.

Digitized by Google

ELECTRIC LIGHTING.

GOSHEN, N. Y.—Improvements costing $40,000 have been made to the Newton electric lighting plant.

GREELEY, COL.—Work has begun on a $20,000 water and electric light plant for the town of Evans.

BIDDEFORD, ME.—The York Light and Heat Company will expend about $40,000 in new machinery and other improvements.

CHARLESTON, MD.—A franchise has been granted to a new electric light company to erect poles and string wires at Chestertown.

CRESTON, IOWA—The Corning Electric Light Company, which has been in the hands of a receiver for some time, has been sold to Charles Munns for $6,000.

LAUREL, MISS.—The electric lighting and power plant of the Laurel Improvement Company has been destroyed by fire. The loss is $14,000, with insurance of $8,000.

MARQUETTE, MICH.—The Marquette light and power commission has closed a $3,300 contract with the Westinghouse company for 125 alternating-current street lamps, two seventy-five-lamp converters, switchboard panels and other equipment.

LA CROSSE, WIS.—Application has been made by Walter B. McDonald for a franchise, allowing the Chicago Electric Light Company to furnish light for the city of Onalaska. An application will also be made to the common council of La Crosse for a franchise to furnish current to that city.

YORK, PA.—Plans are now being considered and perfected by the York Haven Water and Power Company for the construction of cable lines to Harrisburg, Steelton and Middletown, for the transmission of electric power from the plant to these towns. It is planned to supply power by July.

ELBERTON, GA.—O. H. Sheffield, of Atlanta, who has charge of the work of damming the Savannah river at the lower edge of Elbert County for the purpose of putting in a large electric plant and other machinery, has completed his arrangements, and hopes at an early date to have the plant completed.

ALBANY, N. Y.—The Colonie Electric Company election resulted as follows: directors, H. M. Sage, J. H. Jackson, F. W. Joslin, A. T. Benjamin, J. D. Johnson, T. C. Murray and J. A. Lawson. The directors elected: president, Henry M. Sage; vice-president, John H. Jackson; secretary and treasurer, Joseph A. Lawson; general manager, Francis W. Joslin.

GREENVILLE, OHIO—The result of the election held by the stockholders of the Greenville Electric Light and Power Company was the selection of the following gentlemen to serve as directors during the coming year: Z. T. Dorman, W. T. Fitzgerald, L. C. Anderson, J. M. Bickel, D. L. Gaskill, A. C. Robeson, Sam. Harnish, John Whiteley and A. J. Klinger.

NIAGARA FALLS, N. Y.—At a meeting of the town board of Cambria a franchise was granted the Niagara, Lockport & Ontario Power Company to construct and maintain a transmission line through the town for the conveying of electricity for power, heating and lighting purposes. The franchise carries with it an obligation to expend $50,000 within one year from the time of the granting of the franchise.

NASHVILLE, TENN.—The superintendent of the Nashville electric light plant has submitted his report. This shows that during the past year there have been put in service eighty-four arc lamps and 448 incandescent lamps, making a total of 726 arc lamps, and 2,331 incandescent lamps connected to the plant. The total output of the plant was 1,898,474 kilowatts, and the cost of operation, $32,667.86.

TOWANDA, PA.—M. J. McMahon and W. H. Sullivan have been granted a franchise under the name of the Galeton Electric Heat, Light and Power Company, to furnish electric light for Galeton and to operate a trackless trolley line. The plant will cost from $30,000 to $40,000. The franchise limits the time in which they must have the lighting plant and three miles of trolley road in operation to six months.

TERRE HAUTE, IND.—C. William Whaley and Noland B. Stadley have been granted a twenty-year franchise for lighting the town of Shelburn. The plant will be located halfway between Shelburn and Hymera, as the latter town will also be lighted. The plant will be built at once and will be equipped with a 350-horse-power engine and a 250-kilowatt dynamo. Twenty arc lights will be maintained in Sheburn at a cost of $50 per year each.

LA GRANDE, ORE.—The Grande Ronde Electric Power Company is arranging to build a power-house at the cove, sixteen miles from here, where it will secure power from Mill creek and the Minam to furnish more power to La Grande and light to Union, Hot Lake and Cove. The power-house to be constructed at the cove will be entirely of stone, according to present plans, and will be thirty by thirty-four feet. It will contain a 550-horse-power Pelton wheel.

OBITUARY NOTICE.

MR. EDWARD HEMPHILL MULLIN, whose death was announced in these columns last week, died very suddenly from heart disease on Wednesday, January 25. Mr. Mullin was an old-time newspaper man of very extensive acquaintance and high attainment. He was born in Castlederg, County Tyrone, Ireland, on October 22, 1859. He was educated at the Methodist College Public School, of Belfast, Ireland, and Queen's College, Belfast, where he took his bachelor's degree with honors in physics and chemistry in 1881. Shortly afterward he came to New York and engaged in newspaper work. From 1887 to 1895 he was an editorial writer on the staff of the New York *Evening Sun*. The two following years he spent on the staff of the New York *Times* in charge of the technical reporting of that newspaper. Subsequently he became editor of the *Bookbuyer* and a prolific contributor to the magazine and technical press. On February 1, 1898, he entered the service of the General Electric Company, at first as manager of its advertising department and latterly as a confidential representative of the company in many matters. He was the authorized representative of the company in all relations with the press, and the official host of the company whenever foreign engineers or capitalists desired to visit its works. He was a thirty-second-degree mason, a member of the Engineers', Press and Transportation clubs, vice-president of the New York Electrical Society, a director of the American Institute of Electrical Engineers, and also vice-president of the Association of American Advertisers. Mr. Mullin had a great number of friends here and abroad, and was known among them for his erudition and wide acquaintance with electrical and engineering subjects. He was a consistent student, and as a writer was distinguished for clarity of style and an Anglo-Saxon simplicity of diction which made his essays on mechanical and electrical matters very easy reading. The funeral services were held at Milburn, N. J., at two o'clock, on Saturday, January 28, and the interment was at Milburn later in the afternoon. Several of the societies and organizations of which Mr. Mullin was a member were well represented, and many prominent in the various branches of electrical engineering were also present. Among those present were Messrs. John J. Carty, Ralph W. Pope, John A. Lieb, F. C. Bates, Calvin W. Rice, Professor G. F. Sever, G. A. Hamilton, I. Keeler, J. J. Mahony, L. R. Pomeroy, J. McGhie, H. D. Hawk, Stephen H. Goddard and J. Beran.

MR. EDWARD HEMPHILL MULLIN.

Digitized by Google

TELEPHONE AND TELEGRAPH.

SHELDON, IOWA—The Sheldon Telephone Company has been granted a local franchise.

LITTLE ROCK, ARK.—Lonoke is to have another long-distance telephone connection with Little Rock.

DETROIT, MICH.—Farmers of Johnson township, Calhoun County, have built a telephone system with an exchange at Lacey.

PERRY, FLA.—W. A. Hendry and allied interest have bought the entire stock of the Perry Telephone Company, except that of J. T. Blair.

LONG BEACH, CAL.—The Home Telephone Company will increase the capacity of its switchboards in Long Beach by 600 connections.

NIAGARA FALLS, N. Y.—The Niagara County Home Telephone Company is planning to erect a new exchange building in Niagara Falls.

JOHNSTOWN, PA.—The Somerset Telephone Company has installed an all-night service, and the exchange in Somerset and Meyersdale will be open continuously.

PORTSMOUTH, N. H.—The New England Telephone and Telegraph Company has purchased a lot of land in Concord and, it is said, will erect a modern central station in that city.

ARDMORE, I. T.—A new telephone exchange, with the latest equipment and to cost from $40,000 to $50,000, is to be installed at South McAlester immediately by the McAlester-Eufaula Telephone Company.

ORANGE, N. J.—The West Orange town council has passed an ordinance, the life of which will be fifty years, granting a franchise to operate in Orange to the New York & New Jersey Telephone Company.

WASHINGTON, N. C.—The Western Union Telegraph Company has completed a new wire between Richmond, Va., and Washington, placing the latter city in direct telegraphic communication with Richmond.

PORTLAND, ORE.—A new rural telephone company has been organized in the Alsea country, known as the Fall Creek Company. Connection is to be made with the Alsea rural line, which has about fifty telephones.

SILVERTON, ORE.—An independent telephone company has been formed to connect Silverton with the adjoining towns. P. L. Brown is the local representative. The new company will be known as the Interurban Telephone Company.

CAMDEN, TENN.—A franchise to operate an exchange in Camden has been granted the Cumberland Telephone and Telegraph Company by the mayor and board of aldermen. The Cumberland company recently bought out the Camden city exchange.

MORENCI, OHIO—The Morenci Telephone Company has elected the following directors and officers: W. W. Crabbs, C. D. House, Ambrose Combs, L. A. Kennedy, Darwin Osgood, directors; W. W. Crabbs, president and manager; Ambrose Combs, secretary and treasurer.

TIVERTON, R. I.—A new telephone system is to be installed in Tiverton by the Strowger Automatic Company. Automatic telephones of an improved style are also to be installed in Little Compton, Tiverton Four Corners and Tiverton proper. Construction work will begin in the spring.

WATERTOWN, N. Y.—At the annual meeting of the Alexandria Bay Telephone Company the following officers were elected: president, G. L. Olds; secretary and manager, William E. McDonell; treasurer, Charles U. Putnam. The company at present is in a prosperous condition, and is contemplating extensive improvements.

LITTLE ROCK, ARK.—The St. Louis, Iron Mountain & Southern Railway and the Western Union Telegraph Company have begun the work of rebuilding the telegraph line from Little Rock to Malvern. It is estimated that with ordinary success it will require upward of four months to complete the work, which will cost $25,000.

HOOPER, NEB.—The following have been elected directors of the Hooper Independent Telephone Company: T. B. Pairling, Bernard Monnich, M. E. Shipley, J. Howard Heine, H. Meyer, T. W. Lyman, E. O. Spielberg, H. Bartling, M. A. Wehling, August Heller. The company has three lines running out of Hooper, and has connection with all the important independent lines.

ELIZABETH, N. J.—The Interstate Telephone Company, of which the Elizabeth Telephone Company is a branch, is connecting the various towns in New Jersey and Pennsylvania in which it has branches. The connecting lines run from Elizabeth to Trenton, taking in the principal Jersey towns south of Trenton, thence to Philadelphia. A large number of Pennsylvania towns is brought together.

ELKHART, IND.—The Home Telephone Company has elected the following directors: president, I. W. Short, of Elkhart; vice-president, J. A. Arthur, of Goshen; treasurer, H. B. Sykes, of Elkhart; secretary and manager, J. K. Johnston, of Elkhart; G. W. Miller, J. B. Pollard, James Kavanagh and Wilson Roose, of Elkhart, and E. L. Barber, of Cleveland.

MOBILE, ALA.—At the annual meeting of the Home Telephone Company the following officers and directors were installed for the ensuing year: John Craft, president; A. S. Lyons, vice-president; A. Proskauer, treasurer; R. L. Douglas, secretary; W. H. Bryant, manager; directors, John Craft, A. H. Spira, Adam Glass, P. J. Lyons, L. C. Fry, J. K. Glennon, A. S. Lyons, S. C. Schaffner, William Vizard.

KINGSTON, N. Y.—The independent telephone companies at Delhi, Franklin, Walton, Sidney, Hancock and Deposit, and the Davis Telephone Company and Rose Telephone Company, the principal independent lines in Otsego, Delaware and Broome counties, having an aggregate of 2,500 subscribers, have made a traffic arrangement with the Bell Telephone Company by which their patrons are connected with the Bell system.

DAYTON, IOWA—The stockholders of the Dayton Telephone Company at their annual meeting reelected their old directors and officers, and voted to increase their capital stock from $10,000 to $25,000. The company has proved a prosperous one since its organization, and is planning to extend its service during the coming season, instituting new exchanges and building new lines, as well as substantially improving its present service.

DULUTH, MINN.—At the annual meeting of the Duluth Telephone Company C. H. Graves, of Duluth, was reelected president; C. P. Wainman, of Minneapolis, general manager; and C. M. Mauseau, of Duluth, assistant general manager. During the year about $75,000 will be expended for improvements. In the city of Duluth 4,000 to 5,000 feet of 400-pair underground cable will be installed, and several miles of 50 to 100-pair aerial cable will be put in place.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has put its new exchange, "Wolfe," into operation, taking about 2,500 subscribers off the switchboard at the congested Mount Vernon exchange, which has been overcrowded for several months, on account of the fire of last February. In the annual report of the company the receipts are shown to be $604,630.87, telephone earnings, and $39,041.09, real estate earnings, a total of $643,671.96. The total expenditures are given as $629,561.03, and the net earnings as $14,110.93. The total receipts on account of capital in the District of Columbia are shown to be $476,118.84. The expenditures, amounting to this sum, are divided as follows: for construction of underground conduits and cables, $148,007.93; construction of poles, aerial wires and fixtures, $41,541.70; for central office equipment, $286,569.21. The cost of the works is given as $2,462,263.59.

NEW COMPANIES.

MALDEN, MASS.—The Continental Motor Company has been organized with a capital of $1,000,000. The incorporators are Albert E. Knowlton, Harold P. Knowlton, both of Malden.

INDIANAPOLIS, IND.—The Maier-Oliphant Electrical Company, with a capital of $5,000, has been incorporated by Frank L. Maier, Lee H. Oliphant and Lewis Maier.

ALBANY, N. Y.—The Federal Sign System, of New York city, has been incorporated with a capital of $1,000,000 to deal in electrical supplies and devices. The directors are Edward Butcher, Jr., C. L. McFetrish and W. H. McClain, of New York; J. M. Gilchrist, of Chicago, and J. H. Grenelle, of Brooklyn.

Digitized by Google

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is distributing a number of leaflets giving new prices on its various specialties. These are designated as price lists No. 81 and No. 82, and cancel the lists given in price lists No. 70 and No. 80.

ALBERT ROTHERMEL, 686 East One Hundred and Forty-ninth street, New York city, is requesting catalogues of hardware and electrical supplies. Mr. Rothermel has opened a large store at the above address, and will carry a complete stock of these supplies.

THE CENTURY ELECTRIC COMPANY, 1007 Locust street, St. Louis, Mo., announces its removal on February 1 to 404 North Fourth street, where it will have much larger and better quarters to take care of its rapidly increasing ceiling fan and power motor business.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is distributing a handsome calendar for 1905. The calendar pad is rather small, but the mat is made very attractive by a reproduction of the painting by Thomas Blinks, entitled "The Thoroughbreds."

THE WESCO SUPPLY COMPANY, Seventh street and Clark avenue, St. Louis, Mo., is distributing a new catalogue descriptive of the Wesco telephone. This takes up in detail the various parts of the telephone apparatus, illustrating each and giving a careful description of the mechanical and electrical features.

THE HANCOCK INSPIRATOR COMPANY, New York city, has prepared a pocket-sized catalogue descriptive and illustrative of the Hancock inspirator for stationary, marine and locomotive service; Hancock ejectors and general jet apparatus. In addition to a careful description of the apparatus, complete lists of prices are given.

THE EASTERN ELECTRIC COMPANY, Boston, Mass., manufacturer of incandescent lamps, has opened a branch office at 5 Beekman street, New York city. Mr. L. V. Weil will be in charge of this office. The company has greatly increased its productive capacity, and will be able to fill orders promptly from the new office.

THE UNITED TELPHERAGE COMPANY, 20-22 Broad street, New York city, has published a handsome catalogue descriptive of electric telpher apparatus. The work covers twenty-four pages, and is entirely made up of reproductions of typical installations. Some of these show the successful solution of difficult problems in the transport of material.

THE H. O. S. ENGINEERING COMPANY, New York city, has removed its factory and general office from 88 Warren street to 16-22 Boyden place, Newark, N. J. The company will be able to manufacture its line of goods to better advantage, and it has installed a very complete plant which will enable it to satisfy the trade in every respect much better than heretofore.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt street, New York city, is distributing an attractive folder calling attention to its various forms of vitrified single and multiple-duct conduit. The frontispiece is an illustration showing the company's conduit in process of installation at the power-house of the Niagara Falls Power Company, Niagara Falls, N. Y.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing bulletin No. 117, descriptive of Gates rock and ore breakers, styles D and F, and auxiliary machinery. Sectional and assembled views of these gyratory rock and ore breakers are shown. There is also a careful description of the apparatus and its applications, together with diagrams giving dimensions and weights.

THE PITTSBURG TRANSFORMER COMPANY, Pittsburg, Pa., is calling attention to its pipe-thawing outfits. At this time of the year considerable damage is being done to water pipes due to freezing. The old method of digging up the street and thawing out by the application of a flame is giving way, in almost every city of any importance, to the scientific application of the electric current.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, is distributing a valuable and attractive calendar for 1905. The mat is illuminated by a beautiful velox portrait. The calendar pad contains a lighting schedule for each month. The dates are so arranged that the lighting hour for each day is easily determined. At the bottom of each page the total lighting hours for the month are indicated.

THE MICHIGAN CENTRAL, Niagara Falls route, has prepared two new time-tables and reference books which are of great interest to travelers. The first takes up the system between New York, Boston, Buffalo and Chicago, the West and Northwest, and the second the Chicago-Grand Rapids line. Either of these booklets may be had from Mr. O. W. Ruggles, general passenger and ticket agent, Chicago, Ill.

THE AMERICAN CONDUIT COMPANY, 822 Manhattan Building, Chicago, Ill., has a corps of experts in underground construction, and is prepared to furnish supervision of work if desired. The company prefers to cooperate with contractors in underground construction, but, if desired, will submit estimates and bids and take contracts for completed underground systems in all parts of the United States or Canada.

W. N. MATTHEWS & BROTHER, 200 Carleton Building, St. Louis, Mo., are working on a new thirty-two-page catalogue, devoted entirely to the Stombaugh guy anchor. This is to be the most attractive piece of literature that this enterprising firm has sent out. The company expects to have it ready for distribution about March 1. It should prove of great interest to those who have poles to anchor. The catalogue will be sent upon request.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., is sending out several attractive folders calling attention to P-K cartridge fuse cutouts and P-K panel cutouts and boxes. On April 1 the new standard for enclosed fuses goes into effect. The new code standard cartridge fuse blocks, which the H. T. Paiste Company is placing on the market, will take any new code fuse of any standard make. The circulars which the company is distributing show a full line of these devices.

A. L. IDE & SONS, Springfield, Ill., announce that they have established a New York office at 11 Broadway. All export, New England and Middle States business will be transacted at this office hereafter, under the management of Mr. J. G. Robertson. A. L. Ide & Sons are the original manufacturers and patentees of the celebrated "Ideal" engines. These engines are being used extensively in manufacturing establishments, office buildings and for power and electric plants.

THE HAYDEN & DERBY MANUFACTURING COMPANY, New York city, has prepared a pocket-sized edition of its large catalogue descriptive and illustrative of Metropolitan ejectors. The Hayden & Derby Manufacturing Company makes the Metropolitan automatic injectors, Metropolitan "1898" injectors, Metropolitan double-tube injectors, H-D injectors and jet apparatus. All of this apparatus is described, and diagrams are also given showing various sizes.

MESSRS. QUEEN & COMPANY, INCORPORATED, Philadelphia, Pa., have issued a new circular in which are compiled the various instruments that the company make for resistance measurements. This list includes all types of instruments, from an elaborate and complete Wheatstone bridge and rheostats of the Anthony and Kelvin type to small individual unmounted resistance coils. The catalogue also describes in detail Queen & Company's "Acme" and "Decade" sets. Considerable space is given to a description of the Queen portable cable-testing system. This catalogue is illustrated throughout, and will be sent to any one interested upon request.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 6. NEW YORK, SATURDAY, FEBRUARY 11, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Municipal Lighting ... 223
Central Station Development ... 223
The Electrification of an Important English Railway ... 224
Significance of the Hydroelectric Developments at Niagara Falls ... 224
Disruptive Distance in Air ... 225
Gaslights in Bedrooms ... 225
Annual Dinner of the American Institute of Electrical Engineers ... 226
Light and Power Plant and Suburban Railway in Santiago de Cuba ... 226
The Narragansett Electric Lighting Company's Plant ... 227
High-Speed Railway Propositions in Germany ... 231
Distribution and Dollars, by C. H. Williams ... 232
Legislation for the Milan (Italy) Exhibition ... 237
The Gas and Electric Plant at Muskogee, I. T. ... 238
Wave Distortion on Transmission Lines, by William S. Franklin ... 240
Accuracy Checks of Switchboard Instruments, by Clayton H. Sharp ... 243
The Use of Incandescent Lamps for Decorative and Advertising Purposes ... 246
The Meeting of the Electrical Contractors' Association of New York State ... 248
Tendencies in Central Station Design ... 249
A Long-Distance After-Dinner Speech ... 249
New York Electrical Society ... 249
Sources of Radium ... 249
The Automatic Telephone Exchange at Battle Creek, Mich. ... 250
Meeting of the American Trade Press Association ... 251
The Electrification of the London, Brighton & South Coast Railway, England ... 251
Notes on Induction Integrating Wattmeters and Their Use ... 251
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 252
Electric Lighting of Trains in Belgium ... 253
INDUSTRIAL SECTION:
Thomas Soldered Rail Bonds ... 254
Jandus Series Alternating-Current Arc Lighting System ... 255
Some New Snap Switches ... 256
Direct-Connected Generating Set with Horizontal Engine ... 256
Westinghouse Type K Voltmeters and Ammeters ... 257
Panel-Board Cabinets ... 257
The Adams Secondary Generator ... 258
An Electrically Operated Whistle ... 258
New Form of Ceiling Switch ... 258
Fuseless Rosettes ... 259
The Westinghouse-Parsons Steam Turbine ... 259
Eastern Carbon Works Products ... 259
The Crescent Time Switch ... 259
Pease Blue-Print Washing and Drying Machine ... 260
Comparative Test of a Small Boring Mill ... 260
"The Insulator Book" ... 261
"Pointers" ... 261
Prometheus System of Electric Heating and Cooking ... 262
Cartridge Fuse Cutouts ... 263
Motor-Starting Panels for Constant-Speed Motors ... 263
Changes in Allis-Chalmers Sales Office Organization ... 263
Annual Convention of the Officers and Branch Managers of the Crocker-Wheeler Company ... 264
Incandescent Lamp Filament ... 264
CURRENT ELECTRICAL NEWS ... 265

MUNICIPAL LIGHTING.

Certain of the daily papers stated recently that the Brooklyn bridge is lighted "at an annual maintenance cost of $20,000, in round numbers." This statement is criticised in a communication by Mr. Arthur Williams to a New York contemporary. It appears that, not only is the figure $20,000 too small—for the city record shows that the aggregate labor charge for lighting is nearly $24,000—but no allowance is made for fuel, water, maintenance of lamps, maintenance, interest and depreciation of plant, nor for those charges which a private company would have to carry, insurance and taxes. Making allowance for these, Mr. Williams finds that the annual cost to the city should be put down as $58,257, which brings the annual cost of each arc lamp up to $168.94, and that of the incandescent lamps to $29 each. Of course, if we wish to deceive ourselves and use foolish methods of keeping records, we are free to do so. Every municipality likes to think that its business is conducted as efficiently and cheaply as possible, but to use records as inaccurate as this as a basis for estimating the cost of operating a municipal plant is dangerous and wrong.

CENTRAL STATION DEVELOPMENT.

During the past twelve or fourteen years the central electric generating station has undergone great changes. In the early nineties the reciprocating steam engine was the only motive power considered seriously, the contest at that time being between the high-speed and low-speed types. Belts were the usual thing, and countershafts were common. As steam only was considered, the generator-room equipment had little effect upon the boiler house.

The first step was the elimination of the jack shaft and, following it, the belt. The high-speed engine led in this, for generators in those days were normally what would to-day be considered high-speed machines. But the slow-speed engine soon followed, as the dynamo designer gained skill and confidence, for the operating engineer demanded not only direct-connection, with a saving in space, but high operating economy. As the economy of the station was improved, instead of being satisfied, the operating engineer demanded still greater economy. To meet this the internal-combustion engine was taken up and improved in every way, until it may now be considered a dangerous rival of the reciprocating engine, and the merits of the steam turbine at last received some consideration.

The steam turbine has brought about a great change in station arrangement. In general, the station is divided into three parts—the boiler house, the machinery house, and the distributing house. The boiler house contains nothing but boilers, and such auxiliary devices as can not be placed elsewhere. The machinery house contains not only the main generating units, with their exciters and condensers, but all of the operating machines which can be placed there. The distributing house or switch-house contains all the electrical devices for handling the current after it leaves the generator terminals. This arrangement has been adopted for several reasons: it simplifies matters, and is thought to add to the reliability of the plant. As a further guarantee of reliability, each generating unit is made as independent as possible of the others. Thus, the energy represented by the coal pile is distributed among the different boiler houses and does not come together again until, as electrical energy, it is fed into the main distributing buses.

Digitized by Google

THE ELECTRIFICATION OF AN IMPORTANT ENGLISH RAILWAY.

The English technical papers announce that the directors of the London, Brighton & South Coast Railway have decided to electrify their system, and will start at once upon one branch. The London, Brighton & South Coast Railway is an important system extending south of London, and having an extensive network of lines which carries an enormous suburban traffic.

Some years ago it became apparent that something must be done to relieve the congestion on this system. The terminal stations in London were so crowded that not another train could be added to any of the lines running into them. At the same time the lines within the immediate vicinity of London were losing much of their traffic on account of the many electric tramways which are being run through this district. Experts were secured to report upon the situation, and after a long investigation they reported that the only thing to be done was to electrify the road. This would bring back the traffic which had been lost, and would largely increase the capacity of the terminal stations, since shunting of the trains, which causes much loss of time at the stations, would become unnecessary. At the same time, a better service could be maintained with electrically operated trains. At the time this report was made no particular system was recommended, because at that time the single-phase systems had not been fully developed, and there was a strong objection to the use of a direct-current system with a third rail for distributing the current to the trains. The difficulty with the third-rail system lies in crossing Clapham Junction, where there is a complex network of tracks which would make very difficult the installation of a third rail, and the latter, if installed, would be a menace to trackmen. Now, however, the railway company's engineers are satisfied that the single-phase system offers a solution to all their troubles, and they have decided to adopt it, and will immediately begin equipping the Battersea Park and Peckham Rye section.

The plans proposed for this work present some features differing from any other plans which have yet been made public. There will be no novel features at the power-house, for standard design will be followed there, the generators being driven by steam turbines. Nor will the car equipment show any unusual features, although the car bodies themselves are a compromise between the American and English types. The method of distribution proposed, however, differs considerably from any which has yet been tried. The voltage supplied to the trolley will be 6,000—double that proposed by the Westinghouse Electric and Manufacturing Company and the General Electric Company for their single-phase systems. This high voltage will not affect the motors at all, but it will make necessary a special transformer. The return will be by way of the track, but not through it, for the separate rails will not be bonded together, but to a common return. The collector decided upon is of the bow type.

It would be interesting to know why 6,000 volts was decided upon for the supply system. It is true that doubling the voltage, as compared with the American plan, will not make much difference in the transformers on the car, for transformer designers are not troubled by the comparatively low voltage of 6,000; but it will make extra care necessary for the overhead system. Doubtless, some type of catenary suspension will be used, and special care will be necessary in the selection of a type of insulator. Six thousand volts is not high for a transmission line, but it is high for a line which is at once a transmitting line and a supply line. The higher voltage would enable power to be transmitted economically to a greater distance than the lower voltage, but it has been said that even with 3,000 volts there is no necessity for feeders, the trolley wire itself having ample conductivity. Moreover, in this particular case the line will be cut into sections, each section being fed at a middle point.

The method of returning current seems somewhat peculiar. The rails, as has already been said, are to be bonded to a common return, and not bonded together. This common return is the outer conductor of a concentric cable, the inner conductor being the high-tension feeder. The outlines of the system which have appeared in the English papers give no explanation of this unusual arrangement.

The success of this road will be followed closely by railroads throughout the entire world. Forming, as it does, an important part of the system serving the suburban districts of London, where traffic is very heavy, and having been forced to abandon steam because the maximum possible service by this means had been reached, it will give an excellent object lesson of what will be gained by electrification. At the same time, as one of the first roads to adopt the single-phase system, and because of the peculiarities pointed out above, the performance of the equipment will be watched by railway engineers.

SIGNIFICANCE OF THE HYDROELECTRIC DEVELOPMENTS AT NIAGARA FALLS.

That great power plants are being constructed on the Canadian side of Niagara falls is well known, but probably not many recognize the stupendous character of the work now going on, nor appreciate the relation of the new plants to the total hydroelectric development of the world. The three great power stations now being built will have an aggregate output of 285,000 horse-power, distributed as follows: the Canadian Niagara Power Company, 110,000; the Toronto & Niagara Power Company, 115,000, and the Ontario Power Company, 60,000. The last-named company intends increasing its stations ultimately to 180,000. Comparing the total for the present plans of 285,000 with the grand total for the world, which is given by the *Engineer* (London) as 1,483,000, shows what an important addition to the world's water power the Canadian plants will form. But this is not the whole story, for adding in the additional 120,000 planned for by the Ontario Power Company gives a total of 405,000 horse-power for the new Canadian stations; more than twenty-seven per cent of the world's present hydroelectric power.

It is interesting to sum up the total power development of the Niagara falls district, in use and prospective. On the American side there is about 150,000 horse-power in the three stations. One the Canadian side, along the old Welland canal,

Digitized by Google

there are two stations with a present output of 26,000 horse-power and a total planned for of 52,000. Right at the falls is the small plant of the International Railway Company, which has an output of 1,500 horse-power. The total is about 625,000 horse-power.

In an excellent description of the work going on now at Niagara Falls, which is contributed to the *Engineering Magazine,* for February, Mr. C. B. Smith says that for a generation at least the Niagara Falls district is not likely to make use of more than 400,000 horse-power. This allows for the large factories now being built there and for the probable development of the district. Should Mr. Smith's estimate prove correct, and he has had excellent opportunities to study the situation, as he was, until recently, engineer for the Ontario Power Company, there will be a number of generators idle or long-distance transmission will have to be resorted to to dispose of the available surplus. Mr. Smith thinks the railroads will avail themselves of the opportunity as soon as they are convinced that they can rely upon the supply.

It is worth while looking at the present state of hydroelectric development for those countries where this has been carried well forward. The following are the figures given in the *Engineer* (London): the United States leads with 527,467 horse-power. Canada comes next with 228,225 horse-power. When the new Canadian plants have been put into service she will push this country closely for first place. Third on the list of countries is Italy with 210,000 horse-power; next comes France with 161,343, and then Switzerland with 133,202 horse-power. Germany has 81,077, and Sweden has 71,000 horse-power. In all other countries the hydroelectric development is small, being only a few thousand horse-power for each.

DISRUPTIVE DISTANCE IN AIR.

Although the sparking distance between needle points has been used to a great extent as a means of measuring high voltages, particularly when such are used for testing purposes, there has always been some uncertainty as to the accuracy of this method. It has long been known that the disruptive distance depends upon the condition of the air, and upon the shape of the terminals between which the spark passes. Just how this was brought about was not clearly understood. In a recent issue of the *Elektrotechnischer Zeitschrift,* Mr. Hugo Grob, of Zurich, describes an elaborate series of tests conducted by himself with a view of shedding light on the subject.

Shortly after he had begun these tests, Mr. Grob was struck by a sudden change in the sparking distance, due to a slight increase in voltage. The curve giving the relation between disruptive distance and voltage showed a decided hump. It was found, moreover, that a slight change in the arrangement of the electrical circuit altered the curve so as to bring this hump at a different point, although the same general shape was maintained. This indicated that here was a phenomenon which might be investigated with profit, and after a careful search the cause was found to be the capacity of the high-voltage circuit which seemed to produce a condition of resonance, with a corresponding rise in voltage. It was found that the point at which this hump occurred in the curve could be controlled by adjusting the capacity of the circuit, but that all of these humps seemed to fall along a fairly smooth curve.

These experiments were conducted with needle points, but Mr. Grob believes that the effect of terminals having other shapes is due principally to their capacity. With a given shape of terminal and a fixed capacity in the circuit, there is no difficulty in obtaining a definite curve. This indicates that the length of spark may be used as a means of measuring approximately high potentials, if the necessary precautions are observed and the circuit be calibrated; otherwise the results are too unreliable to be of value. The circuit may be so adjusted as to bring the hump at a comparatively low voltage or to make it of but slight importance. The curve then follows approximately a straight line, and a simple equation may be used for estimating the voltage. Indeed, this may be done in any case, provided the hump is passed before readings are taken.

GASLIGHTS IN BEDROOMS.

Attention has been called frequently to certain dangers arising from the use of illuminating gas and to the easily observed precautions which greatly reduce, if not entirely remove, the risks. In matters of this kind, and particularly as it is impossible to reach everybody concerned with one warning, the warning should be repeated from time to time.

One danger from the use of gas was touched upon in a recent issue of our esteemed contemporary, the *New York Times,* a newspaper which is ever alive to the public welfare, which is quick to recognize existing evils, and which usually has some well considered suggestion to offer. The following is what it says about leaving gaslights burning in bedrooms:

Frequent casualties emphasize the danger of turning down the gas and leaving it burning "low" all night. This danger exists at all times, but especially in winter, and is much greater in New York, where water gas is supplied, than it is in cities which still depend upon retort gas. The reason for this is that water gas carries on the average four or five times as much carbon monoxide per unit of bulk as retort gas. Carbon monoxide is a very energetic blood poison. It has for the hemoglobin of the blood about four hundred times the affinity of oxygen, and as little as two-tenths of one per cent in air breathed is certain to produce very serious symptoms of heart derangement in persons exposed to it, while in the presence of four-tenths of one per cent no form of animal life can long be sustained.

Gas does not freeze; neither do gas pipes. What may freeze is the vapor of water carried by all gas in larger or smaller percentages. This watery vapor is condensed as frost on the inside of a cold pipe and may build up enough to close it. A very few degrees of heat will reconvert it into water, and when such conversion takes place a pipe which may have been temporarily closed is open again and permits gas to pass through. This happens frequently in dwellings, and explains why a gaslight turned low will sometimes "go out" and gas is subsequently found flowing through the burner.

There are many safe lights for the bedroom, and gas is so unsafe that its use for this purpose can only be attributed to ignorance of the danger it involves at all seasons, but especially in winter.

Gas is to-day the illuminant most widely used in cities. It is as well a valuable fuel. There is no probability of its being driven completely from its well established position, at least for a long time. Therefore the dangers incident to its use should be realized by all who have occasion to use it, either as a source of light, or for heating or cooking.

Digitized by Google

Annual Dinner of the American Institute of Electrical Engineers.

The annual dinner of the American Institute of Electrical Engineers was held in the grand ballroom of the Waldorf-Astoria, New York city, Wednesday evening, February 8, 1905. About 300 members and guests were assembled, and the dinner was served promptly at 7.30 P. M. Prior to the dinner a reception was held in the Astor gallery, the guests being received by John W. Lieb, Jr., president of the Institute; Mr. Leo Daft, of pioneer railway fame, and a number of other engineers who have had much to do with the development of electric traction. In the Astor gallery there was on view the painting of Dr. Gilbert experimenting on magnetism before Queen Elizabeth. This painting was presented to the American Institute of Electrical Engineers by the Institution of Electrical Engineers, of Great Britain, on the occasion of the International Electrical Congress, held at St. Louis last September. A bust of Galileo Ferraris was also on exhibition.

The grand ballroom, where the dinner was served, was beautifully decorated with festoons of smilax interspersed with incandescent lamps. Upon each table was mounted a centre-piece of ferns and smilax, embellished with numbers of miniature incandescent bulbs. About fifty six-foot Cooper Hewitt mercury vapor lamps were strung around the second balcony, and immediately after the dinner had been served and the tables cleared, these lamps were turned on and a photograph made of the assemblage.

Following this a number of highly interesting biograph views were shown with the apparatus of the American Mutoscope and Biograph Company. The pictures shown included views of the welding of a ten-foot, 1,000-kilowatt generator ring, assembling a huge rotary converter, and a general view of the main aisle in the Westinghouse Electric and Manufacturing Company's works at Pittsburg, Pa. The Manhattan viaduct and other features of the Interborough Rapid Transit Company's system were shown, and then there were several exciting scenes of races between the Empire State express and the new electric locomotive built for the New York Central & Hudson River Railroad Company.

Shortly after ten o'clock President John W. Lieb, Jr., arose to bid the guests and members welcome. He dwelt briefly upon the great strides which had been made in electric traction, and quoted from the history of this progress.

Mr. T. G. Martin was introduced as the traditional toastmaster of the Institute. In a few well-chosen words he introduced Mr. Frank Julian Sprague as one to whom American and foreign engineers owed a great deal for the remarkable work he had performed in the electric field.

Mr. Sprague's address was upon the topic "Art and the Men." He called attention to the fact that, where electric traction had been successful, the conditions obtaining were largely favorable to that success. On trunk lines where steam locomotives were holding their own the question should be taken up in a different manner. There was, however, no road suffering under any conditions that could not be operated by electricity. The great question was not a matter of high speed, but of sustained speed. Just so soon as the passenger and freight traffic on a steam trunk line justified the electrification of that line the line would be electrified. Electrification of trunk lines, he said, was a matter of finance, and not a matter of technical engineering.

Mr. Sprague was followed by Mr. Leo Daft, who replied to the toast, "These Twenty Years." Mr. Daft spoke briefly of the trials and rewards which had come to the pioneers during the last twenty years. He paid a tribute to the men of capital who had stood so solidly behind the engineers, and had given them such great aid in their undertakings.

Mr. Herbert H. Vreeland, president of the New York City Railway Company, responded to the toast, "The Broomstick Train." Mr. Vreeland spoke entertainingly for a short time upon the conditions of passenger traffic in a great city.

Mr. Lewis Buckley Stillwell, electrical director of the Interborough Rapid Transit Company, in reply to the toast, "Traction Above Ground and Under," recited some interesting data in connection with the electrical equipment and operation of the Interborough Rapid Transit system.

Brigadier-General A. W. Greeley, chief signal officer, U. S. A., responded to the toast, "Other Uses of Electricity." He spoke in an interesting manner of the great work which the signal corps of the United States army was doing in bringing intercommunication between the distant points. Within very recent years there has been built by the signal corps sufficient all-American cable to reach entirely around the world. In Alaska a cable had been laid during the last year which would reach from Newfoundland to Ireland. Across Norton sound, in Alaska, a wireless telegraph system was working for 107 miles. This had been in operation for several months without a single interruption. On one occasion thirty-five messages of varying lengths were sent to and fro by this system without having a single word repeated. In the Philippine Islands, in Cuba and in Porto Rico good systems of telephone and telegraph had been instituted, and in the Philippines it is possible to telegraph anywhere in the islands, 1,300 miles north and south, for forty cents.

Besides the president and the toastmaster, the following were seated at the speaker's table: C. C. Schneider, W. G. Ross, James Gayley, L. B. Stillwell, C. A. Coffin, Nikola Tesla, Elmer A. Sperry, General Greeley, Leo Daft, C. F. Scott, R. W. Pope, General Eugene Griffin, E. W. Winter, H. H. Vreeland, T. C. MacCarter, F. J. Sprague, Dr. A. R. Ledoux, Dr. F. B. Crocker, W. B. Potter, C. G. Curtis, W. J. Wilgus, F. D. Underwood, H. H. Westinghouse, Dr. S. S. Wheeler, G. W. Stockley, John R. Freeman, H. Ward Leonard and B. J. Arnold.

Light and Power Plant and Suburban Railway in Santiago De Cuba.

United States Consul Holaday reports that there has been organized in Santiago de Cuba a joint stock company called the Compañía Eléctrica de Santiago, with a capital stock of $300,000 and an authorized bond issue of $300,000 additional. The company operates under a concession given by the president and secretary of the government of the Republic and a charter granted by the municipality of Santiago de Cuba. It proposes to build immediately a plant to supply light and power to private consumers and later to construct a street and suburban railway. The following contracts have been let: to the Babcock & Wilcox Company, of New York, for supplying three boilers of 500 horse-power and one steel smokestack 110 feet high; to the Buckeye Engine Company, of Salem, Ohio, for supplying two stationary engines of 235 horse-power each; to the General Electric Company, of New York, for supplying all the electrical machinery necessary for the equipment of the plant. Mr. José Marimon is president, and Mr. Eduardo J. Chibas, vice-president and managing director.

Digitized by Google

The Narragansett Electric Lighting Company's Plant.

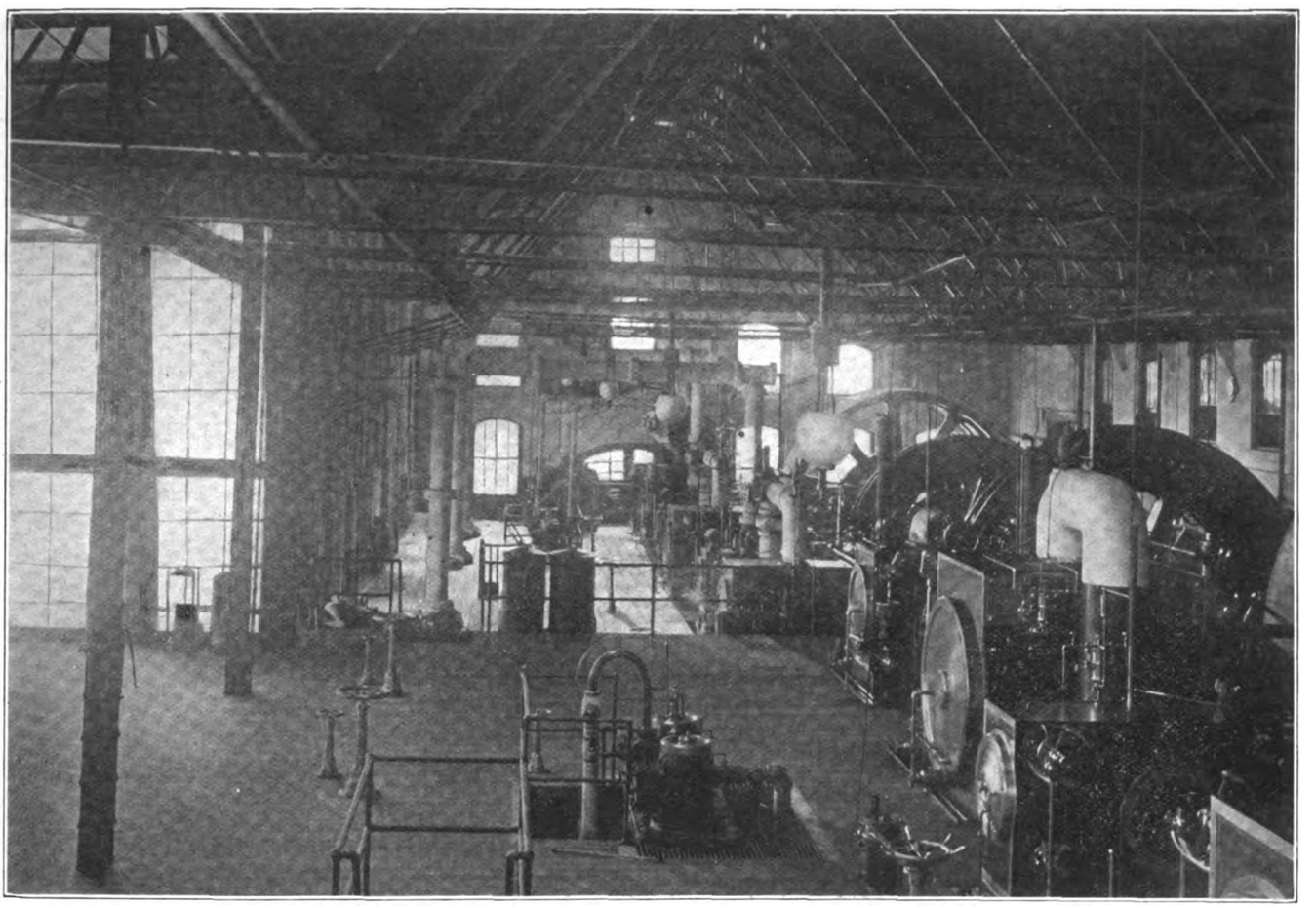
THE Narragansett Electric Lighting Company, Providence, R. I., supplies current for light and power to the city of Providence and the territory included within a circle of about fifteen miles radius. The central station is located in Providence, at the corner of South and Eddy streets, on the Providence river, and consists principally of three buildings—boiler house, engine room and dynamo room. The buildings are all of brick, with one main floor.

The boiler house is placed across the end of the engine and dynamo houses, which are arranged side by side. It is seventy feet by 120 feet, and twenty-four feet high. In it are installed twelve 375-horse-power Babcock & Wilcox boilers, which are set in batteries of two. The boilers are arranged in two rows of three batteries each, facing each other, with a passage about ten feet wide between them. Each boiler has 216 tubes four inches in diameter, and three drums thirty-six inches by sixteen feet. They are fitted with Roney mechanical stokers, the latter being driven by a shaft which runs the length of the boilers. The shaft is driven by a seven and one-half horse-power induction motor at one end, and a seven and one-half horse-power engine at the other end. Coal, at present, is wheeled into the building in wheelbarrows, and dumped on the floor, whence it is shoveled to the stoker hoppers. Plans have been completed, however, for a complete coal-handling equipment, with overhead storage bins.

Steam is taken from each boiler by an eight-inch nozzle, and is fed to a sixteen-inch header over each row of boilers. The header runs to a twenty-inch main steam pipe, which conveys the steam to the engine room. All the steam pipes in the boiler house are steel castings, some of them being twelve feet long and three-quarters of an inch thick. The flanges on the twenty-inch pipe are two and one-half inches thick, and all pipes were bored out a distance equal to twice the flange thickness from the end in order to discover blow-holes.

Each battery of boilers is supplied with a Green economizer, each economizer containing 256 tubes. The main flues from each set of boilers are eight feet by six feet. They lead to a brick stack fourteen feet in diameter and 250 feet high.

Water is supplied to the boilers by two Worthington duplex, outside-packed feed pumps, fifteen by ten by fifteen inches. The feed pipe at each boiler is two and one-half inches in diameter. The feed water, before entering the boiler, passes through a Gleaner feed-water heater, which has 750 square feet of heating surface. The steam auxiliaries in the engine room and boiler room exhaust to this heater. The heater is provided with horizontal U-tubes, arranged in series, the steam entering at the top and passing through to the bottom. The feed water is raised to a temperature of about 170 degrees Fahrenheit, and the condensed steam leaves the heater at a temperature of about five degrees above that of the entering water. In addition to the exhaust from the auxiliaries, all the drips



ENGINE ROOM, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

Digitized by Google

from the main engines are passed to the heater. City water is used in the boilers. The boiler pressure is 175 pounds.

The engine house is 200 feet by sixty feet, and has a wing forty-five feet by 100 feet. It contains all the engines used in the plant, except one 1,800-horse-power engine, which is installed in the dynamo house. Three engines, aggregating 3,600 horse-power, drive a shaft underneath the floor of the dynamo room, the generators for city lighting, and five direct-current generators being belted to this shaft. The shaft is 145 feet long, and varies in diameter from seven inches to six inches. The engines are:

One 600-horse-power, Allis triple-expansion engine running at 100 revolutions per minute. The cylinders are fourteen inches and twenty-four inches and thirty-three inches by forty-eight inches. The flywheel is seventeen feet by forty-eight inches. Steam is supplied to this engine by a five-inch pipe. The exhaust steam from the engine is passed to a jet condenser with a steam-driven, twin vertical air-pump nine inches by twenty inches by twelve inches. This engine is the first triple-expansion engine made in the United States for land service.

One 1,500-horse-power, Allis triple-expansion engine with cylinders twenty-two and thirty-six and fifty-two by forty-eight inches stroke, running at ninety revolutions per minute. The flywheel of this engine is twenty feet in diameter by eighty inches face. Steam is supplied to the engine by a seven-inch pipe, and the exhaust steam passes through a jet condenser equipped with a Blake twin vertical air-pump. The cylinders of the air-pump are twelve by twenty-eight by eighteen inches.

One 1,500-horse-power Allis cross-compound engine with cylinders twenty-four and fifty inches by forty-eight inches, running at 100 revolutions per minute. This engine was originally a triple-expansion engine, but has been changed to a compound. The flywheel is seventeen feet in diameter by seventy-four inches face. Steam is supplied through an eight-inch pipe, and the exhaust steam goes to a Blake jet condenser fitted with a twin vertical air-pump having cylinders twelve by twenty-five by eighteen inches. This engine is used as a reserve for the city lights. These three engines are connected to the shaft by three-ply belts. No dressing is used on the belts, and no trouble has ever been experienced with them. When an engine is not in use, its driven pulley is disconnected from the shaft by opening a jaw-clutch.

In addition to the above engines there are three engines for supplying direct current. These engines were all built by the International Power Company, Providence, R. I., and are rated at 750 horse-power each. They are cross-compound engines with cylinders nineteen and thirty-six by forty-eight inches stroke, and run at ninety revolutions per minute. The engines are direct-connected to 500-kilowatt, direct-current generators, and are fitted with direct-connected air-pumps and jet condensers. These engines are installed in the wing.

In the main engine room for alternating-current work there are three 750-horse-power, cross-compound engines with cylinders nineteen and thirty-six by forty-eight inches. The engines run at ninety revolutions per minute, and are direct-connected to 500-kilowatt, 2,000-volt, three-phase, sixty-cycle generators with revolving armatures. These engines have direct-connected air-pumps and jet condensers, the air-pump cylinders being thirty-two inches by ten inches. Steam is supplied to these engines through a

DYNAMO ROOM, SHOWING SERIES-ARC LIGHT MACHINES, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

Digitized by Google

seven-inch pipe on each engine. All of the foregoing engines are installed in the main engine room and its wing.

In addition there was installed in the dynamo room about a year and a half ago an 1,800-horse-power Rice & Sargent cross-compound engine with cylinders twenty-eight and fifty-six inches by forty-eight inches stroke. The engine runs at ninety revolutions per minute, and is direct-connected to a 1,200-kilowatt, 2,000-volt, three-phase, sixty-cycle, revolving-field generator. The engine has a jet condenser, with a Blake twin vertical air-pump with cylinders fourteen by thirty-two by twenty-one inches. Steam is supplied through a ten-inch pipe.

All the engines used in the plant are of the Corliss type. They are fitted with Monarch engine-stops, which can be operated from the switchboard or from a small panel-board in the engine room. The current to operate the stops is supplied by a one-half-horse-power motor-generator, which takes current at 250 volts and generates current at ten volts. The engines for alternating-current work are equipped with the Rites inertia governor. The other engines have the ordinary fly-ball governor.

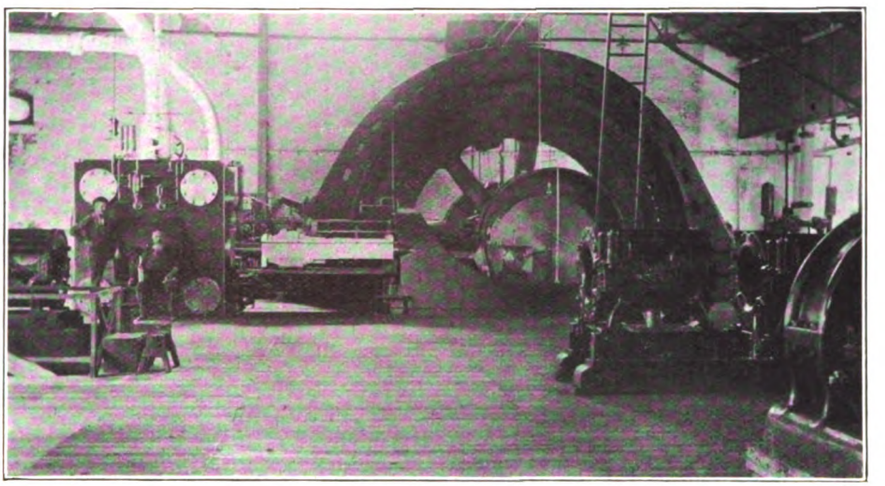
All the oil used in the engines is filtered, and is then lifted to a gravity tank by a two and five-eighths-inch by five-inch triplex pump, which is driven by a one and one-half horse-power Holtzer-Cabot four-pole motor. The motor runs at 1,650 revolutions per minute, and is geared to the pump, which runs at sixty revolutions per minute.

The engine room is lighted by ten direct-current arc lights, and about eighty sixteen and thirty-two-candle-power, 235-volt incandescent lamps.

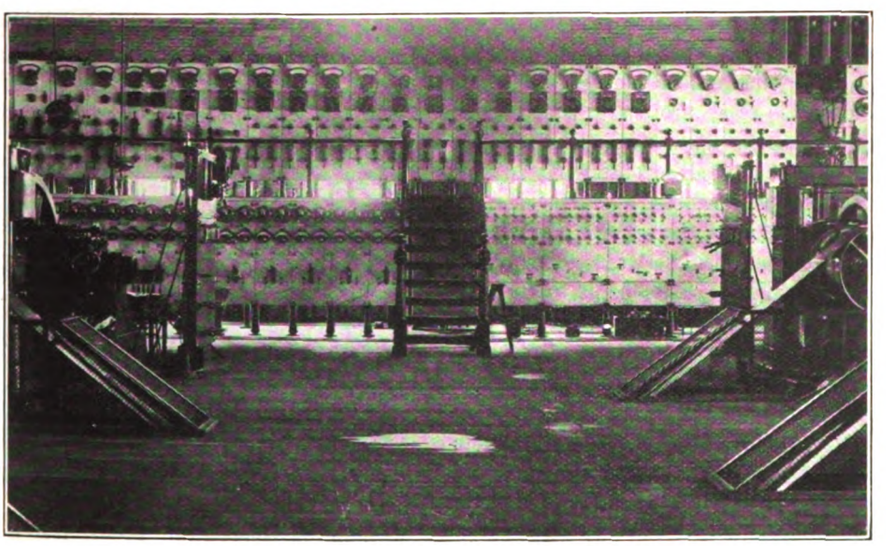
The dynamo room is 60 by 200 feet. At the west end of the room are installed eighteen 125-light "Wood" arc generators, which are used for the series arc lighting in the close fire district of the city of Providence. These machines run at 500 revolutions per minute, and generate ten amperes at 6,250 volts. The machines are arranged in four rows, two on each side, and are belted to the shaft heretofore mentioned, the belts going through the floor.

In addition to the "Wood" machines there are in the dynamo room one 200-kilowatt, two 225-kilowatt, one 270-kilowatt and one 325-kilowatt direct-current generators, also belted to the shaft. These generators are run in parallel with the direct-current generators in the wing of the engine room. All direct current generated, with the exception of that for the series arc lighting, is at 500 volts. The field current on all machines is taken from the mains at 500 volts. On each engine is a pilot lamp, which indicates the closing of the field-switch. The current used in fields is metered.

In addition to the generators there is a 500-kilowatt motor-generator set with an alternating-current induction motor and direct-current generator. This is used when the direct-current load is light, as from midnight to morning, and on Sundays. The induction motor is three-phase, and operates at 2,200 volts. The motor-generator set is arranged so that it may be started either from the direct-current or the alternating-current side. As a matter of fact, the usual method of starting is to use direct current, and after the machine is up to speed to throw the load over on the induction motor.



1,800 Horse-Power Engine and Generator in Dynamo Room, Narragansett Electric Lighting Company, Providence, R. I.



Main Switchboard, Narragansett Electric Lighting Company, Providence, R. I.

Two motor-driven boosters of 150-kilowatts each are used for the battery system, boosting from the bus-bars to the battery.

In addition to the above equipment the company has contracted for two 2,000-kilowatt and one 800-kilowatt Curtis turbines, to be used for direct-current work.

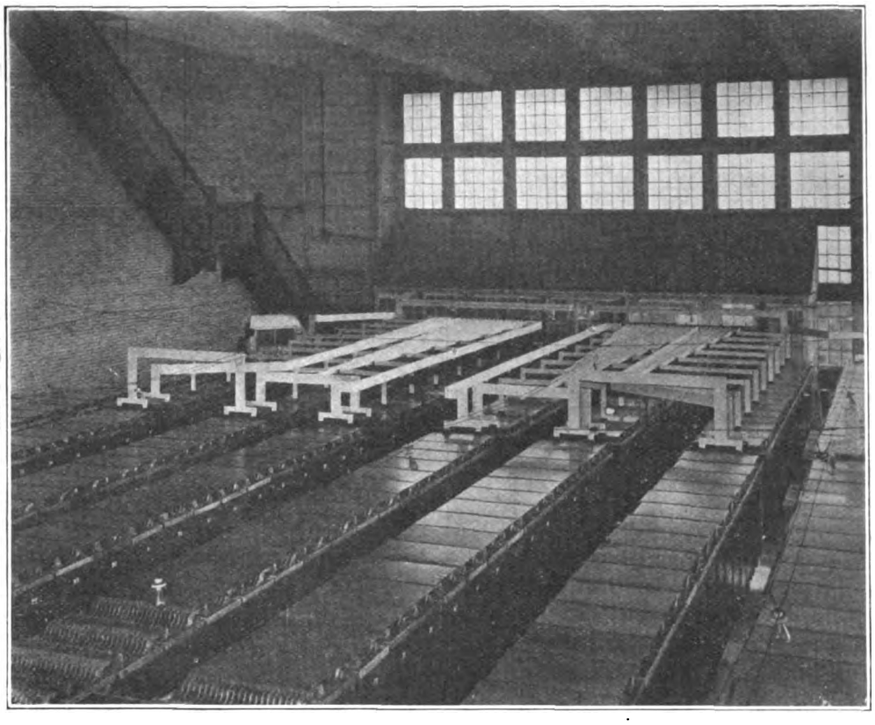
For series incandescent lighting alternating current is used. The current is taken from the generators and passed through fifteen General Electric constant-current, air-cooled transformers, located on the main floor, just beyond the "Wood" series arc machines. These transformers are of thirty-five kilowatts capacity and give 5.5 amperes current. The primary voltage is 2,200.

For the long-distance transmission alternating current is stepped up from 2,200 volts to 10,000 volts in three 250-kilowatt, oil-cooled transformers in the basement. The transformers are all delta-connected.

The switchboard is installed at the west

Digitized by Google

end of the dynamo room, and consists of three main panels, which are used, respectively, for the alternating-current distribution, direct-current distribution and the series arc lighting. A smaller panel is used for the long-distance, alternating-current transmission line. The alternating-current board is on the left-hand side,



INTERIOR OF STORAGE BATTERY STATION, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

and consists of four generator panels, ten feeder panels and one total-output panel. Each panel is of white marble, two feet by five feet. On each of three of the feeder panels are three 200-ampere ammeters, a rheostat, an oil switch on the back of the panel, a voltmeter switch, a field switch and a double-pole, double-throw knife switch for synchronizing. This double-pole, double-throw switch changes the position of the weights on the governor of the engine, thus varying its speed. There is also a push-button which operates the emergency stop on the engines. The fourth feeder panel is the same as the other three, with the exception that there are three 500-ampere ammeters instead of three 200-ampere ammeters. The ten feeder panels each have two Fort Wayne wattmeters of varying capacity, two ammeters, and an oil switch on the back of the panel.

There are two sets of bus-bars, each of which carries its own load, but the two sets can be thrown together or kept independent. This eliminates the danger of a circuit being cut out through a breakdown of one of the engines.

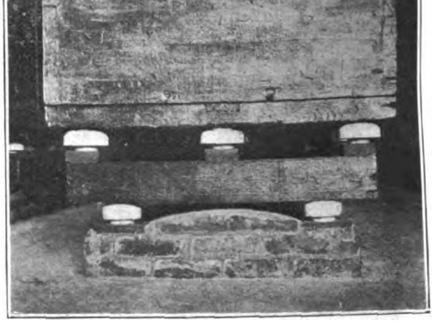
The direct-current switchboard is on a gallery above the alternating-current board. It consists of ten feeder panels and sixteen output panels. Each of the feeder panels carries an ammeter, a rheostat, and two single-pole, double-throw knife switches, which may be used to throw in either set of bus-bars. The output panels carry an ammeter, a wattmeter and two single-pole, double-throw switches.

On the main floor, on the right-hand side, is the series arc board, consisting of seven panels. These are all fitted with stab switches used for throwing any circuit on any machine.

In addition to these three main boards there is a long-distance transmission board on the gallery. This panel carries two wattmeters and two oil switches. The oil switches are located on the wall above the panel, and are separated by soapstone slabs.

The storage battery station is located about 2,400 feet away from the station, and practically at the centre of distribution of the system. The battery consists of 296 cells of forty-three plates each. The original rating was an output of 840 amperes at an eight-hour rate. The battery has been in commission about five years, and was originally furnished by the Electric Storage Battery Company, of Philadelphia, Pa. All renewals, however, have been made by the National Battery Company, Buffalo, N. Y., and by the Gould Storage Battery Company, New York city. No change has been made in the battery since it was installed, except in the method of supporting the tanks. The present method of support is shown in the illustration. A double tier of porcelain insulators is used, the first tier being mounted on four brick piers. These piers are capped with hard pressed tile, thoroughly impregnated by boiling in paraffin. On the tile are triple-petticoated insulators of porcelain. Longitudinally with the cell, and resting on the four insulators, are two hard pine sticks, each four by four and three-quarters inches. These sticks are painted with acid-proof paint. On each stick are placed three tiles boiled in paraffin, and on the tiles is placed a second tier of porcelain insulators. The tanks are supported on this second tier of insulators. From the floor to the bottom of the tank is a distance of twenty and three-quarters inches. The floor under each cell is pitched from a point under the middle of the cell to the aisle between them t an angle of about twenty degrees. This allows any surface water or drip from the tank to drain off rapidly. The changes made in the method of installation consisted in the building of the brick piers and putting in the lower tier of insulators. Originally the pine stick rested directly on the floor.

The distribution system is on the three-wire, 500-250-volt system. The three-wire distribution commences at the storage battery, all the machines at the station being arranged for two-wire distribution. The neutral wire in all cases is grounded. In the close fire district of the city and in a portion of the outlying district the wires



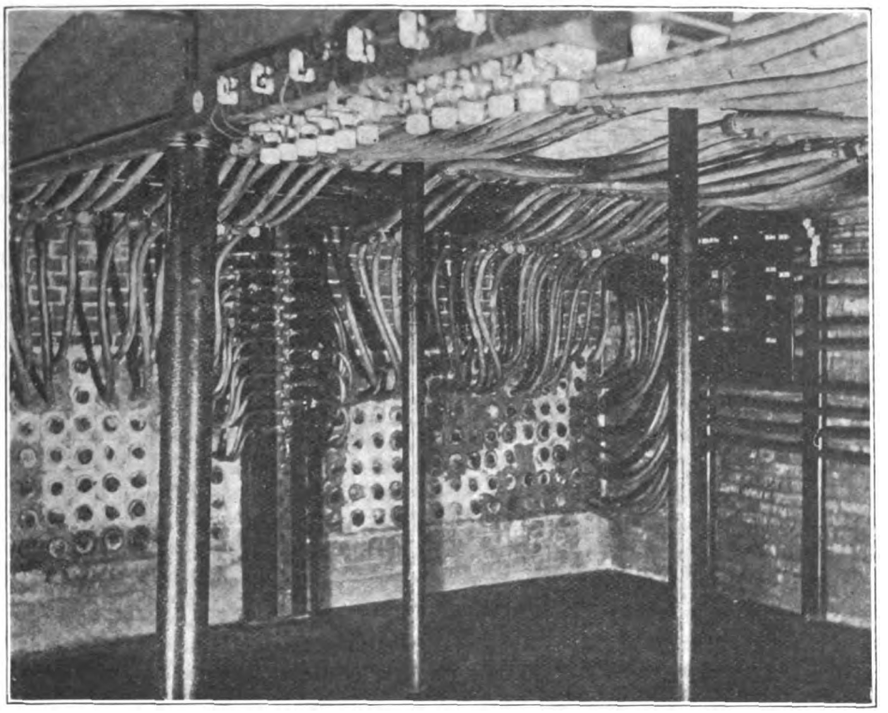
METHOD OF SUPPORTING STORAGE BATTERY CELL, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

are carried underground in conduits. In five years of operation not a single fault has developed in the insulation in the conduits.

The company has two substations, one located at Warren, and the other at Warwick. The station buildings are identical. They are of brick, with granite trimmings,

Digitized by Google

and are entirely fireproof. The equipment of the station at Warren consists of three sixty-five-kilowatt, 125-light, 5.5-ampere, 10,000-volt General Electric constant-current transformers, and four seventy-five-kilowatt, oil-cooled, Westinghouse step-down transformers. These step the line voltage from 10,000 to 2,200 volts.



CABLE VAULT AT STORAGE BATTERY STATION, NARRAGANSETT ELECTRIC LIGHTING COMPANY, PROVIDENCE, R. I.

The equipment at the Warwick station consists of five sixty-five kilowatt constant-current transformers of 125 lights capacity, and four 150-kilowatt, step-down transformers, stepping down from 10,000 to 2,200 volts. The switchboard at each station has General Electric oil switches and instruments. All the high-tension switches are in the basement, and are controlled from the floor above. The stations have been built about one year.

The total connected load on the central station consists of 2,105 Thomson-Houston open arc lamps and 128 6.6-ampere enclosed alternating-current series arc lamps. There are also 5,024 5.5-ampere alternating-current series incandescent lamps, and 115,757 alternating-current multiple incandescent lamps. There are 1,427 direct-current multiple arc lamps, and 502 alternating-current six-ampere enclosed multiple arc lamps. There are 89,300 direct-current multiple incandescent lamps. The motor load consists of 105 alternating-current motors, aggregating 505 horse-power. There are 926 direct-current motors, aggregating 6,300 horse-power. The total connected load is equivalent to 364,473 sixteen-candle-power lamps.

High-Speed Railway Propositions in Germany.

Ever since the experiments in 1902-1903 with high-speed electric traction over the special line between Berlin and Zossen were concluded, and the results analyzed and recorded, the question of an electric railway for rapid service between Berlin and Hamburg has been a topic of interest and constant discussion in the daily and technical press of Germany.

The Zossen experiments demonstrated that, given a straight, well-laid and well-balanced track, with the best modern construction, a speed of 120 miles per hour was possible and safe. It was shown that, to propel a single car carrying the requisite equipment, and with accommodations for sixty passengers, at a speed of 110 miles an hour, 1,300 horse-power was necessary, and this was increased to 2,000 horse-power when the speed was raised to 120 miles an hour. At the latter velocity 1,100 horse-power was required to overcome the air resistance alone.

It was found that to keep on the rails and run steadily the car must be heavy, and its running gear skilfully adapted to slurring over the slight and unavoidable irregularities of the track. For this reason light cars are impracticable for speeds over eighty miles an hour. At higher speeds the lateral oscillation becomes so great as to make the car dangerous. At such high speeds curves must be avoided, or must have a radius of not less than a mile; otherwise the speed must be reduced in passing them. There is at present no steam railroad of any important length in any European country—except possibly Russia—that is sufficiently straight to meet the requirements of high-speed service.

According to United States Consul-General Frank H. Mason, Berlin, Germany, two propositions have been submitted for the construction of a high-speed line between Berlin and Hamburg. The distance is 177 miles, which could be shortened by a new direct line to 155 miles. The country between the two cities is generally level and well adapted to the construction of a high-speed line. The ordinary traffic between Berlin and Hamburg is about 1,200 persons per day. The average fare is $3.80, and the fastest time made on the best steam train is three hours and thirty-two minutes. The accommodation trains take from five to six and one-half hours.

One proposition, submitted by Siemens & Halske, contemplates a single-track line on which a train would be despatched from each terminus every two hours, or oftener if necessary, the two meeting and passing each other at the midway station of Wittenburg, and making the through run in one hour and fifty-five minutes. Such a line, equipped for service, would cost, according to the estimates submitted, $16,666,000. In the opinion of Siemens & Halske this road would carry 520,000 passengers per year, and if each paid $3.57, the road would earn a profit above the interest and working expenses.

The second proposition, submitted by the Allgemeine Elektricitäts Gesellschaft, contemplates a double-track line on which trains would travel at 100 miles an hour, making the through trip in one hour and twenty-five minutes. The cost of the road would be $29,750,000. If a speed of 125 miles an hour were to be maintained, the equipment would cost $35,700,000. At the proposed rate of fare—$3.57 for an ordinary seat, and $1.19 extra for a section *de luxe*—it would be necessary to transport 850,000 passengers yearly to show a profit over interest and running expenses. This plan contemplates trains of from one to four cars, according to the requirements of travel. Each train will be, in all respects, an independent unit.

Should such a road be built, there is some doubt whether it would pay, and it would also compete with existing roads. It is a question whether the Prussian government will consent to sacrifice the bulk of its passenger business on an important trunk line, and incur an expenditure from $16,000,000 to $30,000,000 in order to enable the public to save from one and one-half to two hours in the trip from Germany's capital to its chief seaport.

Digitized by Google

DISTRIBUTION AND DOLLARS.[1]

BY C. H. WILLIAMS.

INTRODUCTION.

Every problem which arises in this branch of engineering may be reduced to a dollars and cents basis, and the engineer of the present day is called upon not only to reach a certain clearly defined result, but to accomplish it with due regard to the investment and expenses entailed.

Engineers are gauged by the results which they obtain, and in this particular line the gauge is most likely to be graduated to dollars or dividends, and the dividends will not be long forthcoming unless good service is rendered, while good service can not be secured without following sound engineering principles.

FACTORS REGULATING THE SIZE AND NUMBER OF FEEDERS TO BE INSTALLED.

When considering the several losses which are to be dealt with in distributing systems, it is but natural to start at the generating station and consider the losses in the regular order in which they are met as the current is conducted from the generating station, over the distributing system to the consumer's lamp.

On leaving the station the question of line construction is the one which naturally first demands our consideration.

The load which is carried on the several circuits depends upon local conditions, the two most important of which are the average length of the feeders and the operating cost of generating the current.

The copper losses in the feeders for any assumed load, figured on the operating cost of generation, compared with interest on line investment, fix the load to be carried; for example, assume the current to be generated at 2,000 volts, and that for a load of 100 amperes a drop of 200 volts is allowable, with an average length of feeder of two miles, which would require the use of 1-0 wire; assume further, that this load of 100 amperes for two hours per day per year represents the copper loss, which is 14,600 kilowatt-hours. This, at a generating cost of two cents per kilowatt-hour, amounts to $292. If a 200-ampere load has been allowed on the same size of wire, the copper loss would amount to $1,168.

Figuring the copper wire at eighteen cents per pound strung, gives for the two sides of the circuit of two miles 21,120 feet, and allowing four per cent for slack and tie wires, gives a total length of 21,965 feet of wire.

[1] Read before the Northwestern Electrical Association, January 18, 1905.

The weight of 1-0 wire is 400 pounds to the thousand feet, which gives a weight and total cost of 8,786 pounds and $1,581.48, respectively, while the interest at six per cent and depreciation at three per cent, which covers the failing of the insulation for which the price of copper is paid, aggregating nine per cent, amounts to an annual cost of $142.38.

On the previous assumption that the load is equivalent to 100 amperes in the one case and 200 amperes in the other, at 2,000 volts, two hours per day, 365 days in the year, there is an annual output of 146,000 kilowatt-hours in the one case, and 292,000 kilowatt-hours in the second, which, divided into the copper losses plus the interest and depreciation, amounts respectively to 0.00295 per kilowatt-hour for 100 amperes, and 0.00448 per kilowatt-hour for the 200-ampere load, which shows conclusively that the 100-ampere circuit is the more economical.

From the above example it follows that we can not predetermine a certain drop which shall be allowed in every case, but each must be worked out for itself.

In secondary work the practice is becoming more and more common of making an interconnected, three-wire network, which allows of close secondary regulation throughout large districts, and also does away with a large percentage of idle transformer capacity, which, consequently, reduces the iron losses, but as this question of transformer iron loss is best taken up by itself, its discussion will not be considered at this point.

CHOICE OF SIZE OF TRANSFORMERS AND SECONDARY FEEDERS.

Conditions, such as active lights per 100 feet of territory fed, determine the proper sizes of transformers and feeders, and to facilitate ready interchanging, and prevent the necessity of carrying half a dozen different sizes of fuses and supplies; multiplicity of sizes of transformers and secondary feeders should be avoided.

Determining or estimating the load, the sizes of transformers depend upon whether the load is scattered over a large territory, or bunched within comparatively narrow limits, and the difference between the interest and depreciation on the transformer investment, together with the cost of current for iron losses for the several sizes of transformers under consideration, on the one hand, and the corresponding interest and depreciation on the investment required for the secondary copper, together with the secondary C^2R loss on the other hand, determines the size of transformer to be used.

It is good practice to adopt some standard size of transformer for residence lighting which covers the conditions for the larger part of the territory under consideration, and to adopt a larger size for the business districts. The number of sizes will then be cut down to two, and a careful study of the conditions will generally demonstrate that this is advisable.

REGULATION AS AFFECTING RENEWALS.

The matter of regulation may be figured for the cost of lamp renewals—provided an accurate record is obtainable of the number of connected lamps, whereby the consumption per lamp per year may be calculated.

If we assume the use of 3.5-watt lamps, and have nearly perfect regulation, and find the average consumption per lamp per year to be twenty kilowatt-hours, the cost of renewals for each lamp figures out to be the cost of the lamp, plus the cost of the labor changing and photometering each lamp, times the connected load in lamps and on the assumption of a 750-hour life, the actual cost for lamp renewals for the system is as follows:

A sixteen-candle-power, 3.5-watt lamp costs seventeen cents and consumes fifty-six watts, and if there is a consumption of twenty kilowatt-hours per lamp per year, each lamp will burn 357 hours per year, or there will be 357-750, or 0.0476 lamp renewals per year, which amounts to $0.0809 per year or $0.004 per kilowatt-hour. The cost of photometering and the labor of changing amount in practice to a cent and a half per lamp or $0.0071 per lamp per year, or $0.00035 per kilowatt-hour, giving a total cost for lamp renewals of $0.00435 per kilowatt-hour.

With a variation of voltage of but one per cent, the life of the lamp drops to 615 hours, which gives 0.58 lamp renewals per annum, which amounts to 0.0986 per year, or 0.00493 per kilowatt-hour, while the labor renewing and photometering amount to 0.0087, or $0.0043 per kilowatt-hour, making a total cost of lamp renewals of $0.00536 per kilowatt-hour, which is an increase of 0.00101 per kilowatt-hour, or for a station with 42,000 lamps connected with an average consumption of twenty kilowatts per lamp per year, and money available at six per cent, $14,140 could be spent to better the conditions of regulations if this one per cent variation could be wiped out, the interest on this amount just equaling the money saved by the decreased lamp renewals.

With two per cent regulation the cost would be 1.48 times the above, and with

Digitized by Google

four per cent regulation the cost for lamp renewals would be 1.48 times that for two per cent regulation. The matter of regulation, then, is a very important one to the central station, other than the consideration of the question of satisfactory service.

NECESSITY OF KEEPING ACCURATE DISTRIBUTION RECORDS.

In considering the connected load on several circuits and on different transformers, it is necessary to know not only the candle-power of the lamps, but the efficiency and voltage as well, for, should a district be designed for high-efficiency lamps of 3.1 watts per candle-power, and then be supplied with four-watt lamps, the entire system would be radically wrong, and satisfactory service could not be given because of the substitution of four-watt lamps in the place of 3.1-watt, the capacity of the lines and transformers as well as the generating apparatus, boilers, engines and dynamos would have to be increased practically thirty per cent.

Herein lies one of the strongest arguments which can be advanced in favor of having the lighting company furnish free lamp renewals, for in no other way will it be possible to control the installation of proper lamps upon its lines.

MEANS FOR OBTAINING SATISFACTORY REGULATION.

Turning to the station as the source of regulation, it is found that the only way possible to accomplish it is to install sufficient feeder regulators on the various circuits and to provide either compensating voltmeters or pressure wires, regulating each circuit separately by hand. In some stations automatic regulators may be made to take care of the changes by properly changing the excitation of the generator, but in the larger stations where of late large polyphase current machines are being operated, it is next to impossible to keep the load sufficiently well balanced to maintain equal secondary pressures on the different phases without the aid of circuit regulators working through a considerable range.

In Madison the regulation is obtained by supplying two of the six circuits with feeder regulators, and after paralleling the generators and exciters, regulating them as one unit automatically from a centre of distribution of one of the remaining circuits through a pressure wire controlling an automatic regulator, and very satisfactory results are obtained in this way.

The automatic regulator used at Madison is a Chapman voltage regulator, built by the Belknap Motor Company, and five years' use has proved its worth. It consists of a relay connected to a pair of No. 6 pressure wires run to the secondary centre of distribution of a primary circuit; a rheostat is connected into the fields of one of the exciters, and a pair of working solenoids operate the rheostat. An arm carrying contact shoe is attached to the cores of the solenoids, the latter having two windings, one of which is fed with the relay current, and this, in turn, induces a current in the secondary in the same direction, thereby preventing sparking.

Having secured proper station regulation and proper line installation, the next step is to see that suitable transformers are properly located.

TRANSFORMER LOSSES AFFECTING DISTRIBUTION COSTS.

The first essential in successful electric lighting is continuity of service, and for this reason it is very important to know that the transformers which are installed are going to withstand any insulation strains to which they may be subjected.

Before placing in service, each transformer which stands between ordinary consumers' circuits and primary circuits subjected to dangerous pressures should be subjected to a test of at least five times the normal difference of potential between the various parts to which it will be subjected in practice, and when transformers on transmission lines are used on voltages exceeding 7,500, it is customary to subject them to a strain of twice the voltage for which they were designed.

The next important item, and a very important one, is that of the question of transformer core loss, for this represents the principal difference between the power generated at the station and the power for which the consumer pays. As this is a dead loss, and one which goes on all the time that the circuit is alive, it is very obvious that its magnitude is a matter worthy of careful consideration by the central station manager. This matter also deserves careful consideration in determining the capacity of transformers which are selected as standards, as the percentage core loss varies as the sizes change, the core loss in a five-kilowatt transformer being nearly double that of the similar losses per kilowatt capacity which are found in a like fifty-kilowatt transformer of some standard makes.

HEATING EFFECTS IN TRANSFORMERS.

Next comes the C^2R loss in both the primary and secondary windings, which, as a direct loss, is not so important, as lighting transformers are usually operated but a few hours per day at full load, but the C^2R loss, together with the core loss, determines the heating in the transformer, and the rise of temperature determines the ultimate capacity, as a high temperature soon deteriorates the insulation, causing it to weaken, break down and give away eventually. Heating in the transformer also causes the iron to age, and this in turn increases the core loss.

Referring to the report of the committee on standardization, we find the following, *viz.:*

"In the case of transformers intended for intermittent service, or not operating continuously at full load, but continuously in circuit, as in the ordinary case of lighting transformers, the temperature elevation above the surrounding air temperature should not exceed fifty degrees centigrade by resistance in electric circuits, and forty degrees centigrade by thermometer in other parts, after the period corresponding to the term of full load. In this instance the test load should not be applied until the transformer has been in circuit for a sufficient time to attain the temperature elevation due to core loss. With transformers for commercial lighting the duration of the full-load tests may be given as three hours, unless otherwise specified."

It is not safe to take temperature readings in the oil of oil-cooled transformers and operate the transformer at such a load that the oil reaches even a comparatively high point, as in many transformers the circulation between the coils is so poor that a very dangerously high temperature may exist in the interior of the coils, while the oil may show but a comparatively low reading. The rise in temperature should be arrived at by measuring the resistance of the coils.

The actual capacity of a transformer in reality depends to a very large extent on its ability to dissipate the internal heat, and if means can be provided for getting rid of this heat and preventing high local temperatures, the actual capacity of a transformer can frequently be safely increased far beyond its rated capacity.

An extreme case may be cited where two fifty-kilowatt booster transformers are made to carry a load of 250 per cent of their normal rated capacity.

This is accomplished by means of a small circulating pump which draws off the cooling oil from near the top of the oil surface, and circulates it through a system of iron pipes built up in the form of a steam radiator; cold water is allowed to run down on the outside of the cool-

Digitized by Google

ing pipes, and the oil, after being cooled, is forced back into the bottom of the transformer cases.

Before this scheme was resorted to the oil temperature rose to 180 degrees Fahrenheit when operating the transformer at 100 per cent overload, whereas the temperature is easily maintained below seventy-five degrees when the transformers are operated at 250 per cent of their normal load when use is made of the oil-cooling system.

REGULATION OF TRANSFORMERS.

Another item of importance is the inherent regulation of a transformer, and by regulation is meant the ratio of the drop of secondary voltage from no load to full load. With transformers of poor regulation on the circuits, difficult problems will enter when an endeavor is made to give all consumers equal and normal voltage, which would necessitate pronounced changes in secondary feeders, or a still more objectionable change in a substitution of lamps of different voltages and efficiencies.

The insulation having been proven satisfactory, the interest on the investment for the transformer, together with the core loss in kilowatts, times twenty-four hours per day every day in the year, times the generating cost per kilowatt-hour, and the full load copper loss, times the equivalent number of hours during which the transformer would operate full loaded, times the generating cost per kilowatt-hour, give the data necessary for finding the actual cost per annum of operating each type of transformer, when operating on a twenty-four-hour lighting load, so that the other conditions being the same, the most desirable type is determined.

It is apparent from the foregoing that the conditions under which the transformer is to be operated have much to do in determining the value of the different factors, for instance, the iron loss goes on as long as the transformer remains in circuit, while the copper loss is nil so long as no current is flowing, and increases with the square of the current as the load is increased.

If, then, a transformer is to be selected for a lighting load where it is on the circuit twenty-four hours per day, and furnishes a total amount of power equivalent to its full load for but two hours per day, it is of first importance, so far as the losses are concerned, to obtain a transformer with a low iron loss, and, on the other hand, if the transformer is to be fully loaded all day, it is much more essential that the copper loss should be as low as possible.

In any case, the two losses must be taken into consideration, and the expenses figured for each before an intelligent selection can be made.

RECORDS OF TRANSFORMER TESTS.

It is essential that a record be had not only of the performance of the transformer at the time when it is put upon the line, but also a record should be kept of periodic tests, in order that any change which takes place as the apparatus ages may be watched and recorded, as it may be advisable to discard it and substitute other apparatus if the change is a material one, as it has often proved to be in a few years. This will be brought out in a very pronounced way if proper records of lost and unaccounted-for current are made each month.

A very forcible example of the rapid change in transformers can be cited in the writer's experience at the plant at Madison, where 460 kilowatts capacity of transformers was purchased under quite stringent specification about five years ago. At the time at which these transformers were purchased, they showed a remarkable record so far as high efficiency, close regulation and low core loss were concerned, but when put into service the depreciation was very high, in that the iron aged very rapidly, increasing the iron loss some 200 to 250 per cent. The insulation failed to withstand the test of time, to the extent that it was finally deemed advisable to dispose of the entire equipment as junk and substitute in its place more modern transformers which were constructed upon better engineering principles and this was done about a year ago.

This example only goes to show that it is necessary to allow a liberal percentage for depreciation to protect the station from being swamped by unexpected failure of apparatus.

LOST AND UNACCOUNTED-FOR CURRENT.

Lost and unaccounted-for current assumes such large proportions in some stations that radical measures have to be taken for its reduction.

The losses in different systems vary from a small per cent in small direct-current stations, to as much as fifty per cent of the station's output in some alternating-current stations where individual transformers are used.

The difference between the amount of electric energy sold and generated represents the loss between the switchboard and the consumer's meters.

The output is registered by the switchboard meters at the station, and the amount sold by the consumer's meter. Some of the losses which go to make up this difference are legitimate losses, and may be calculated for any system of distribution. The amount which remains after deducting these losses is termed "unaccounted-for current," and is usually made up of faulty registration, leakage and theft of current.

The power losses in alternating-current circuits may be divided as follows:

Transformer iron loss.

Transformer copper loss.

Resistance loss in primary transmission wires.

Resistance loss in secondary distribution wires.

Meter shunt loss.

Lost and unaccounted-for electric power.

The first three do not appear in direct-current system, but each of the losses will be considered separately with an endeavor to show how they may be calculated, and possibly reduced.

Each circuit should be considered by itself, taking into account the connected load on the circuit, the length of wire in primary and secondary circuit as well as the characteristics of the transformers, and the watts consumption per lamp per year, thereby offering a means of comparison, at the same time simplifying matters and facilitating the tracing of the losses.

TRANSFORMER LOSSES.

The transformer iron losses are figured by multiplying the iron losses per transformer by the number of transformers on the circuit and this by the number of hours in use.

All transformers should be tested both for iron and copper losses before being placed on the line, and a careful record kept of these tests, while a check on the iron losses should be made whenever a transformer is brought in, or if changes are infrequent, certain pilot transformers should be selected and periodic tests made upon them. If tests can not be made, approximate results may be obtained by assuming the losses as given by the manufacturers, but the latter is not recommended unless conditions absolutely prohibit the testing by the purchaser. When tests are made care should be exercised to see that the tests are made under running conditions, particularly with regard to voltage and frequency.

The transformer copper losses are figured by the use of previous tests made to ascertain the copper losses on each transformer on the line for one-fourth, one-half, three-fourths and full load.

These losses for all transformers on the line are added together and plotted in

Digitized by Google

a curve, using amperes of load as ordinates and watts as abscissæ. Then for each ampere reading taken on the circuit during the twenty-four hours' test run, the corresponding watts loss is found on the curve. These losses are added up for a period of twenty-four hours, and the loss for a month is found in the same way as the primary and secondary C^2R losses, as these copper losses are strictly resistance losses.

For Madison station the copper losses for twenty-four hours are very nearly equivalent to full-load copper loss for two hours, the balance of twenty-two hours being considered to be running at no load. This, of course, would vary somewhat with the ratio of transformer capacity to maximum demand.

RESISTANCE LOSSES.

In figuring primary resistance losses, knowing the size and length of the copper in the mains, the C^2R loss is figured by assuming one ampere to be flowing to a point where the circuit divides, and then assuming that the one ampere divides in proportion to the connected load on each respective branch. The sum of all these C^2R losses is taken as a constant for figuring the all day losses, which is done by taking the station ammeter readings at intervals of thirty minutes during light load and ten minutes during peak load. Each of these readings is then squared and multiplied by the constant, and afterward reduced to kilowatt-hours; by considering the time intervals of the readings, the sum of the results of these calculations represents the all day C^2R loss.

The station output for the period must be measured by the station wattmeter.

In order to obtain the monthly resistance loss in the primary circuit the monthly output, as shown by the station meter, is divided by the output during the test run multiplied by the number of days in the month. This figure is squared and multiplied by the resistance loss for that of a single day as determined by the test run, and then multiplied by the number of days; this will give the resistance losses as near as it is possible to calculate them practically, for the losses increase and decrease in proportion to the square of the increase or decrease of the output for the particular circuit under consideration.

The secondary resistance loss is figured in much the same way as is the primary, only it is necessary to use more judgment in the distribution of current in secondaries. The current distributed is determined and divided in proportion to the connected load, and the number of lamps in each block is counted and the number reduced to a basis of amperes, which gives the amount of which to figure the secondary losses.

Quite recently there has been placed upon the market an instrument designed by Mr. C. W. Humphrey, which is invaluable in determining the division of load on the several branches between transformers working on an interconnected secondary network.

The instrument consists of a small series transformer, the coil of which is placed on an iron ring, so arranged that a small segment of the ring can be opened and closed over the conductor carrying the current to be measured.

The transformer proper, which weighs about two pounds, is connected to sixty feet of flexible duplex cable, the free ends of the cable being fitted with terminals suitable for clamping in the binding-posts of a portable ammeter. The ammeter, which in reality is a milli-voltmeter properly graduated, reads direct the value of the current flowing in the conductor.

By means of this instrument a large system can be checked up in a single evening. One man takes the small coil to the top of the pole and snaps it successively onto the two outside wires of the three-wire secondaries leaving the transformer, and another man at the foot of the pole on the ground reads and records the load that each side is carrying.

By the use of this instrument it is shown that no matter how carefully an estimate may be made as to what the probable division of load will be, that gross errors will be found, one transformer carrying much more load than was intended for it, and one side of the system may be found overloaded, while the other will be found to be underloaded.

In connection with this method of keeping connected load records, a card system adapts itself admirably.

CARD SYSTEM FOR KEEPING RECORD OF CONNECTED LOAD.

At the Madison plant the first division is made up of the individual circuits—six in number—each circuit occupying one drawer of the card cabinet. Next, each circuit is divided according to the transformers connected on it, a pilot card being used for each transformer, there being but forty-three transformers in all for a connected load of 42,000 lamps. Under the head of each transformer appears a minor card for each street which makes up the district fed by the transformer's network of secondaries as far as the junction points between adjacent transformers, and numerically according to the house numbers are cards for each connection, or rather, each meter, as one connection may feed a number of meters. On the other card is given the installation of lamps, giving the number installed of each candle-power, also the equivalent number when reduced to a sixteen-candle-power basis, also showing whether the same are on No. 1 or No. 2 side of the secondary network. A cross index giving the name and street address is also kept for the purpose of easily locating any consumer.

Every lamp sent out is recorded, and once a month all changes in connected load are changed on the cards, and new consumers' cards are filled in at the proper place, and disconnections are removed, the removals being kept for future reference, should the same or another party apply for a connection at the same number.

A count is then made which shows the connected load upon the transformers, the connected load upon the circuit, the connected load upon the station, as well as the connected load on each side of each three-wire secondary network, which so frequently becomes entirely unbalanced if stringent means are not used to maintain the proper distribution of load between the two sides.

METER SHUNT LOSS.

The next loss to be considered is the meter shunt loss.

A record is kept of all meters sent out on each circuit, their make, size and type, and a record of their test, and from these data the meter shunt loss may be easily calculated for each month, a careful test having been made of a sufficient number of meters to obtain a constant for the shunt loss of each size and make and type of meter.

The average shunt loss for late type alternating-current lighting meters may be considered to be about two and one-half watts, and as the average loss is so small, one would naturally think that this loss could almost be neglected, but this is far from true; for instance, the station under consideration had one circuit where the meter shunt losses aggregated more than did the transformer core losses, being for a certain month 5.93 per cent of the output for meter shunt loss, and 5.01 per cent for transformer core loss, and in many cases these items will be found to be equal. In the case of T. R. W. type of meter, such as are used on most direct-current power circuits, considerable unaccounted-for current may be brought to

Digitized by Google

light by making it a rule to give the meter jewel a careful overhauling after each run, consisting of 400,000 turns of the shaft, which may easily be determined from the reading of the meter.

The lost and unaccounted-for current, besides arising from faulty registration, leakage and theft of current, may come from lost records. Few plants will find that a careful checking over of their circuits will not bring to light some consumers whose names are not upon the books.

After these data are collected for the several circuits it is an easy matter to determine where the trouble lies. Such information will show at a glance whether or not line losses are excessive, or core losses too high, or whether all transformers are properly loaded, and, in fact, will enable changes to be made so that the lines may be operated at the highest possible efficiency.

As an illustration a tabulation is given as worked out for the Madison plant for an October day.

Circuits.	Output.	Core Loss.	Per Cent.	Cpper Loss.	Per Cent.	Meter Shunt Loss.	Per Cent.	Primary C²R Loss.	Per Cent.	Secondary C²R.	Per Cent.	Total Loss.	Per Cent.
1..... ...	421,000	28,488	6.76	3,461	0.82	14,916	3.54	19,006	4.51	1,456	0.55	67,327	15.98
2.....	522,400	19,752	3.78	6,379	1.22	19,092	3.65	14,103	2.7	2,604	0.49	61,930	11.84
3.....	300,000	28,680	9.56	4,313	1.44	23,316	7.77	10,744	3.58	1,969	0.66	68,749	22.91
4.....	413,000	20,712	5.01	3,208	0.77	24,504	5.93	20,079	4.86	6,404	1.55	74,907	18.12
5.....	477,600	42,576	8.55	3,653	0.73	18,720	3.76	21,817	4.38	3,297	0.68	90,163	18.10
Total..2,134,000		140,208	6.51	21,014	0.97	100,548	4.67	85,749	3.98	15,830	0.72	363,076	16.85

The losses on the 500-volt power at the same station for the same time were as follows:

Output.	C²R Loss.	Per Cent.	Meter Shunt Loss.	Per Cent.	Total.	Per Cent.
1,183,400	42,644	3.6	63,571	5.4	106,235	9

SELECTION OF INCANDESCENT LAMPS.

We come now to the question of the proper selection of incandescent lamps, which is a very important one to the central station manager. It is undesirable to have more than one voltage and more than one wattage of lamps in use, as they are sure to get exchanged and mixed up, increasing the cost of lamp renewals where the low-voltage lamp gets installed in place of the higher voltage and creating a just cause for complaint where the lamp is operated at a lower voltage than that for which it is designed.

Probably nine-tenths of our consumers, if left to purchase their own lamps, would buy a low-efficiency lamp that would burn 1,500 hours or more, without taking into consideration that fact that to secure the same candle-power they would be paying for about thirty per cent more current.

If the matter is left to the lamp salesman he will recommend high-efficiency lamps with the corresponding shorter life, because this will naturally increase the lamp sales in his territory.

The question of what efficiency lamp should be used is one which lends itself to a comparatively easy solution.

For its solution it is necessary to determine:

1. Average regulation on the circuit.
2. Generating costs, which are proportional to output.
3. The investment made per kilowatt capacity.
4. The average consumption per lamp per year.

To take an example.

For a 3.1-watt lamp burning 263 hours would consume 16 × 3.1, times 263, or 13,044.8-kilowatt hours, which, divided into seventeen cents and one and one-half cents, gives us the cost per kilowatt-hour for the lamps and for the labor of renewing them, or added together, a total cost per kilowatt-hour for lamp renewals.

Having determined that the regulation is maintained within three per cent, we find from standard lamp specifications, assuming that the first cost of the lamp is seventeen cents, and that the cost of photometering, handling and renewing costs one and one-half cents each, as follows:

Efficiency.	Life.	Lamp Cost in Cents per Kw.-Hour.	Cost of Renewing per Kw.-Hour in Cents.	Total Lamp Cost per Kw.-Hour in Cents.
3.1	263	1.30	0.114	1.414
3.5	492	0.618	0.054	0.672
4.0	910	0.29	0.026	0.316

As a simple proposition let it be considered that the plant is selling light to itself, which will bring the interest of the producer and consumer to a common ground in considering the best efficiency to be selected.

It must be considered that it is light which is being sold, and not kilowatt-hours, for it is light which the consumer wants, and other things being equal, he does not care whether he obtains that light through a 3.1-watt lamp or a four-watt lamp.

If light is being supplied through a 3.5-watt lamp, and a change is made to a four-watt lamp, the station will be called upon to increase its expense under two different heads.

In the first place it will have to increase its capacity throughout in direct proportion to the increased wattage of the lower efficiency lamp, which, in the case under consideration, will amount to an increase of 14.3 per cent.

The investment per lamp installed can be easily figured for any station knowing the total investment and the connected load, and in this case we will assume that the station investment is $10 per lamp, which will probably be a close average. If interest is taken at six per cent, and depreciation covering the general equipment is taken at six per cent, we have an additional cost per lamp of twelve per cent on the 14.3 per cent of the $10-per-lamp investment, or $0.1716 per lamp per year.

The station has a further expense in furnishing sixteen candle-power with the four-watt lamp over that of the 3.5-watt, in that it must furnish the additional 14.3 of the current which would be generated at the part of the manufacturing expense which is strictly proportional to output.

In this we have mainly to deal with boiler fuel and a part of boiler-room labor, for engine-room labor changes but a small amount in a medium sized station with a variation of load.

The repairs to engines and dynamos are somewhat dependent on output, but in a large plant they are fixed, the repairs being nearly as great if the apparatus is running delivering no current, as it is with a fair load.

The remaining items which come in under the head of generating costs are practically fixed with the small changes which would be introduced in substituting a lamp of one efficiency for that of another.

We will assume a total generating cost which is strictly proportional to output at two cents per kilowatt-hour. If the lamp were consuming twenty kilowatt-hours per lamp per year on a three and one-half-watt basis, the consumption would be increased 2.86 kilowatt-hours per lamp per year, if four-watt lamps were substituted, and this at the output cost of two cents per kilowatt-hour would amount to $0.0572 per lamp per year, which, together with the interest and depreciation on the additional investment of $0.1716 amounts to $0.2288 per lamp per year, which is balanced against the

Digitized by Google

difference in the cost of lamp renewals for the year.

The 3.5-watt lamp burns twenty kilowatts per lamp per year, so the lamp renewal cost on the 3.5-watt being 0.00672 per kilowatt-hour, would amount to $0.1344, and the four-watt lamp consuming 22.86 kilowatt-hours to furnish the same amount of light would, at its rate for lamp renewals of 0.00316 per kilowatt-hour, cost $0.0722 per year, or the three and one-half-watt lamp would cost $0.0622 per annum more for lamp renewals than would the four-watt, but the four-watt lamp would cost $0.2288 more per lamp per year for additional current and interest and depreciation on the additional investment, so that under the conditions assumed there would be a saving to the producer of $0.1666 per lamp per year by the use of the three and one-half-watt lamp, or for an installation such as the one under consideration, there would be a saving of $6,997.20 per annum on a connected load of 42,000 lamps.

The above is determined by assuming that the lamps are renewed at the end of their useful life, or at a time when they have fallen to eighty per cent of their original candle-power. The cost per kilowatt-hour will then be:

COST OF LAMP.

Efficiency × candle-power × useful life.

It is poor policy for a lighting company to allow old lamps to remain upon its lines after the same have fallen to eighty per cent of their original candle-power, as the illumination from such lamps can not help but be poor and unsatisfactory, and the consumer will have a just ground for complaint.

To prevent the existence of such a condition it is necessary for a company to make periodic wholesale lamp renewals wherein every lamp is taken out of every socket and good lamps placed in their stead. The lamps which are removed should then be cleaned and photometered, and all lamps which fall below ninety-five per cent of their original candle-power should be culled out as seconds, to be used in attics, garrets and cellars, while all falling below eighty per cent should be placed in the junk pile.

With a station having a very pronounced peak load for a very few weeks during the holiday season, a material saving may be found by the substitution of a high-efficiency lamp for the short interval of time during which the peak load lasts. For instance, at Madison, just previous to the holiday season, there are about three weeks when the peak load on the commercial districts overlaps the peak load on the University districts so that the combined peak is very high and sharp, and lasting but a few weeks out of the year, it is very narrow when plotted with months of the year as abscissa.

Suppose the station is fully loaded, so that any additional load will require additional generating and distributing equipment; it is perfectly proper, then, to credit on one side of the balance the interest and depreciation of the investment which will be saved by the substitution of 3.1-watt for a 3.5-watt lamp, for with the same equipment of station and line it will be possible to furnish current for 11.4 per cent more lamps, and against this must be charged, on the other hand, the additional expense which will be incurred by the increased lamp renewals of the higher efficiency lamp and the cost of making the changes.

As shown above, with a three-per-cent regulation, the 3.1-watt lamp gives a life of 263 hours, against 492 hours for the 3.5-watt, or there is a loss of lamp life of 229 hours per lamp for each substitution so made, and where the 42,000 lamps are exchanged, this means a loss of 9,618,000 lamp hours of lamp life, and as lamp renewal costs are made up of the cost of the lamp plus the labor changing and photometering, the cost of per lamp-hour would equal

$$\frac{17 - 1.5}{492}$$ equals $0.0037 for

renewing alone, and having lost 9,618,000 lamp hours by this change, the expense incurred, due to additional lamp renewals, would amount to $3,558.66 provided all of the useful life of each lamp was used up, or the lamps each burned 263 hours.

During this month the actual burning of each lamp averaged about forty-five hours, so instead of having expense of $3,558.66 for the increased lamp renewals which would be occasioned should all the lamps burn 263 hours, the expense would be

$$\frac{45}{263}$$ equals 17.1 per cent of $3,558.66, or $622.76,

and to bank against this expense there would be saved the interest and depreciation at twelve per cent on 11.4 per cent of 42,000 lamps at an investment of $10 per lamp, or $5,745.60, or by such a substitution a saving of $5,122.84 would be effected per annum.

Another factor should come into consideration at this point, and that is that the consumer is using a smaller amount of energy for a given amount of illumination during this short period, and he is benefited during this time by having a decreased bill, to which he will not object, while the station will have its kilowatt-hour sales curtailed by an amount equal to the difference in lamp efficiency, provided the consumer is paying for his current on a straight meter rate.

It is very essential, in following out any of the analyses, to know positively that the data at hand are thoroughly reliable, for without such knowledge nothing can be accomplished; but a careful analysis of these several distribution problems, followed by a practical application of the remedies as set forth, will very frequently bring about such a radical change in the economical working of a plant that the net earnings, which may before have appeared as a minus quantity, will now appear in a substantial way as a positive profit.

Legislation for the Milan, Italy, Exhibition.

The executive committee, for the purpose of better attaining the object of uniting at the Milan Exhibition all the improvements which have been made in the artistic as well as the industrial field, has brought to the notice of the Italian Minister of Agriculture, Industry and Commerce, the necessity of formulating special legislative provisions (as has been done before in the case of all previous international exhibitions) to give protection to everything that will be sent to the exhibition from abroad.

The legal provisions invoked contemplate the derogation of the articles 50, 64 and 68 of the law on Italian patent rights, etc. These provisions should for the objects exposed, suspend first of all the prohibition of introduction into the kingdom of objects similar to those protected in the kingdom, and limit the right to sequester infringements or articles bearing forbidden marks to the sole cases in which the person who provokes the sequestration holds the rights in the same country as the person who is to suffer the sequestration.

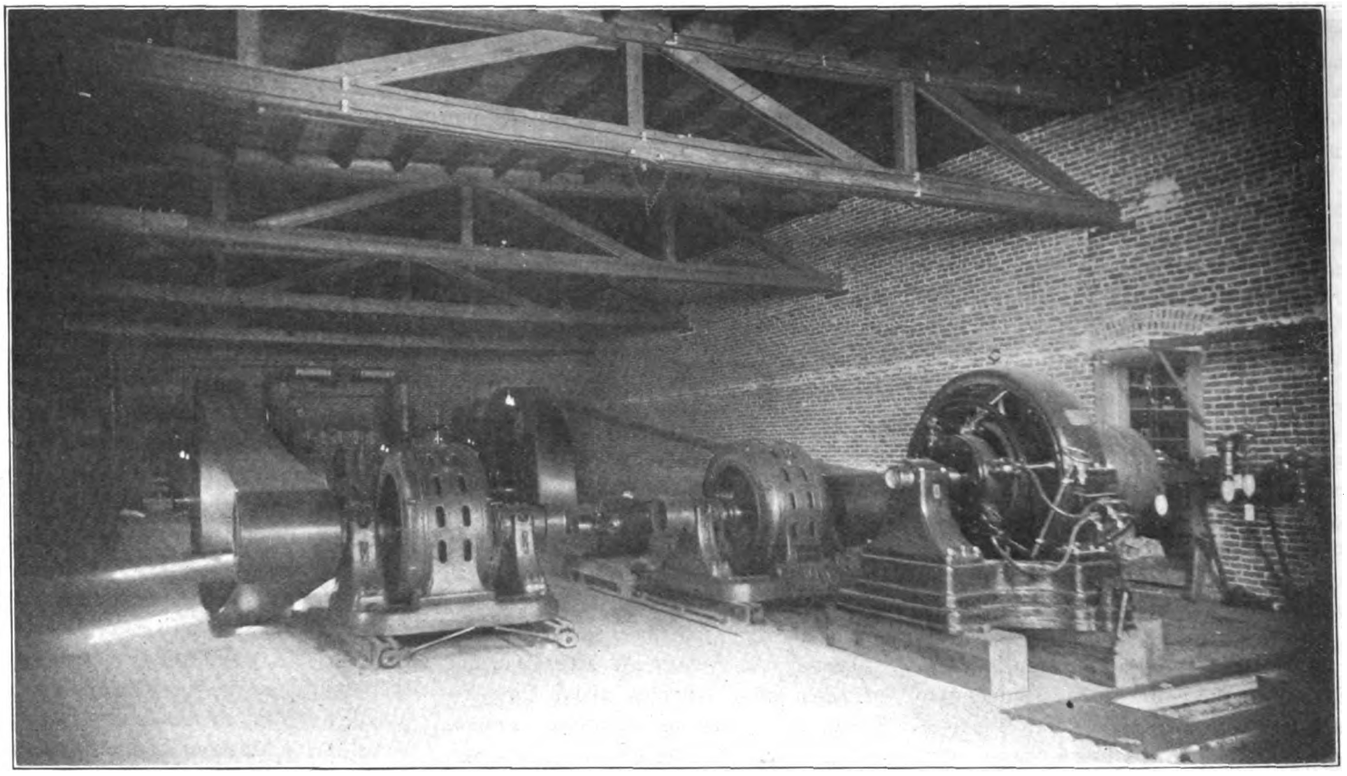
Further, it should be sought to stimulate the showing of new inventions in the exhibition to the promotion and utilization of inventions, and interrupt the expiration of patents, etc. Lastly, to the states who do not belong to the international convention on industrial rights there should be extended a protection to patentable objects exposed.

The Minister of Agriculture, Industry and Commerce has replied that this serious matter has already been taken into consideration.

Digitized by Google

The Gas and Electric Plant at Muskogee, I. T.

AN INTERESTING gas and electric and ice plant installation has recently been completed by H. M. Byllesby & Company, as engineers and managers, at Muskogee, I. T., the headquarters of the Dawes Indian commission and the residential headquarters of the government officers in charge of the various Indian tribes. The present population is approximately 15,000. The city has been the subject of a rapid growth, the population a year ago being 11,000, and four years ago, about 5,000. The surrounding country raises wheat, corn, cotton and ordinary farm products. An oil field was discovered immediately outside of the city about a year ago, and is now a large producer of a high-class oil. An oil refinery is being erected. The main streets of the city are being paved, and every effort is being made to make the town comfortable and modern in every respect. There are five steam railroads entering the city, and it is fast becoming an important jobbing and distributing centre. The usual line of minor manufacturing interests is situated there, including a cottonseed oil mill, cotton gin and several machine shops. The residential buildings are of handsome design, and there have been erected a number of elaborate brick and stone office buildings and mercantile establishments. The city has four boarding schools and colleges, these being largely connected with the Indian reservation. It is anticipated that the town will continue its growth to a population of approximately 50,000 people. It is geographically well located, and with the coming admission to statehood of Indian Territory, a greater increase in growth is expected. This will be largely influenced by the settling of the question of Indian titles. At the present time it is extremely difficult to obtain a legal title to property, owing to the governmental restrictions concerning Indian lands.



INTERIOR OF DYNAMO ROOM, GAS AND ELECTRIC PLANT, AT MUSKOGEE, I. T.

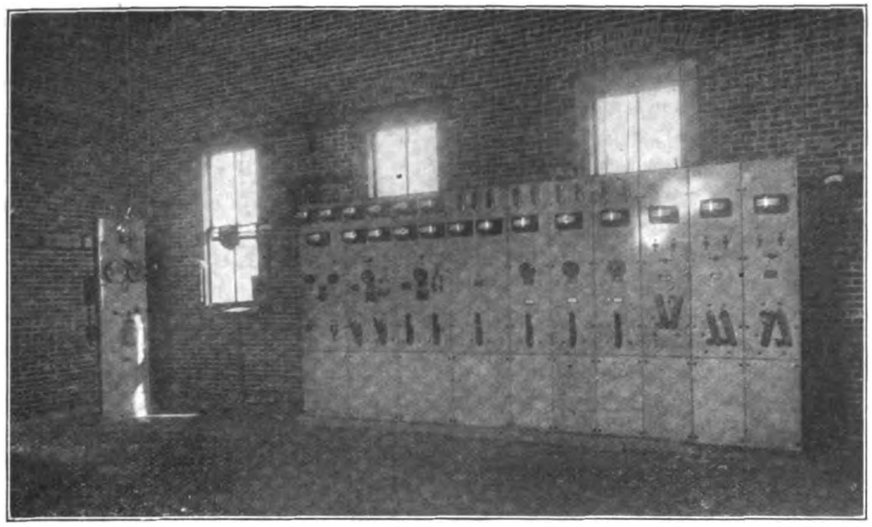
Prior to March 1, 1904, the electric lighting and gas plant was owned by citizens of Muskogee. At that time the present company purchased the plant, and has since made large additions to keep pace with the growth of the town, the reconstruction of the ice and electric plant having been finished in December, 1903. A new gas plant is now approaching completion. All of the buildings are substantial brick structures.

The electrical equipment consists of two General Electric three-phase alternators of 200-kilowatts capacity each, two St. Louis Corliss engines, two Babcock & Wilcox boilers, a General Incandescent Arc Light Company marble switchboard, and a General Electric enclosed alternating system for street lighting.

The ice plant has a total capacity of thirty-five tons per day, with duplicate compressors. The gas plant is on the modern high-pressure system. The gas is manufactured from coal, exactly as in the old-fashioned method, and is delivered to a low-pressure holder. From the low-pressure holder it is passed through duplicate compressors and compressed to twenty pounds per square inch, and is then passed into a high-pressure holder. From this it is distributed through wrought-iron mains to the consumers' premises. Each consumer's equipment, in addition to the meter, is furnished with a reducing valve for lowering the pressure. The gas plant has twelve miles of mains. The telescopic holder has a capacity of 30,000 cubic feet. The gas plant contains two benches of sixes and a spare arc built by the Missouri Fire Brick Company. The purifying and scrubbing apparatus and the holder were built by the Stacey Manufacturing Company, Cincinnati, Ohio.

At the present time there are over 450 consumers connected by electric meters. There is a rated capacity of 375 horsepower in motors connected to the electric system, and with the completion of the

Digitized by Google

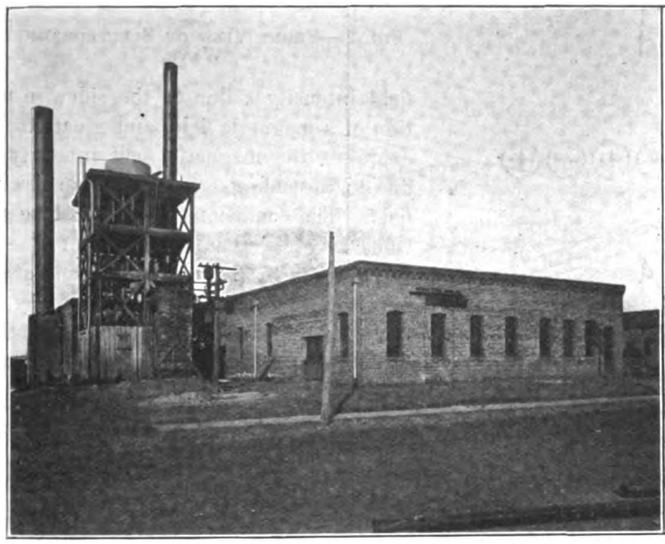


SWITCHBOARD, GAS AND ELECTRIC PLANT, AT MUSKOGEE, I. T.

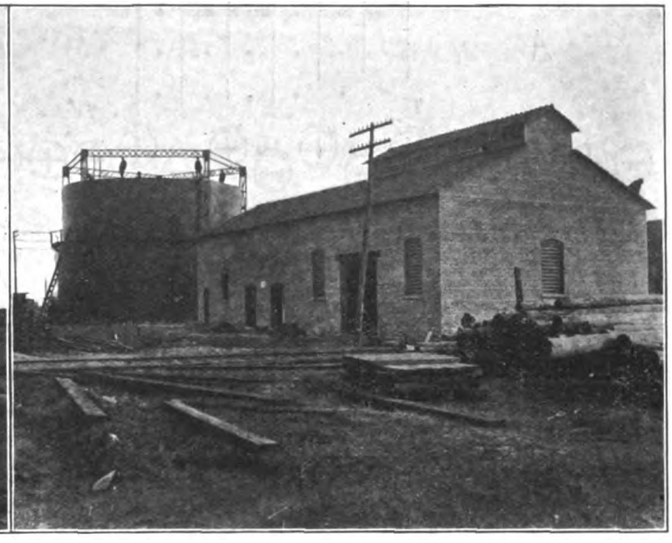
gas plant there will be connected approximately 600 consumers, principally for fuel gas.

A street railroad is being built in the town, with about three miles of track. The electric and gas company furnishes current for this system on a meter basis. The railway generator has a capacity of 100 kilowatts, and was furnished by the Fort Wayne Electric Works, Fort Wayne, Ind. The car equipment for the railway system is of General Electric manufacture. H. M. Byllesby & Company are also engineers for the street railway system.

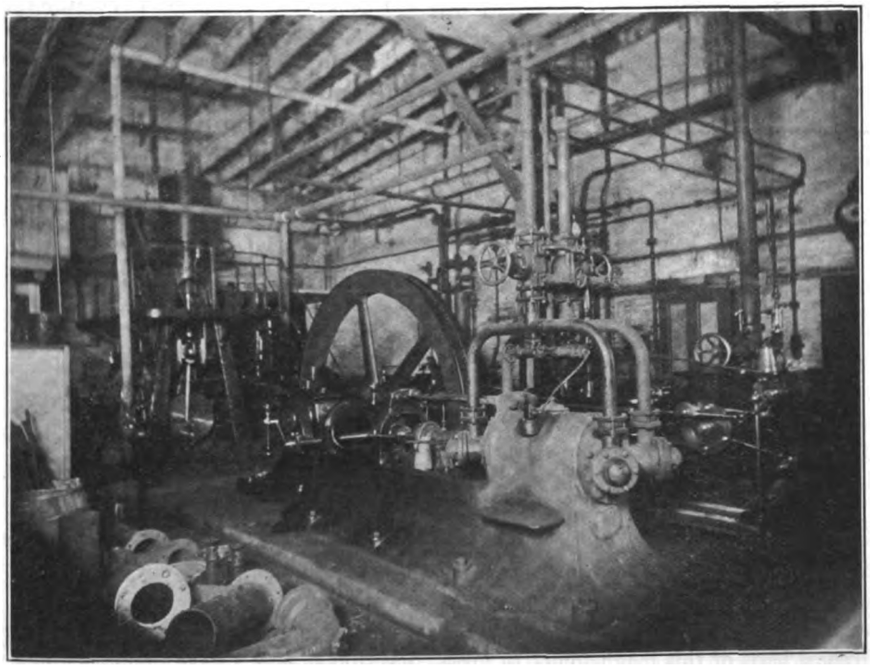
The company has a city contract which runs for a period of five years, at ninety-six dollars per lamp per year. At the present time there are only fifty-four of these lamps connected up.



EXTERIOR OF ICE AND ELECTRIC PLANT, MUSKOGEE, I. T.



GAS PLANT AT MUSKOGEE, I. T.



INTERIOR OF ICE PLANT, GAS AND ELECTRIC PLANT, AT MUSKOGEE, I. T.

During the year ending March 1, 1904, under the former ownership the plant made a profit of $12,000 net. In the ten months from March 1, 1904, to January 1, 1905, a profit of $21,938.47 was made.

The officers of the company are as follows: president, B. R. Burroughs, Edwardsville, Ill.; vice-president, L. D. Turner, Sr., Belleville, Ill.; secretary, L. D. Turner, Belleville, Ill.; treasurer, W. N. Warnock, Edwardsville, Ill. The directors are R. D. W. Holder, Belleville, Ill.; Clarence W. Turner, Muskogee, I. T., and M. M. Stephens, East St. Louis, Ill.

The Cleveland Electric Railway Company, of Cleveland, Ohio, has abandoned the system of three-cent fares for a ride of two miles from the centre of the city, which was instituted some time ago. The plan was not popular with the public, and was unprofitable to the company. A new plan has been put in operation, by which a passenger may ride the full distance on one line for four cents. To obtain a transfer a five-cent fare must be paid.

Digitized by Google

WAVE DISTORTION ON TRANSMISSION LINES.[1]

BY WILLIAM S. FRANKLIN.

The first part of the lecture was devoted to the development of the mechanical conceptions of electromagnetic action. The object of this introductory part of the lecture was to furnish a concrete basis, a model as it were, for the discussion of electric waves and wave distortion.

These mechanical conceptions are due to Maxwell and they have been discussed in a popular way by Lodge in his "Modern Views of Electricity." The best exposition of these conceptions is to be found in chapter xv, vol. ii, second edition, Nichols and Franklin's "Elements of Physics." The student who wishes to familiarize himself with these conceptions should read Lodge as an introduction, then read Nichols and Franklin's discussion.

A wave over the surface of water consists of an elevation or depression and a localized state of acceleration of the water particles both of which move along together, and the unbalanced forces associated with the elevation or depression are the forces which produce the accelerations which accompany the wave.

An electric wave consists of an electric field (ether distortion) and a magnetic field (ether motion) which move along together, the magnetic field being due to the electric field and the electric field being due to the magnetic field. This state of affairs is shown in Fig. 1 in terms of Maxwell's mechanical model.

The mutual dependence of the electric and magnetic fields, which together constitute an electromotive wave, may be formulated as follows: (1) a wire of length l moving sidewise at velocity v across a magnetic field of intensity H has induced in it an electromotive force $E = l\,H\,v$. Now $E \div l$ is the electric field intensity e parallel to the wire, this electric field is the physical basis of the electromotive force, and, in general, instead of H we should use flux density μH so that

$$e = \mu\,H\,v \qquad (1)$$

(2) An iron wire of length l moving at velocity v across an electric field of intensity e has a magnetomotive force equal to $l\,e\,v$ ($= l\,H$) produced along it, and the physical basis of this magnetomotive force is a magnetic field of intensity H parallel to the iron wire and due to its motion across the electrical field; but instead of e we should in general use electric flux density $k\,e$, where k is the inductivity of the medium, so that

$$H = k\,e\,v \qquad (2)$$

Equation (1) expresses the electric field intensity e due to the sidewise motion of a magnetic field, and equation (2) expresses the magnetic field intensity H due to the sidewise motion of an electric field. The conditions which must be satisfied in order that the whole of H may be produced by the motion of e and at the same time the whole of e produced by the motion of H may be found by treating equations (1) and (2) as simultaneous equations which give at once

$$v = \frac{1}{\sqrt{\mu\,k}} \qquad (3)$$

and

$$\frac{1}{2}\mu\,H^2 = \frac{1}{2}\,k\,e^2 \qquad (4)$$

Equation (3) expresses the velocity at which H and e must move sidewise so as to be mutually dependent on each other. This is the velocity of an electromagnetic wave. Equation (4) expresses the further condition, that in a so-called pure electromagnetic wave the magnetic energy is everywhere and always equal to the electric energy.

Fig. 2 represents a front view of a pure electromagnetic wave approaching the reader. The full lines represent electric

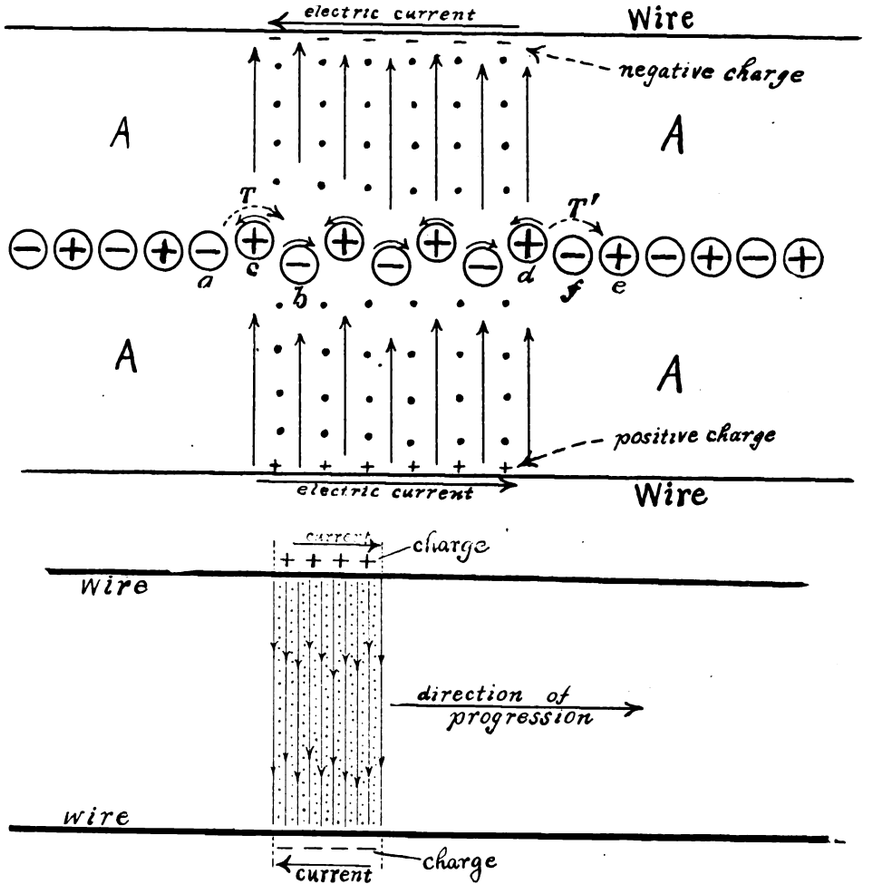


FIG. 1.—INTERDEPENDENCE OF ELECTRIC AND MAGNETIC FIELD, SHOWN BY MAXWELL'S MODEL.

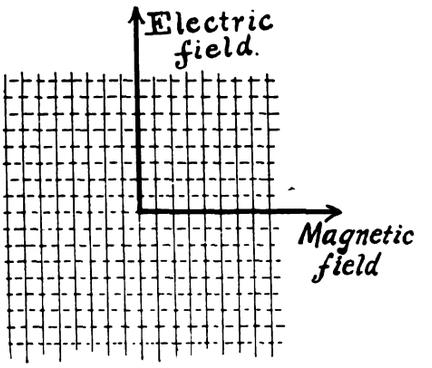


FIG. 2.—FRONT VIEW OF ELECTROMAGNETIC WAVE.

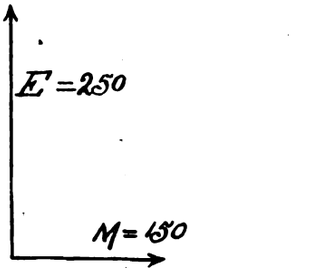


FIG. 3.—ELECTROMAGNETIC FIELD WITH MAGNETIC FIELD REDUCED.

[1] Abstract of a lecture delivered before the New York Electrical Society on Wednesday evening, January 18, 1905.

Digitized by Google

field and the dotted lines represent magnetic field.

One may see from Fig. 1 that the angular velocity of the ether cells (magnetic field) is diminished continually by the

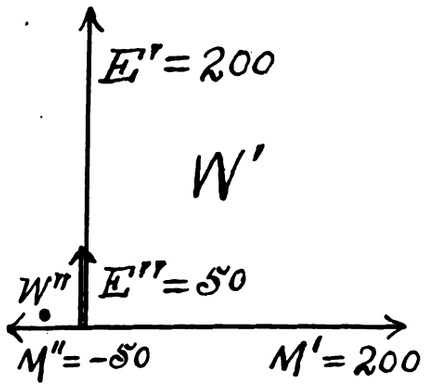


FIG. 4.—REPRESENTATION OF TWO OPPOSITELY MOVING WAVES.

friction of the rotating cells (resistance of wires) which are next the wires at upper and lower limits of the wave. In fact, the effect of line resistance is primarily to cause a decrease of the magnetic

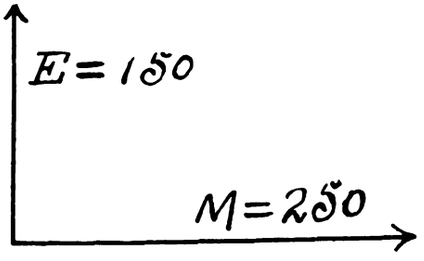


FIG. 5.—IMPURE ELECTROMAGNETIC FIELD WITH ELECTRIC FIELD REDUCED.

field in an advancing electric wave without affecting directly the electric field. On the other hand, if the structure of the medium in the region occupied by the wave gives continuously to the stress

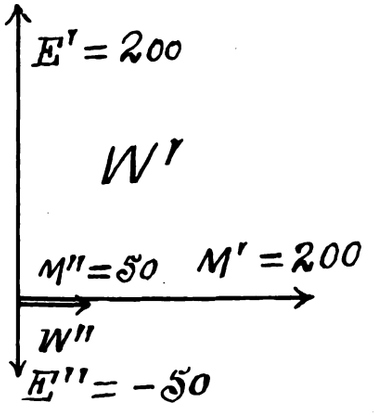


FIG. 6.—REPRESENTATION OF TWO OPPOSITELY MOVING PURE WAVES.

which is represented by the zig-zag chain of ether cells in Fig. 1, this ether stress would continue to decrease in value as the wave advances. In fact, the effect of imperfect insulating property of the material between the two wires of a transmission line is primarily to cause a decrease of the electric field in an advancing electric wave without affecting directly the magnetic field.

The distortion of an electric wave pulse as it travels along a transmission line is due wholly to the fact that line resistance reduces the magnetic field only and that poor insulation reduces electric field only. A detailed description of wave distortion depends upon the conception of an impure electromagnetic wave.

Fig. 3 represents an electromagnetic wave in which the magnetic field has been reduced from its original value of 250 units to 150 units by the effect of line resistance. If E and M in Fig. 3 were moving together at velocity v $\left(=\frac{1}{\sqrt{\mu k}}\right)$, E would produce more than 150 units of M and 150 units of M would not produce the full value of E. That is to say, a wave like Fig. 3 is not a simple progressing wave. What Fig. 3 is, however, is shown in Fig. 4, which shows two oppositely moving pure waves which are together equivalent to Fig. 3, and Fig. 3 represents what is called an impure electromagnetic wave. Fig. 5 represents an impure electromagnetic wave in which the electric field has been reduced from its original value of 250 units to 150 units by the effect of poor line insulation, and Fig. 6 shows two oppositely moving pure waves which are together equivalent to Fig. 5. This resolution of an impure wave seems a mathematical fiction, but it actually takes place. The physical process involved may be best understood by considering only the excess of M or E; that is, by considering a layer of magnetic field alone or electric field alone. The reader who is fairly familiar with the mechanical actions assumed to take place in the hypothetical cellular ether (see Fig. 1) will readily see how such a layer breaks up into two equal and oppositely moving pure waves.

Before describing the actual process of distortion, it is necessary to adopt a scheme for representing an electromagnetic wave pulse graphically. Such a representation is indicated in the rectangular curve in the lower half of Fig. 7. This curve

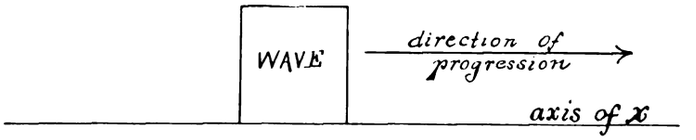


FIG. 7.—REPRESENTATION OF ELECTROMAGNETIC WAVE IMPULSE.

represents the wave shown in the upper half of the figure.

The black rectangle A, Fig. 8, represents a pure electromagnetic wave which at a given instant is supposed to be called into existence out on an indefinitely long pair of wires. As this wave proceeds its magnetic field is decreased by line resistance (or its electric field by line leakage) and the wave becomes impure. The result is, as explained above in connection with Figs. 3 to 6, that a portion of the original energy in this wave begins to shoot backward as a reflected wave; a portion of the original wave being thus reflected at every point along the wire. This reflected wave, which in its turn is, of course, partially reflected at every point as it travels backward, generates what Heaviside calls the tail of the wave. The form of the wave after t seconds is shown

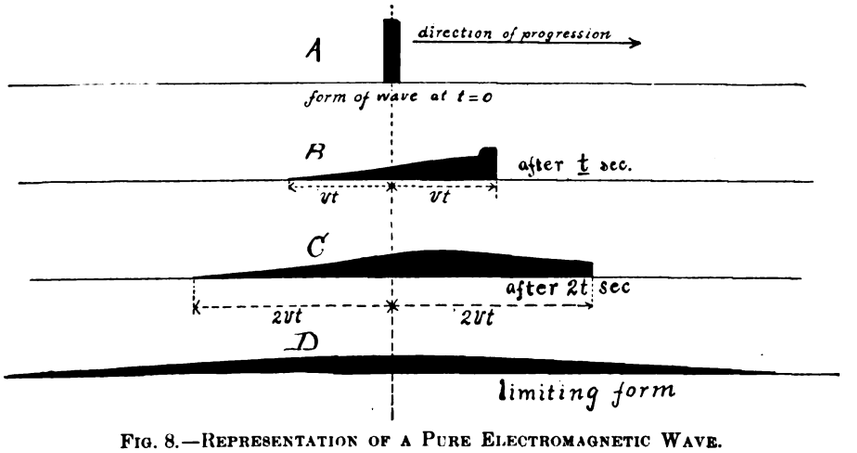


FIG. 8.—REPRESENTATION OF A PURE ELECTROMAGNETIC WAVE.

by B. The head of the wave has been considerably reduced (in values of E and M), and the tail reaches to a distance $v\,t$ back of the original position of the wave. The form of the wave after 2 t seconds is shown by C and the final limiting form

Digitized by Google

of the wave is shown by D. The fatness of the tail is somewhat exaggerated in Fig. 8.

The distortion of a wave due to line leakage is in a certain sense opposite to that due to line resistance, inasmuch as the first is due to a decrease of E, and the second is due to a decrease of M. If line resistance and line leakage are so proportioned as to decrease E and M equally, then the wave will remain pure, no portion of the wave will shoot backward and the wave will not be distorted. A circuit in which line resistance and line leakage are related so as to produce this result is called the distortionless circuit by Heaviside.

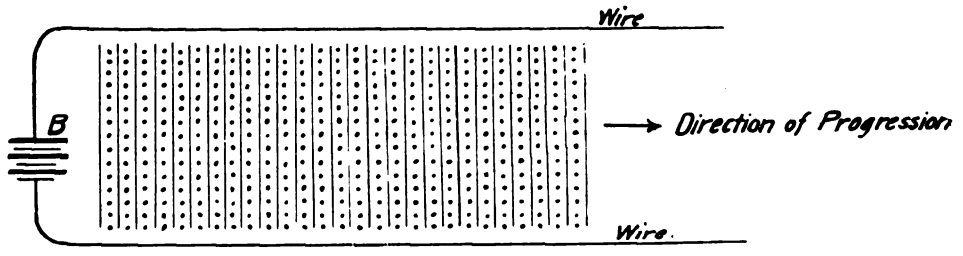


FIG. 9.—SPECIAL CASE.

The effect of resistance is always much larger than the effect of leakage on ordinary telephone lines and even on cables,

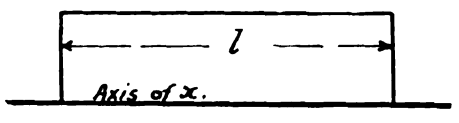


FIG. 10.—RECTANGULAR WAVE.

and therefore an increase of leakage reduces the distortion.

The effect of increasing leakage to the point necessary to give distortionless transmission is, of course, first to eliminate all distortion and the effect is furthermore to slightly affect the energy dissipated in transmission (counting only energy in the head of the wave pulse) as follows: suppose a wave having originally E = 250 and M = 250 is reduced by line resistance to E = 250 and M = 150. The unsustained electric field, that is the part of

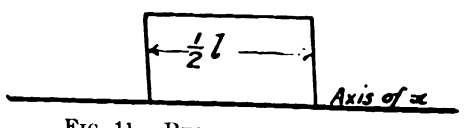


FIG. 11.—RECTANGULAR WAVE.

E which is not held up as it were by the sidewise motion of M (= 150), breaks up into two oppositely moving waves. The result is that all the energy represented by the reduction of M from 250 to 150 is lost as heat in the line wires, whereas half of the energy which is represented by the excess of E is thrown back into the tail and half goes forward as a newly created wave. Therefore, where the head of the wave arrives at the distant end of the line it has lost one and one-half times as much energy as is accounted for by the R i^2 loss in the line. Now if leakage is introduced so as to compensate for the distorting action of line resistance then all the energy due to the R i^2 loss shows itself as a reduction of M and an equal loss of energy is associated with the equal decrease of E by line leakage, so that when the head of a wave would arrive at the distant end of the line it will have lost energy to the amount of 2 R i^2 t instead of 1½ R i^2 t when leakage is zero.

The use of increased inductance for decreasing wave distortion and for decreasing the loss of energy in the head of a wave pulse while traveling over a given line may be shown in a very simple and elementary way as follows:

In the first place equations (3) and (4) may be written

$$v = \frac{1}{\sqrt{L\,C}} \qquad (5)$$

$$\frac{1}{2}\,L\,i^2 = \frac{1}{2}CE^2 \qquad (6)$$

in which L is the inductance of the transmission line per unit length, C is its capacity per unit length, i is the current flowing outward in one line and backward in the other at a given point on the line, and E is the electromotive force between the lines at the given point. The derivation of (5) and (6) from (3) and (4) need not be considered, although it is simple.

Let us consider a special case for the sake of clearness. Suppose a battery of electromotive force E is suddenly connected to the sending end of the line and a moment later disconnected. A rectangular wave like Fig. 10 would be started along the line. This wave contains a certain amount of energy, a certain portion of which is dissipated along the line, and the remainder arrives in the head of the wave at the receiving station. Suppose now that L is quadrupled, C and E being kept unchanged for the sake of comparison. Then from equation (5) v would be halved and i would be halved. If the sending battery is connected to the line for the same length of time as before, a rectangular wave of length one-half 1 will be started along the line as shown in Fig. 11, inasmuch as v is halved. Now current flows in the line wires only where the wires bound the wave, that is in length l of the double line in the first case and in length one-half l of the double line in the second case. Furthermore, the time required for the wave to reach the distant end of the line is twice as great in the second case. Therefore R i^2 t, or the total energy dissipated in the wires from the head of the wave, is one-quarter as great in the second case as in the first, since R is halved, i^2 is quartered, and t is doubled. But the total energy in the wave is half as great in the second case as in the first case, since l is halved and the energy per unit length is unchanged. $\left(\frac{1}{2}\,L\,i^2 + \frac{1}{2}\,CE^2\right)$. Therefore the percentage loss of energy from the head of a wave is halved by quadrupling the line inductance.

It must be remembered that equations (4) and (6) apply to pure waves only. As applied to pure waves these equations indicate that for a given line there is a fixed relation between voltage and current, neither can be changed without changing the other, or without changing the line constants. Furthermore, these equations indicate that voltage and current are always exactly in phase with each other in pure wave transmission. On the other hand, when reflected waves merge into the advancing waves on a line we no longer have pure wave transmission, and the relation between voltage and current, both as to relative values and as to their phases, depends upon conditions external to the line itself.

The limitation of the discussion to the wave pulse was deemed advisable by the lecturer for two reasons, *viz:* (*a*) the theory of distortion may be completely covered by a consideration of the behavior of a wave pulse, and (*b*) the physics of wave motion in a medium involving reactions, which in optics gives rise to absorption and dispersion and in electric transmission gives rise to distortion and attenuation, is vastly simpler for the wave pulse than for the wave train. The wave train represents the steady state of a system under the action of a periodic force which has been kept up long enough for the system to settle down to steady motion, and this steady state depends upon what is taking place at every point in the system, whereas the wave pulse, the head at any rate, has to do only with what takes place at one single point in the system.

The reader should keep in mind the fact that all of the discussion as outlined

Digitized by Google

above is based first upon the determination of electromotive force, and current relations on the assumption that line resistance and line leakage are zero, and then a consideration of line resistance and line leakage as disturbing effects.

The writer may be permitted to state that it is entirely misleading to the learner to dwell upon the limitations of Maxwell's cellular theory of the ether. There is scarcely a phenomenon of electromagnetic action which is not very greatly simplified by the use of these conceptions. The choice is between the use of differential equations, not for final integral solutions, but for descriptive purposes as it were, or the use of mechanical conceptions. In fact every phase of the foregoing discussion might be easily expressed in differential notation. It is, however, needless to say that such mode of expression would be to a great extent ineffectual. The difficulty with the ordinary mechanical notions which are so fundamentally fixed in electricians' minds, as evidenced by the very terms current, resistance and electromotive force, is that they do not give any insight into electromagnetic action, and the difficulty with the cellular theory, aside from the unmentionable one mentioned by Poynting, namely, that it fails in three dimensions!! is perhaps that it may never give any insight into the phenomena of moving electrons. My advice to the younger readers is to swallow Maxwell's cellular theory and digest it and do not turn away from it in disgust because some one says, truly, that it does not contain the secret of the universe.

In the discussion which followed the reading of this paper, Dr. M. I. Pupin complimented Dr. Franklin upon the great value and interesting nature of his paper. He said, however, that it was too much to expect an electrician to get any grasp of the subject in a short time. Dr. Franklin, he said, had been talking about electrical phenomena from alpha to omega in one lecture. It took four years of undergraduate teaching and two more years of post-graduate work to cover the subject. If the student, after six years, received a mark of six he was good; if he received a mark of eight he was very bright. He suggested that the use of mechanical devices illustrating electrical wave propagation should be dealt with carefully, because the student found it extremely difficult to reconcile electrical phenomena with mechanical analogies. He was glad, however, that Professor Franklin had called attention to mechanical models. They can neither be appreciated nor understood at once, but they form a basis upon which much investigation and study can be built, and lead eventually to much clearer concepts of the phenomena under discussion.

Mr. C. O. Mailloux considered that the use of the mechanical model was of the greatest advantage. While the subject presented by Dr. Franklin was undoubtedly a very complex one, requiring many years of study, he thought that he had succeeded in conveying his ideas very clearly and by relatively simple means.

ACCURACY CHECKS OF SWITCHBOARD INSTRUMENTS.

BY CLAYTON H. SHARP.

It is a matter of great importance in central station operation that the instruments on the switchboard should indicate accurately. Inaccurate instruments lead not only to unsatisfactory operation, but also to incorrect results in the central station bookkeeping. It is manifestly impossible to determine the exact conditions under which the station is running if the instruments used are not correct. Without an accurate knowledge of conditions, it is difficult to make betterments and impossible to determine when the station is operated in the most economical manner. It is particularly important that the central station voltmeters should be correct. If these read low, the incandescent lamps on the lines are burned at too high an efficiency and do not give a satisfactory life. If the voltmeters read high, the candle-power and efficiency of the lamps are low and the result is unsatisfactory to the consumer of electric current. It is of course quite unnecessary that the switchboard instrument should possess the same degree of accuracy and refinement that standard instruments do, but it is unfortunately impossible to rely upon switchboard instruments to maintain permanently even the required degree of accuracy for proper operation.

Switchboard instruments are liable to changes in their calibration due either to mechanical or to electrical and magnetic derangements. Of these the former are less insidious, since they can usually be detected by inspection, while the latter can not. Mechanical derangements may be due to friction either of the pivot on its jewel, of the moving part against particles of dust, or of iron in the air-gap, or of the pointer on fixed parts of the instrument. In view of the very small total moving force in an instrument, considerable errors may be introduced by a very minute friction. Starting with a moving force which is small in itself, an error of one per cent, say, corresponds to an increase of only one per cent in the restraining force which opposes the moving force and is equal to it. A retardation of this amount may easily be introduced by the pointer brushing over a little fur raised on the paper scale, by a roughening of the jewel or pivot, or in other ways. When this trouble occurs, it may usually be detected by irregularities in the movement of the pointer; that is, it sticks in certain places.

A further derangement is due to bent pointers. This is detected by noting that the instrument does not register correctly on zero. It is to be noted, however, that an incorrect zero indication may be due to other causes than a bent pointer. Derangement of the controlling springs may also produce this effect. The result of a bent pointer is that the instrument indicates uniformly high or low over the entire scale.

A further mechanical derangement is that caused by changes in the controlling springs. These may be weakened or displaced so as to make the instrument inaccurate. Such troubles can not usually be detected by inspection unless they are of a very aggravated nature, such as when two turns of a spring become interlocked.

Electrical and magnetic derangements to which instruments are liable are also of several kinds. It is not unusual for short-circuits and high-resistance breaks to occur in the fine wire of voltmeters and wattmeters. When such an accident happens in the auxiliary resistance, the effect of it is a short-circuit, to make the instrument read high, and effect of breaks is just the opposite. Changes in the value of the auxiliary resistance may occur through overheating, etc., and so the accuracy of the instrument may be impaired. Unless such changes are relatively very large, their presence can not be detected by inspection. Only an accurate check of the calibration of the instrument serves to determine their occurrence.

Of similar nature are the errors induced by changes in the permanent magnets. These are always in the direction of a weakened field. In case where the permanent magnet is used to furnish the field for a moving coil, direct-current, indicating instrument, this results in the instrument reading uniformly low over its entire scale, while the zero reading is unchanged. Where the magnets are used for braking motor meters, a derangement of this sort causes the meter to run fast. Magnets may be weakened by mechanical shock or by the influence of demagnetizing fields due to other magnets or to powerful currents in the vicinity.

There is another class of causes of incorrect readings which can not be classed as derangements, being either inherent in the instruments or due to outside influences. The most prominent of these is the effect of temperature. The best modern instruments are but little influenced by temperature changes within ordinary limits. Switchboard instruments are sometimes set up where temperature conditions

Digitized by Google

are abnormal, and their influence may be quite perceptible.

More important in its effects on the indications of instruments, particularly alternating-current instruments and those containing soft iron, is the influence of stray magnetic fields. Large feeders and bus-bars carrying heavy currents in the vicinity of the instruments may cause very large errors in their indications. Alternating-current instruments are affected most strongly, but even in the case of permanent magnet instruments these errors may amount to several per cent. Errors due to this cause can be located only by checking the instrument in position under working conditions. In making such a check it is of the utmost importance to use an instrument which either on account of its position or of its construction is uninfluenced by the stray fields which are giving the trouble.

Instruments, particularly those having a feeble controlling force, may go wrong on account of a static charge on the glass cover. The attractive force between such a charge and the pointer may exert a relatively large torque. Electrostatic instruments are particularly liable to this source of error. The trouble may be removed by grounding the entire surface of the glass, as by breathing on it.

Changes in the frequency of the supply current may also produce measurable errors in some types of alternating-current instruments. Such instruments need to be checked on current of the same frequency as that with which they are to be used. The form of the alternating-current wave is also a factor in some cases, making it necessary to carry out checks on the identical current with which this instrument is to be used.

In view of the many possible causes of errors in switchboard instruments and the impossibility of detecting these errors by other than electrical means, the necessity for periodic checking of these instruments becomes manifest.

The results of a check are for many purposes best expressed in the form of a correction curve to the instrument. A curve of this sort shows the amount of the correction, plus or minus, which must be added to the indications of the instrument at different points throughout the scale, in order that the true volts, amperes or watts may be determined therefrom. The amount of the correction will, in general, be different in different parts of the scale, due either to irregularities in calibrating the scale or to subsequent changes. An instrument furnished with an accurate correction curve becomes doubly valuable, since the true values desired are so readily obtained from the indications of the instrument. The form of such a calibration curve will, in general, not change unless the instrument is subject to outside disturbances or to inside friction. Electrical and mechanical changes and changes in the elasticity of springs may raise or lower the correction curve as a whole, but will not change its form. Correction curves for switchboard instruments, one for an ammeter and one for a voltmeter, are shown in Fig. 1.

In the case of instruments which are not too heavy and bulky, and which are so placed as that their accuracy is not impaired by outside causes, the instrument may be removed from the switchboard and taken to a laboratory for check. The Electrical Testing Laboratories, New York city, have made very complete and reliable arrangements for making checks not only of switchboard instruments, but of the finest standard instruments as well. The standardizing laboratory of the company is equipped with a very extensive series of the most accurate standards and of the best secondary apparatus to be used therewith. In laying out this equipment the endeavor has been made to arrange everything so that checks of instruments can be made with a minimum expenditure of time, and consequently at minimum cost. All measurements of electromotive force, current strength and power are founded on standardization made against standard cells and standard resistances; the potentiometer method being used. For checking direct-current voltmeters, ammeters and wattmeters to a moderate degree of precision, such as is required for central station instruments, Weston laboratory standard voltmeters and millivoltmeters with shunts are used as secondary standards. These instruments have been carefully checked throughout their scale against the standard cells and the standard resistances. They are kept in a fixed position and their constancy determined by frequent rechecks against the primary standards.

Alternating-current voltmeters are checked either on direct or on alternating current at the required frequency by comparison with a Weston laboratory standard alternating-current voltmeter which has been calibrated on alternating current of various frequencies, using a reflecting electrostatic voltmeter as a transfer instrument. Another standard instrument which is used for this purpose is a Hartmann & Braun reflecting astatic alternating-current voltmeter, which also has been carefully checked.

Alternating current of any frequency required is generated in the laboratory, the alternator being driven by a motor on a storage battery circuit. In this way very steady alternating-current pressure for purposes of checking is obtained. Alternating-current ammeters are checked on alternating current of the required frequency against either a Kelvin balance of the proper range or a Hartmann & Braun astatic alternating-current ammeter which has been carefully checked against primary standards. Very heavy alternating currents are available, so that ammeters of large capacity can be checked. By the use of this apparatus it is easy to measure exactly the ratio of transformation of current transformers used in connection with high-tension transmission lines. It is quite as important to know the ratio of transformation of the current transformer exactly as it is to know the error of the instrument which is used on its secondary side. This quantity can be determined once for all with the various loads of the transformer, and being known, the instrument which is used in connection with the transformer may be rechecked periodically and the accuracy of the measuring system secured. Indicating and integrating wattmeters are checked by reference to standard wattmeters, the current being of the frequency used in operation. In a similar way recording instruments are checked for accuracy.

The alternating-current generating system in use makes it possible to determine readily the effect of small or large changes in frequency on the accuracy of instruments.

It not infrequently happens that switchboard instruments can not be removed from their places or that they are liable to be influenced by outside causes. In a case of this sort the instrument must be checked in position. One of the chief difficulties of making a check of this kind is to introduce a standard instrument into the circuit in such a way that the latter will not itself be influenced by outside disturbances. Another difficulty is to get satisfactory comparisons between the standard instrument and the instrument to be checked on the fluctuating current of a central station. The first difficulty, which is very far from being an imaginary one, may be circumvented quite readily in certain cases. For instance, in the case of a direct-current voltmeter, it is possible

Digitized by Google

without introducing appreciable error to extend a pair of lines from the voltmeter to be tested to a standard voltmeter which is placed at such a distance from the switchboard and from heavy cables that it is certainly free from the influence of stray fields. The check then may be carried out by taking a series of simultaneous readings on the two instruments.

With direct-current ammeters the case is somewhat different, since either the heavy currents must be carried to the vicinity of the instrument, or the leads connecting the instrument to its shunt must be unduly extended in order to remove the instrument from the field of outside disturbances. This extension of the leads changes the shunt ratio to a greater or less degree and renders the measurements more uncertain. This uncertainty may largely be removed by making a laboratory check of the standard instrument with the same leads as are used in the central station check.

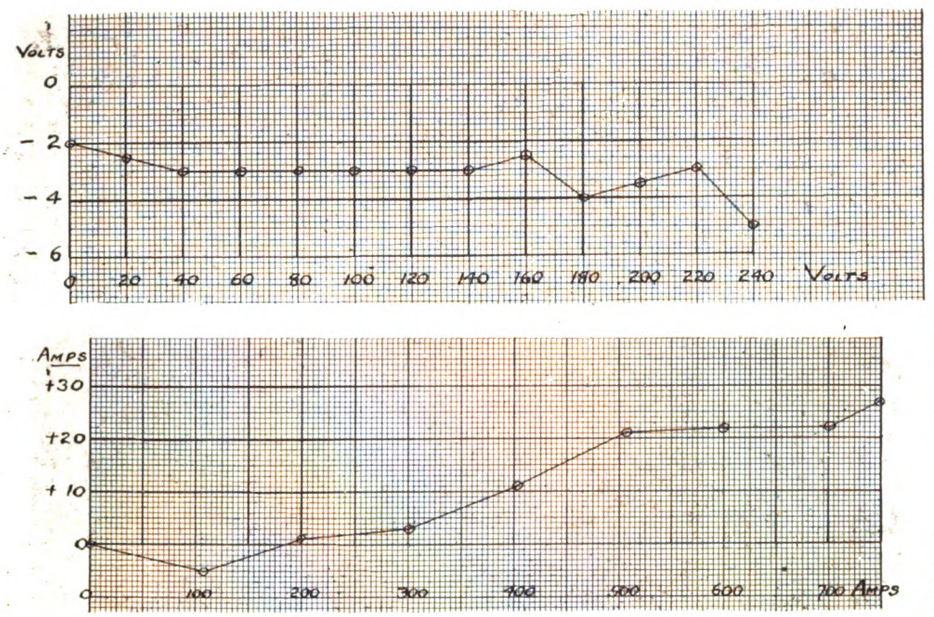


Fig. 1.—Correction Curves for Voltmeter and Ammeter.

Alternating-current voltmeters and ammeters have to be checked against standard instruments which themselves have had a laboratory check at the proper frequency and which are removed from the sphere of outside disturbances. In this connection it is important to note that an alternating-current voltmeter or wattmeter of the electrodynamometer type can be used even in the neighborhood of conductors carrying large currents, dynamos, etc., if certain precautions are taken. The necessary precautions consist in sending a current through the moving coil of the instrument alone, the stationary coils being cut out. This can be done with any wattmeter. To do this with a voltmeter, it is necessary to bring out a tap from the line connecting the stationary coils with the moving coil to an extra binding-post on the face of the instrument. When a current is sent through the moving coil alone, if a stray field is present which disturbs the instrument, the needle will, in general, deflect to the one side or to the other of its zero. It is possible, by rotating the instrument, to determine a direction such that the effect of this stray field upon the moving coil is eliminated and the instrument indicates zero, whether the current is on or off. Having made this determination, the direction so found is fixed by setting up two markers in the prolongation of the pointer of the instrument when the pointer is resting on zero. The line so indicated will pass through the pivot of the instrument and through the zero of the scale. When the pointer of the instrument lies in this line the effect of the outside field is nil. Now let the instrument be connected into the circuit in the ordinary way for making measurements. The pointer will be deflected and the moving coil will, in the deflected position, be influenced by outside fields. If the instrument is rotated until the pointer once more comes in the line between the two markers, the influence of the outside field will again be eliminated and the indication of the instrument will be the true indication.

In this way a standardized alternating-current voltmeter can be used for checking a direct-current voltmeter with a good degree of accuracy. It is, however, on general principles better to use an instrument which is itself unaffected by such disturbances. The potentiometer is such an instrument. In its ordinary form the potentiometer is rather too complicated and difficult for ordinary central station use. The advantages of the potentiometer, however, are so great that the Electrical Testing Laboratories have brought out a simplified form of this instrument, which has been introduced into their ordinary practice by a number of the largest electricity supply companies in this country. This instrument, which is known as the Lamp Testing Bureau model, is designed to measure only six voltages, which can be chosen at will. For stations or isolated plants operating on the Edison three-wire system, these voltages are usually 100, 110, 120, 200, 220 and 240. Comparisons are made against the electromotive force of a Weston standard cell. The electromotive force of this cell does not change appreciably with the temperature, so that no troublesome corrections have to be made. The instrument is entirely self-contained and consists of a standard cell, a galvanometer and the necessary resistances, all enclosed in a small box with a cover and lock. Connections to outside circuits are made by opening the cover and joining the leads to binding-posts on the hard rubber top.

This instrument has been found very useful in checking the principal points of a standard voltmeter with which all the other voltmeters connected with the station are compared. If it is to be used for checking the switchboard instruments directly, it should be arranged so that one of its points corresponds exactly to the voltage at which the station is operated. The instrument is light, portable and highly accurate and enables the central station manager to be certain of his most important measurements. It may be used also in connection with a bank of lamps which has been standardized by determining its ampere consumption at a given voltage. With this auxiliary, ammeters and wattmeters can be accurately checked.

It is desirable that all standard instruments should be checked throughout their entire scale against a standard potentiometer; in order to determine variations in their calibration. A check of this sort having been carried out, a curve is plotted showing the error of the instrument at all points. This need be done once for all. Periodical checks can be made with a six-point potentiometer to determine the change in the accuracy of the instrument as a whole. Such a change corresponds to a uniform percentage shift upward or downward of the entire error curve.

In conclusion, it should be emphasized that whatever method of checking switchboard instruments is employed, such checks are of great importance and should be made frequently, periodically and with great care.

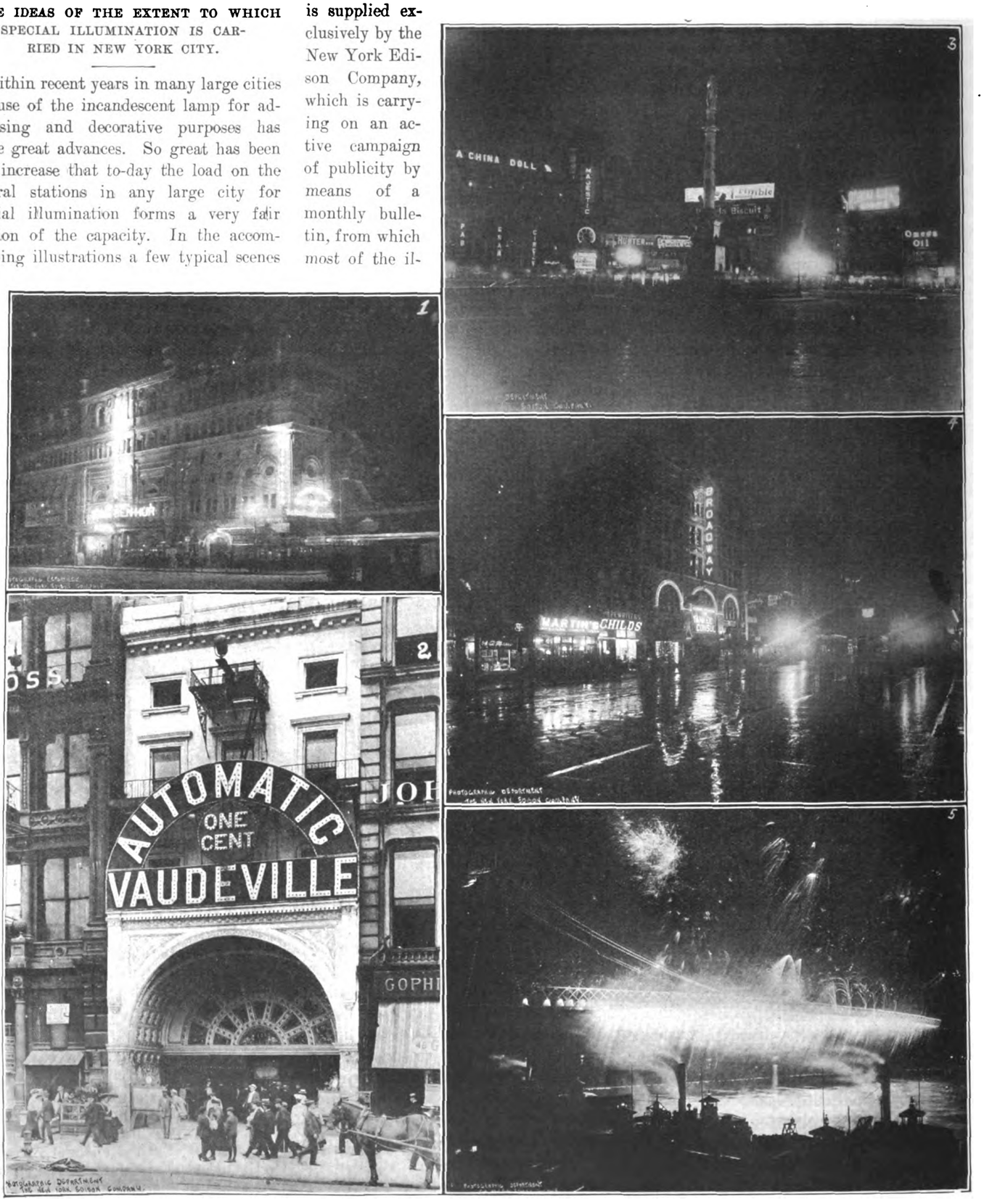
Digitized by Google

THE USE OF INCANDESCENT LAMPS FOR DECORATIVE AND ADVERTISING PURPOSES.

SOME IDEAS OF THE EXTENT TO WHICH SPECIAL ILLUMINATION IS CARRIED IN NEW YORK CITY.

Within recent years in many large cities the use of the incandescent lamp for advertising and decorative purposes has made great advances. So great has been this increase that to-day the load on the central stations in any large city for special illumination forms a very fair portion of the capacity. In the accompanying illustrations a few typical scenes is seen night after night throughout the year in New York city. For all of the places shown in these illustrations the current is supplied exclusively by the New York Edison Company, which is carrying on an active campaign of publicity by means of a monthly bulletin, from which most of the illustrations herewith have been reprinted. Fig. 1 shows the front of the New York Theatre, in Times square, and is fairly representative of the use that almost every theatre in New York city is now making of the illuminated sign.

Fig. 2 is a daylight picture. It is impossible to get a fair result from a night exposure. So many lights are used on this large sign that the building is one glare of light. There are 2,500 incan-



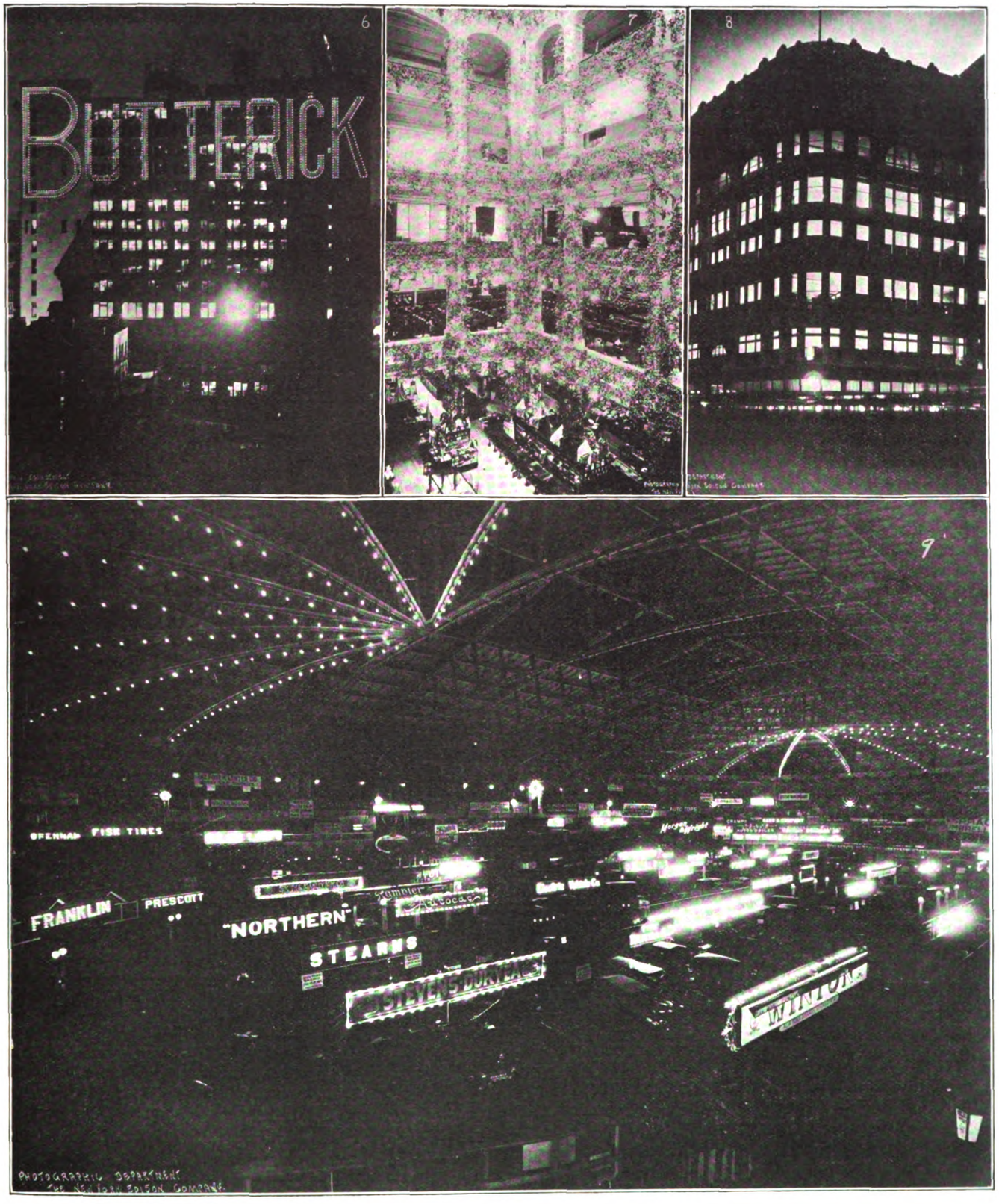
Spectacular and Decorative Illumination in New York City.

Digitized by Google

descent lamps used in the archway and flashed sign. In addition to this, however, current is supplied for 125 motors which operate the small machines inside the building.

Fig. 3 shows the illumination at the Columbus circle. When it is realized that the nearest light is probably some sixty feet from the Columbus monument, the amount of illumination necessary to produce so clear an effect will be appreciated.

The upper part of Broadway on a rainy night is well shown in Fig. 4. It may be noticed that every store in the block has some form of electric illumination.



Spectacular and Decorative Illumination in New York City.

Fig. 5 is peculiarly spectacular. For the most part the illumination is pyrotechnic, but the photograph has reprinted the tracery of the towers and cables,

Digitized by Google

which was made entirely with incandescent lamps, the occasion being the opening of the new Williamsburg bridge.

In Fig. 6 is shown the largest illuminated sign in the world. The height of the eight smaller letters following the initial letter is fifty feet, while the height of the initial letter is sixty feet. The lamps are four-candle-power lamps, with a voltage of 120, and a consumption of seventeen to twenty-eight kilowatts. This sign is illuminated for five hours each day. It is lighted just as the business day closes, and is continued almost until midnight. The sign contains 1,152 lamps, which are spaced eighteen inches apart. It is estimated that the cost of maintenance of this sign is about $3 per day. The sign was designed and erected by the Electric Motor and Equipment Company, Newark, N. J.

Fig. 7 is a fair example of the extent to which interior decoration may be carried with the aid of incandescent lamps. This view shows the spring opening of the Simpson, Crawford Company. Flexible cables are entwined with smilax and other green decorations, presenting a beautiful effect which could be approached by no other form of illumination.

The large amount of light used for practical interior illumination is well illustrated in Fig. 8. This photograph was made during the Christmas holidays, when the building was lighted from top to bottom.

One of the most recent illustrations of sign lighting, and the flexibility of electric distribution, is shown in Fig. 9. This photograph was taken during the recent automobile show in Madison Square Garden, New York city. It is easily seen how the general scheme of illumination has been almost obliterated by the intense light thrown out by the various illuminated signs.

Seventh Annual Convention of the Electrical Contractors' Association of New York State.

The seventh annual convention of the Electrical Contractors' Association of New York State was held at Troy, N. Y., on Tuesday, January 17. The convention headquarters were at the new Hotel Rensselaer. The contractors from the western end of the state and from New York city began to arrive Monday evening. The real work of the convention began at 9 A. M., with the directors' meeting, which was held at the Chamber of Commerce.

There were present at this meeting the full board of directors, as follows: J. C. Sterns, Buffalo association; Frank L. Frost, Eastern New York association; James R. Strong, New York city association; Morris J. Almstead, Rochester association; James S. Hilton, Syracuse association. President Marshall L. Barnes, of Troy, was in the chair, and Fred Fish at the secretary's desk.

This session was executive, and a large amount of routine business was transacted.

The delegates' meeting was called to order at 10.30 A. M. Mayor Hogan welcomed the delegates to the city in a very pleasing address. A response was made by Vice-President James R. Strong, of New York.

At roll call the following contractors answered:

Julius C. Sterns, of J. C. Sterns & Company; J. D. Robertson, of the Robertson Electrical Construction Company; H. I. Sackett; F. H. Williams, of F. P. Little Electrical Company; Emmett Fleming, secretary Buffalo local association, Buffalo. Marshall L. Barnes, of Barnes & Payton, Troy. F. W. Newman, of the Albany District Telegraph Company; Morton H. Havens, Jr., Albany. K. C. Radliffe, of the Hudson Valley Electrical Supply Company, Watervliet. Harvey R. Collins, Mechanicsville. J. W. Wright, of J. W. Wright Company, Sandy Hill. Frank L. Frost and A. G. Sheldon, of Frost & Sheldon, Albany. E. G. Bernard, of E. G. Bernard & Company; C. E. Hindsill, of the Troy Electrical Company, Troy. James F. Burns, Schenectady. Mr. Hughes, of the Central-Hudson Construction Company, Poughkeepsie. A. L. Payton, of Barnes & Payton, Troy. A. E. Clute, of Clute Brothers, Cohoes. W. H. Morton, of Johnson & Morton; G. C. Brayton, of Brayton & Hooks, Utica. L. M. Blanding, of the Binghamton Electrical Construction Company, Binghamton. A. Stewart, of Stewart & Bergen, Fort Plain. James R. Strong, of the Tucker Electric Construction Company; A. J. Martin, of the Commercial Construction Company; Robert Lawrence, of Edwards & Company; J. C. Hatzell, of Hatzell & Buehler; George Wm. Russell, Jr., of Russell & Company; E. A. Kuefer, of the construction department Western Electric Company, New York. Rudolph Schmidt, of Rudolph Schmidt & Company; Morris J. Almstead, of the Almstead Electric Company; Clarence Wheeler and Harvey Smith, of the Wheeler-Green Electric Company; Fred Fish, of Fish & Horton Company, Rochester. James S. Hilton, of Rogers & Hilton, Syracuse.

W. H. Morton, secretary National Electrical Contractors' Association, Utica, N. Y.; J. P. Coghlin, third vice-president National Electrical Contractors' Association, Worcester, Mass.; George M. Chapman, director for state of Connecticut, National Electrical Contractors' Association, Waterbury, Ct., were present as visitors.

The meeting then went into executive session until noon when an adjournment was had and the members and their guests were entertained at the works of E. G. Bernard & Company. From the Bernard works the guests were escorted to the Fifth Avenue Hotel where luncheon was served.

At 1.15 P. M. the guests went to the collar and shirt factory of Cluett, Peabody & Company, and were shown through the works by representatives of the management. Returning to the Hotel Rensselaer the regular session was resumed at 2.30 P. M. and lasted until 7.30.

At this session the following officers were reelected for 1905: president, Marshall L. Barnes, Troy; vice-president, James R. Strong, New York; secretary, Fred Fish, Rochester; treasurer, Julius C. Sterns, Buffalo.

Directors of National Electrical Contractors' Association for New York State: James R. Strong, New York; Marshall L. Barnes, Troy; James S. Hilton, Syracuse.

At 8.30 P. M. the members and guests sat down to a banquet at the Hotel Rensselaer.

Addresses were made by the following speakers: national Vice-President J. P. Coghlin, of Worcester, Mass.; ex-state President Rudolph Schmidt, of Rochester; Thomas H. Bibber, of Boston, Mass.; state Vice-President James R. Strong, of New York; Fred W. Newman, of Albany; C. E. Corrigan, of New York; Dr. William N. Campaigne, of Green Island, and Samuel E. Hutton, secretary of the Troy Chamber of Commerce.

Among those present were the following traveling men: Alex. Henderson, of the Sprague Electric Company; Avery P. Eckert, assistant treasurer Safety Insulated Wire and Cable Company; C. E. Corrigan, of the Osburn Flexible Conduit Company; Arthur Dunlop, of the Bernard Company; H. C. Owen, of the Western Electric Company; V. C. Gilpin, of the DeVeau Telephone Manufacturing Company; George W. Swan, of the John A. Roebling's Sons Company, New York. Thomas H. Bibber, of the American Circular Loom Company; James E. Wilson, of the Stuart-Howland Company, Boston, Mass. J. C. Moulton; H. P. Kimball and C. Wiesblatt, of Standard Underground Cable Company; J. C. MacDowell, of the Manhattan Electrical Supply Company, New York. A. M. Little, of Pass & Seymour, Syracuse.

Digitized by Google

TENDENCIES IN CENTRAL STATION DESIGN.

BY WILLIAM H. BRYAN.

In considering the subject of present tendencies in central station design, it seems very evident that a matter for just consideration is the design of the boiler room upon advanced lines. Until quite recently this portion of the plant has usually been given scant attention, almost anything being good enough. This precedent thus established by the designer has been followed by the attendants in charge, who have neglected it. At the same time, a wealth of brains and energy has been devoted to the engine and generator rooms, and to methods of distribution. Of late there has been a growing tendency to change this situation, due, no doubt, to a tardy realization that marked economies are possible with a well-designed boiler room.

Among the features most worthy of encouragement are:

1. A better understanding of the possibilities and limitations of automatic stoking.

2. Automatic fuel and ash-handling apparatus, and fuel storage.

3. Higher pressure boilers with superheaters.

4. A realization of the fact that smoke-making always means fuel waste.

5. A better understanding and appreciation of benefits of economizers and mechanical draught, the latter particularly where sudden and severe overloads must be cared for.

6. The elimination of scale, oil and other impurities from the boilers.

Other details which are having intelligent study and which promise profitable results are:

7. The use of briquettes made from inferior and waste fuels.

8. Methods for the use of powdered fuel.

Accompanying all this is a better understanding of the detailed and convenient arrangement of boiler-room apparatus, and better provision for easy access to all parts, together with improved light and ventilation.

Another direction in which there appears to be a tendency toward development, is the increased and more intelligent use of exhaust steam for heating, and other by-processes, and a realization of the fact that condensing engines may be operated profitably in connection with heating systems, with advantage both to the engine and to the heating system.

A Long-Distance After-Dinner Speech.

The Paper Trade Association was addressed at its recent dinner in Boston, Mass., by the Hon. William S. Greene, member of the House of Representatives, but as his duties prevented the congressman from coming to Boston, arrangements were made by which he spoke into a transmitter at Washington, while at the Somerset, where the dinner was held, 500 miles away there were forty receivers connected to the long-distance line and placed at the tables so that the guests could hear the address without rising from their seats.

The president of the association introduced the congressman in the usual manner, except for an apology at their departure from strict hospitality in asking to speak a person who had not already been with them at table, while a nearby transmitter also enabled their Washington guest to hear the presentation, which he acknowledged by saying that it was an appreciated honor to appear before such a fine-looking body of men, and then he plunged into an earnest plea for their cooperation in the development of foreign markets for the products of American manufacture, speaking in this line for about fifteen minutes, every word of which was as clear to those present as if he was at the table.

Their guest at Washington was also able to hear the applause which greeted his eloquence and wit.

The other speaking of the evening was devoted to the telephone in accordance with the Boston custom of providing a symposium on a theme, the modern Athens in this respect following the custom of ancient Athens, as related in the Dynosophists of Athanæus.

The Hon. Michael J. Murray eloquently spoke upon the telephone in its relation to the law, and C. J. H. Woodbury of the American Telephone and Telegraph Company illustrated by a few experiments the principles of the operation of the telephone, and then by means of some large models showed the construction of receivers and transmitters.

The telegraphone was brought into the room, charged with a message which was transmitted to the guests, after which the magnetized wire was cleared with a magnet, and the cornet player of the orchestra played a selection into the instrument in the presence of the guests, making a record which served an encore, given through the same telephones which delivered the address from Washington.

Afterward the record of the solo was given backward, the disconnected toots of the cornet having little resemblance to the original record and serving as an object lesson upon the rules of musical composition, which are as positive as those of grammatical construction of speech.

New York Electrical Society.

The 248th meeting of the New York Electrical Society will be held in the assembly room of the Metropolitan Street Railway Association, 761 Seventh avenue, New York city, on Wednesday evening, February 15. Mr. Herbert H. Vreeland, president of the New York City Railway Company, will address the society on "Electric Railway Operation in a Great City." Mr. Vreeland will discuss the development of electric railways in crowded municipalities, with special reference to the relation of the electrical engineer to the operating department. He will show precisely what the ends are that manufacturing engineers must conserve in the construction of a machine which low-salaried men must always be capable of handling. He will describe in detail the organization of a great railway company in a thickly populated community, the relation of the various departments, and the consequent varied points of view which the electrical engineer must have in mind in dealing with this particular subject.

Mr. Vreeland's address will be based on thoroughly practical lines, and will embody the wide experience, not only of himself, but of other eminent and successful men.

Sources of Radium.

In a report from Mr. Joseph I. Brittain, United States consul at Kehl, Germany, it is stated that the slime or residiuum of the thermal springs of the city of Baden-Baden, Germany, contains considerable quantities of radium salts. Professor H. Gertel, of Wolfenbüttel, says that the radium compound extracted from these deposits is forty times more powerful than that found in the residiuum of cold-water springs or in mud baths. Heretofore these deposits have been considered worthless, but they are now carefully collected and sent away for treatment. These baths have for a hundred years had the reputation of possessing healing qualities.

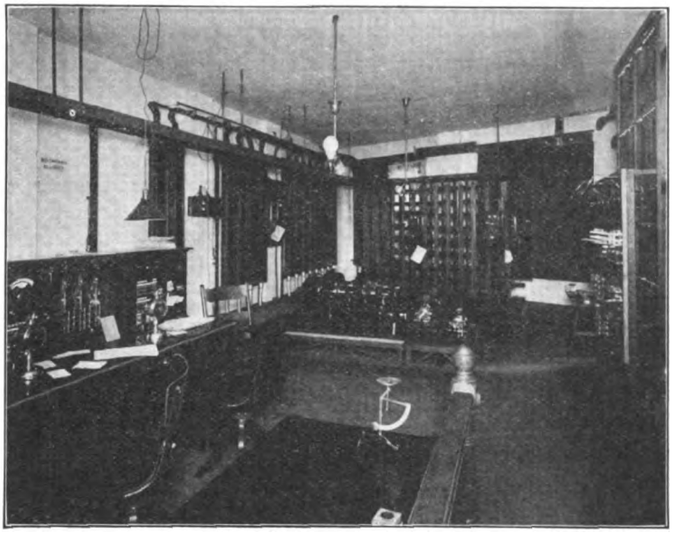
The railroad department of the international committee of Young Men's Christian Associations is distributing an attractive pamphlet describing the work accomplished by this department during the past year, and giving the outlook of the future. It describes and illustrates the buildings owned by a number of the railroad associations, some of which are valued as high as $25,000.

Digitized by Google

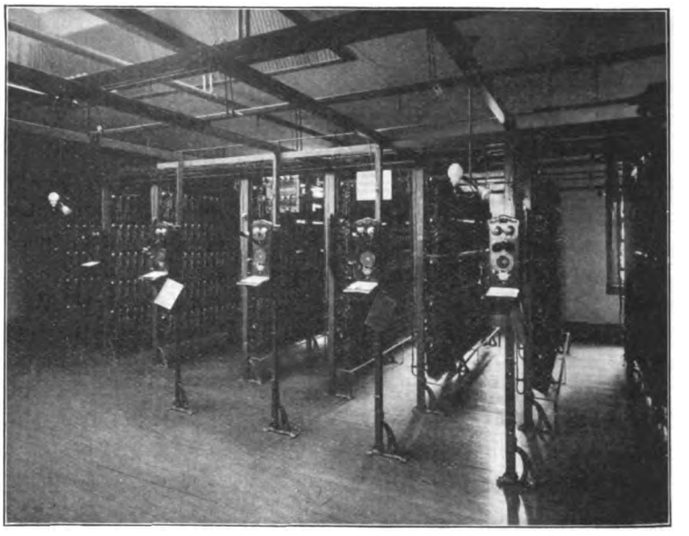
The Automatic Telephone Exchange at Battle Creek, Mich.

THE Automatic Electric Company, Chicago, Ill., has recently installed one of its automatic telephone exchanges for the Citizens' Telephone Company, of Battle Creek, Mich. This company is controlled by the Citizens' Telephone Company, of Grand Rapids, Mich., which has been using the automatic system since January, 1904. It is significant of the satisfaction which automatic service has given the operating company and the subscribers in Grand Rapids that the former should be equipping its other exchanges with automatic apparatus.

The Battle Creek exchange was installed for a capacity of 1,000 individual lines, the system having an ultimate capacity of 10,000. A trunking capacity of ten per cent is allowed and is capable of being increased to any desired amount should it become necessary.



General View of Interior of Automatic Exchange of the Citizens' Telephone Company, Battle Creek, Mich.



Switches and Selectors, Automatic Exchange of the Citizens' Telephone Company, Battle Creek, Mich.

The switches are mounted on angle-iron framework, there being five shelves to each unit, and a total of ten units, each unit holding switches for 100 subscribers. Each shelf is capable of holding twenty-five switches, the bottom shelves being equipped with first selectors and being entirely filled. The top shelf is equipped with ten second selectors on the left-hand end and ten connectors at the right end. An angle-iron footguard is arranged at the base of each unit in such a manner that it is impossible for a person walking in front of the switches to accidentally damage them by running against them.

Beeswaxed switchboard cable is used for the switchboard cabling and this is all run to the top of the units and thence in angle-iron runways to the various points as is required. The current for use in connection with the switches is brought to a slate main feeder terminal—carried through fuses and distributed to the various boards. On this main feeder terminal are mounted special tell-tale relays so wired that in case any fuse blows an audible alarm will immediately be given. Each switch is further protected by a self-soldering heat coil of the Automatic Electric Company's make. When any one of these heat coils blows an audible alarm is also given and a lamp lighted showing on which shelf the fuse is burned out.

Power for operating this exchange is furnished by two sets of storage batteries. One set consists of twenty-seven cells of 150-ampere-hour capacity, the other set consists of twenty-seven cells of 100-ampere-hour capacity, each set being contained in 150-ampere-hour glass jars. These batteries were made by the American Battery Company. The cells are mounted on a special battery rack consisting of two divisions, each division having two shelves. Each individual cell is mounted on a specially prepared wooden base, which in turn is mounted on porcelain insulators, and the shelves are so arranged that any base may be removed and the jar taken out through the bottom of the shelf without disturbing the elements.

Arrangements were made for charging these storage batteries by means of two Holtzer-Cabot motor-generator machines in duplicate. The motor of each being 110-volt, sixty-cycle, single-phase, direct-connected to a dynamo capable of delivering nine kilowatts at seventy-five volts. Current for ringing, and also for busy and howler attachments, is furnished by two ringing machines, one machine consisting of one-fourth-horse-power, 110-volt, sixty-cycle, single-phase motor, direct-connected to an eighty-volt, twenty-cycle ringing generator. The other machine consists of one-sixth-horse-power dynamotor, primary wound for fifty-five volts, the secondary to deliver eighty volts, twenty-cycle alternating current. Both of these machines were also made by the Holtzer-Cabot Electric Company. The one-sixth-horse-power fifty-five-volt dynamotor is intended for night service and for emergency work and is to be run from the storage battery. The four machines are placed on slate bases mounted on an iron machine pier.

The machines, storage batteries and also the power for the switchboard are controlled from a power-board which is constructed of pink Tennessee marble mounted on an iron frame. On the front of this board are mounted copper switches (each switch being designated by a name-plate showing its use), also enclosed fuses, underload and overload circuit-breaker, tell-tale lamps from each board in the exchange, Weston voltmeter and ammeter are arranged with switches so that readings may be taken on any of the different circuits. One feature of this power-board is that there is no wiring on the back of the board except at the point where a connection is made, an iron

Digitized by Google

power rack situated about eight inches from the back of the board receiving all wires and carrying them to the power runway.

The board is lighted by two incandescent lamps with green shades and artistically curved supporting arms, one in front of the voltmeter and the other in front of the ammeter.

The outside lines are brought in through lead-covered cable to sealed terminal heads and thence to the distributing board of the F. B. Cook type. This distributing board is equipped with self-soldering heat-coils and carbon lightning arresters and is so arranged that any outside line may be connected to any switchboard line by simply running jumper wires; thus any subscriber, upon moving, may be allowed to keep his old number.

A combined wire chief's and information clerk's desk is furnished, the wire chief's desk being arranged for making various tests on the lines. The cabinet is of highly polished golden oak and on it are mounted a Weston voltmeter, keys and lamps for operating the various circuits and one set of standard switches for testing the outside lines direct to the wire chief's desk without going through the regular board, also arranged with two Automatic Electric Company's nickel desk sets.

Information position is so wired that a subscriber making a wrong call and calling it on a dead-line is connected with the information clerk and can thus be instructed to make the proper call. In the same manner telephones out of service are brought into this information desk as well as certain lines which are designated for information trunks.

The toll-board is furnished by the local company and is so arranged that any subscriber by calling "O" at his telephone is connected directly with the toll-board and by pushing his ringing button signals the operator, to whom he gives his directions.

Meeting of the American Trade Press Association.

A general meeting of the members of the American Trade Press Association will be held in the rooms of the Hardware Club, 253 Broadway, on Friday evening, February 17, at six o'clock. On this occasion Mr. Arthur E. Warren, director of the department of publicity of the Allis-Chalmers Company, Milwaukee, Wis., will be a guest of the association. Mr. Warren will deliver an address on the "Sphere and Usefulness of the Technical Press from the Manufacturer's Standpoint." A large attendance is particularly desired. Mr. L. J. Montgomery is secretary of the association.

The Electrification of the London, Brighton & South Coast Railway, England.

The English journals announce that the London, Brighton & South Coast Railway Company has decided to electrify a portion of its suburban system. This decision is not due to a sudden impulse on the part of this company, or a wish to follow the lead of other railway companies. The matter has been under consideration for the last few years, and Mr. Philip Dawson has been at work upon this question for the past three years. Every phase of the situation has been gone into thoroughly, and very voluminous reports have been made.

The report which was presented to the directors early in July of last year comes to the conclusion that a third rail was out of the question, not merely because of its somewhat dangerous nature, but because of the existence of Clapham Junction, which is said to be the busiest railway junction in the world. To carry a third rail through the maze of rails existing there would be merely to set a death trap for trackmen. Since the single-phase motor has become available, the use of the third rail may be avoided, and the directors of the railway company have decided to proceed at once with the equipping of a portion of the system with this type of motor. The portion which will be electrified first is that section which lies between Battersea Park and Peckham Rye.

The electrification of this road will aid greatly in relieving the pressure at the great London termini. Much of the delay there in getting the trains in and out is due to the necessity of shunting the locomotives, an operation which can not be completed at London bridge in a less period than seven to eight minutes with steam haulage. With electric traction there will be no necessity for shunting, and it is anticipated that a train will depart again within two minutes of its arrival. This will increase the possible number of trains handled at these tremini about three times.

The management of the road will also turn its attention to developing the more remote suburban districts within a radius of thirty miles. Hitherto it has been out of the question to attempt this, on account of the impossibility of accommodating a single additional train at the termini.

Another reason which has had some influence in bringing about this decision is the effect upon the railway of the electric tramways in the same section of the country. Nearly every branch of the road is paralleled by an electric tramway.

The main features of the system will be as follows: power will be generated at New Cross. The generators will be driven by steam turbines; and the station will be erected on the complete unit system. The alternators will generate current at 6,600 volts, twenty-five cycles, and power will be supplied directly to the overhead conductors at 6,000 volts, without the interposition of any transformer apparatus whatever. The conducting cables will be laid underground, and each section of the working conductor will be separately fed near the middle of its length. Switch gear will be provided in signal boxes controlling the distributors, and for coupling sections of the conductor together in case of necessity. The running rails will not be bonded together for the return current, but each rail will be bonded to a concentric cable laid underground between the tracks, while the inner conductor of the cable will constitute a high-pressure distributor. The rolling stock will consist of two-truck cars, divided into sections, with side doors. The cars will be open from end to end above the seats. The sliding doors will be operated by compressed air or by hand. Current will be collected from the overhead conductor by a sliding bow. The traffic over the Peckham Rye section, between Victoria and London bridge, amounts to 7,000,000 passengers per year, exclusive of short-distance passengers and season ticket-holders.

Notes on Induction Integrating Wattmeters and Their Use.

At the second annual meeting of the Colorado Electric Light, Power and Railway Association, held at Colorado Springs, Col., September 21-23, 1904, Mr. A. A. Serva delivered an address on "Induction Integrating Wattmeters and Their Use." This paper has been reprinted and is being distributed with the compliments of the Fort Wayne Electric Works, Fort Wayne, Ind.

The paper takes up in detail the theoretical considerations involved in the construction and operation of the induction integrating wattmeter, giving diagrams of the connections and showing a number of interesting performance curves. The apparatus under consideration is the type K wattmeter manufactured by the Fort Wayne Electric Works, and a number of carefully prepared half-tone illustrations exhibit all of the assembly and mechanical details of this apparatus. The paper is well worth going to a good deal of trouble to secure.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

A Model Illustrating Hittorf's Theory of the Migration Velocity of Ions.

An ingenious model, which may be used as an aid in explaining the conception of Hittorf, is here described by Mr. Frederick H. Getman. The model consists of a baseboard fifty centimetres long and seven centimetres wide, upon which are two upright supports. Through these supports pass two cylindrical wooden rods, six millimetres in diameter and forty-seven millimetres long. Upon these rods are placed sixteen wooden balls, eight on each rod, one set of eight being colored black, the other set white. Across the top of the support is fastened a scale divided into sixteen equal parts. Between the third and fourth divisions and the twelfth and thirteenth divisions are placed two light strips of wood which represent the electrode. To make the use of the model clear, suppose the anion of the electrolyte to have a velocity twice as great as that of the cation. The row of balls which represents the anions is then moved two divisions to the right or left, and the other row is moved one division in the opposite direction. This will leave at each end three unpaired balls, which are to be moved beyond the vertical partition, this action representing their removal from the electrolyte. Upon inspection of the model it will be found that there has been a transference in the electrolyte, and while each anion is paired off with a corresponding cation, they are not disposed symmetrically about the meeting line. A common abacus might be used as a model of this kind.—*Abstracted from Science (New York), January* 27.

Electric Radiography.

If, upon an electrified plate of ebony, a tube containing a salt of radium is placed, and allowed to remain for ten or fifteen minutes, and then the plate be dusted with a mixture of sulphur and red lead, such as is used in making the Lichtenburg figures, upon the surface of the plate will appear, according to Herr V. Gabritschewski, images of all objects which have been resting upon it or held immediately over it. It is not necessary that the tube containing the radium should be upon the plate. The effect will be the same whether it is held some distance away, or even upon the other side of the plate. If only half of the plate is charged, and the radium be placed upon the neutral part, a yellow image of the radium tube is formed in a weak red field, and there will be found two parallel straight lines, marking the boundary between the electrified and the neutral portion of the plate—one a red line on the electrified half, and the other a yellow line. If three vertical rods are placed in line on the plate, and the tube containing the radium compound is held in line with them, each rod will form an image on the plate. The one nearest the radium tube will be oval and eccentric to the rod, projecting away from the tube. The one at the far end of the row will also be oval, but will project toward the tube, while the central image will be oval, but will be symmetrically placed with regard to the rod. These effects are explained by the inductive action set up between the electrified plate and neighboring bodies.—*Translated and abstracted from the Physikalischer Zeitschrift (Leipsic), January* 15.

The Electrical Equipment of a London Hospital.

A description is here given of the electrical equipment of Guy's Hospital in London. There is a large Finsen-light apparatus, which enables four patients to be treated at the same time. There are, in addition, a smaller Finsen-Reyn lamp and a Lortet-Yenoud lamp, used for the treatment of single patients. A complete high-frequency equipment enables high-frequency currents to be used in treating rheumatism and neurasthenic conditions. Direct current is available for hydro-electric bathing, and for applying electrolysis. Vibratory massage apparatus and a large motor-driven Wimshurst static machine are installed, as well as a complete Rœntgen-ray outfit.—*Abstracted from the Electrical Review (London), January* 20.

Reversal of Charge from Electric Induction Machines.

In this communication Mr. V. Schaffers refers to the method of reversing the charge of static machines which was mentioned in the ELECTRICAL REVIEW for January 28, and he gives the following method, which is said to be more trustworthy and simpler than the other. This consists in discharging by hand, at the same time, both the inductors of the fixed disc. Then a reversal is invariably observed without stopping the machine.—*Abstracted from Nature (London), January* 19.

Electric Automobiles.

A critical study of present practice in the construction of electric automobiles, and suggestions as to the best method of improving it, are here given by M. R. de Valbreuze. Seven or eight years ago it was hoped that the electric automobile would rapidly come into use. To-day these vehicles are considered as luxurious and as suitable only for short runs. Practice has shown that the electric automobile can not make an average of over forty-five to fifty kilometres on a single charge, if the batteries weigh only one-third of the total weight of the car and are not improperly treated. This is rather surprising, since during the automobile trials of 1898 the electric vehicles were rated as having ranges of from 92 to 107 kilometres. It would seem, therefore, that there has been retrogression rather than progression in the construction of these vehicles, but when account is taken of the many ways in which losses of energy occur, and remembering the improvement which has been made from the point of view of stability, it is found that there has been considerable advance. The author then takes up in detail the question of the batteries, the system of driving, and the methods of regulating speed. It is customary to-day to separate the batteries into two sections, mounting one in the front and the other in the rear of the vehicle. While this gives a good distribution of weight and easy riding, it is bad, because this arrangement makes it difficult to take proper care of the cells, and results in their neglect. It is better to place the batteries under the seat of the driver, and arrange this so that it may be lifted up, thus making access to the cells easy. The usual method of increasing the capacity of accumulators is to use lighter plates and increase the density of the battery, but this gives a weak cell and one which is quickly sulphated. The author believes that Planté plates may be constructed no heavier than the pasted plates, and he believes that this is the proper direction in which to work. With frequent washings the positives of this kind will give 250 to 300 dis-

Digitized by Google

charges, and batteries of this kind are not affected seriously by bad treatment. There are several ways of driving the cars, but two points should be borne in mind. One is that the system of driving and transmission should be as simple as possible, and easy of access. The second is that all parts should be made as light as possible. The first point is too frequently neglected. In regard to the second, it is not sufficiently realized that a slight increase in the weight at any point calls for a corresponding increase in the weight of the batteries. This gain makes it necessary to strengthen the car so as to carry this extra weight of battery. It will be found that an increase in weight of any part of the car other than that of the accumulators will increase the total weight of the car by nearly twice as much. There are two main methods of driving, one using a single motor, and the other making use of two or more motors. The single motor drive gives a lighter equipment and a higher efficiency, but makes necessary a differential gear. While two motors enable the differential to be done away with, the motor equipment is less efficient and weighs more. In any case, it is desirable to use light, and hence high-speed motors. The advantages of the different methods of transmitting power from the motor to the axle are considered. The cost of upkeep of a battery is given as about thirty-five dollars a month. The total cost of keeping an electric automobile is given at $218 per month.—*Translated and abstracted from L'Eclairage Electrique (Paris), January* 14.

The Power Plants in the Canadian Niagara District.

A detailed account is given here by Mr. Cecil B. Smith, until recently in charge of the Canadian Niagara Power Company's plant, of the various power schemes now being carried out at the Canadian side of Niagara Falls. The total hydroelectric development of Canada is now about 228,000 horse-power. This puts Canada next to the United States, and gives her one-tenth of the world's total. The Niagara district presents unusually favorable conditions for hydroelectric development, such as certainty of water, but slight fluctuations in head, vigorous and varied markets, and reasonable freedom from ice troubles. Although there are no large cities on the Canadian border at Niagara, the total population of southwestern Ontario, within 125 miles of Niagara Falls, is about 1,500,000. A number of United States firms are building large Canadian works, where it is expected a good part of the power generated will be employed. The older plants on the Canadian side are those located along the Welland canal, there being at De Cew Falls a plant operated by the Hamilton Cataract, Power, Light and Traction Company, where the head is 267 feet, and the output of the station about 6,000 kilowatts. The old Welland canal has been practically closed to vessel traffic. The Dominion government has leased to various users limited quantities of water on each level, in addition to that already so used while the canal was in operation for vessel traffic. In this way a large number of small stations have been equipped, operating under falls of from twelve to fourteen feet, the power thus produced being used for various purposes. The Hamilton company has also secured from the city of St. Catherines the water rights in the Beaver Dam valley, and is equipping there a power-house which will have an initial capacity of 16,000 kilowatts, but which may ultimately be increased to 42,000 kilowatts. The International Railway Company's plant at Niagara Falls is equipped with two 1,000-horse-power vertical turbines operating at fifty-five feet, which drive three 200-kilowatt railway generators and two 450-kilowatt, 2,200-volt alternators, now used by the Canadian Niagara Power Company. The Canadian Niagara Power Company's plant is similar to that of the Niagara Falls Power Company on the American side. This station, however, has adopted 10,000 electrical horse-power units, with a consequent shortening of the wheel-pit and power-house from eighty to forty-eight feet per 10,000 horse-power. The tail-race tunnel, which will make available 110,000 horse-power, is now finished. The wheel-pit is 570 feet long, eighteen feet wide, and varies from 165 to 148 feet in depth. The present installation will have an output of 50,000 horse-power. The turbines will operate under an effective head of 136 feet. The Ontario Power Company will draw water from the neighborhood of Dufferin Islands, carrying it through a flume which is formed of an eighteen-foot steel pipe encased in concrete to Table Rock, where the penstocks branch off downward to the turbines situated in the generating station at the base of the main cliff. The receiving station will have a capacity of 180,000 horse-power, but the single eighteen-foot flume now being built will develop only 60,000 horse-power. The water through this flume will flow at the rate of fifteen feet per second. There will be six 10,000-horse-power units in the present equipment. The Toronto & Niagara Power Company is using the wheel-pit construction, and is cutting a tunnel 1,900 feet long under the bed of the river to a point immediately behind Horseshoe falls. By reversing the alternate penstock positions, the wheel-pit of this company has been reduced from ninety-six feet to seventy-five feet per 20,000 horse-power. The power-house will ultimately contain eleven 8,000-kilowatt, three-phase, 12,000-volt alternators. This company purposes transmitting current to Toronto—eighty miles—by three-phase, 60,000-volt transmission. The wire is to be carried on steel towers 400 feet apart. There are now between twenty and thirty million dollars being invested in developing the water power on the Canadian side. While a good deal of the power generated will be used in Canada, it is expected to export a large amount of it to the United States whenever additional markets are found. It is thought that the railways will turn to electricity as soon as they are sure of continuous service, and that this will utilize a good part of the output of the Niagara Falls plants. It is difficult to estimate what these different demands will amount to, but as there will be from 150,000 to 175,000 horse-power on the market from these plants within a few years, and as they are being developed with a view to a total output of 375,000 to 400,000 horse-power, it is a safe conclusion that the probable demand within the next five years will about equal the smaller amount mentioned. On the other hand, it is hard to conceive of a total demand in both countries, within a reasonable distance of Niagara Falls, for more than 500,000 horse-power within the next generation.—*Abstracted from the Engineering Magazine (New York), February.*

Electric Lighting of Trains in Belgium.

United States Consul James C. McNally, Liege, Belgium, reports that the Belgian government railway authorities have for some time past been engaged in building a locomotive equipped with a dynamo and storage batteries, for lighting electrically a train of several cars. The batteries are not placed on the cars, on account of their weight. This experimental train is now about ready, and will be tested in a short time.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Thomas Soldered Rail Bonds.

The Lord Electric Company, 112 Water street, Boston, Mass., makes the Thomas soldered rail bond, a number of forms of which is shown in the accompanying illustrations.

The type A bond, shown in Fig. 1, is

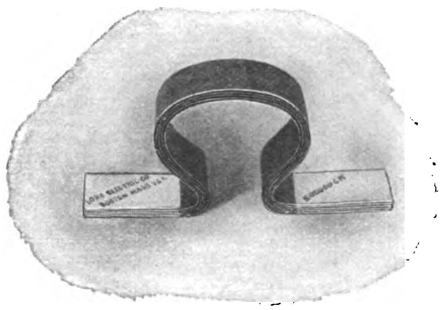


FIG. 1.—TYPE A BOND.

used for track, third rail or structure bonding, where large capacity is required. Where joints are suspended it is usually applied to the base of the rail, although it can be applied to the top of the flange in many cases. It can be used to great advantage wherever the base of the rail is exposed. On new work where the joints are to be suspended these bonds can be applied with the rails turned bottom up in sections of about 300 feet. This section, joined by fish-plates, can easily be turned by four men. After the bonds have been applied and the ends of each section thoroughly tinned, the rail is turned and spiked, leaving only the bonds connecting the several sections to be applied. This type of bond can be applied to old work without removing the bolts or joint-plates, or interfering with traffic. The base of the rail affords ample contact area for a

FIG 2.—TYPE B BOND.

bond of large capacity. A screw or bolt may be used to hold the bond more firmly than by soldering alone. It is put through the rail flange into the bond, and serves the double purpose of a clamp to draw the bond into contact with the rail during the process of soldering, and then aids the solder to resist the strains due to the motions of the rail in regular service.

The type B bond is shown in Fig. 2. It is adapted for use where the fish-plates or angle-plates are used as a conductor, and where the base of the rail is not accessible. It is also used where the space under the joint-plates is too limited for a concealed bond of the required capacity, or where it is too difficult or expensive to remove the joint-plates and bolts. If applied from rail-web to joint-plate, and *vice versa*, it is virtually a substitute for the long bond around the plate, and is much lower in first cost and less liable to theft. The bond is provided with a series of slots to increase the vertical flexibility of the bond, and to provide for the motions of the rail in that direction, as well as for the regular expansion and contraction.

The type C bond, shown in Fig. 3, is

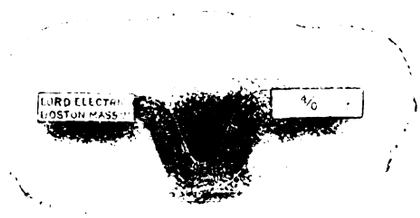


FIG. 3.—TYPE C BOND.

used for bonding guard rails, and can be applied to either new or old work. It can be used on the side ball of the rail, opposite the flange, or as a concealed bond under the joint-plates. This type of bond can be applied without interference to traffic, making a very inexpensive and satisfactory installation on suburban lines where there is no street traffic.

Where continuous or Weber rail-joints are used the available space for concealed bonds is increased. By utilizing the space on both sides of the rail-web under such bonds, it is possible to obtain large capacity, although seldom equal to the capacity of the rail.

The type D bond, shown in Fig. 4, is a new departure in the utilization of the space under joint-plates. It avoids the difficulties of the plug terminal type of bond, and can be readily applied under any of the existing types of angle-bars or joint-plates which afford opportunity for any bonding whatever between the rail and plate. It can be easily applied to existing roads, the necessary punching in the ends of the rails being done by means of a powerful hand-press. The position of the type D type of bond when applied is such that the flexible portion occupies that part of the space between the joint-plates where the distance is greatest. No part of the flexible portion extends to the narrow space at the head and foot of the rail. The motion of the rails, due to expansion and contraction or

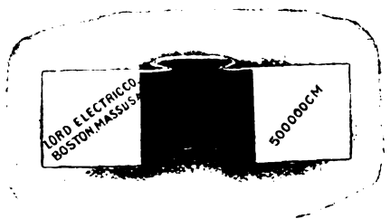


FIG. 4.—TYPE D BOND.

vibration, can cause no injury to the bond by bringing its flexible portion into contact with either the rail or with the joint-plates. This bond can be applied either by soldering or by soldering and bolting.

The type E bond, shown in Fig. 5, was designed for use as a concealed bond under a continuous or Weber rail-joint, where the vertical motion of the rails is limited. The entire length of the bond between terminals partakes in the bending, and the joint will always retain its original shape. The space on both sides of the rail-web is utilized in application, and the

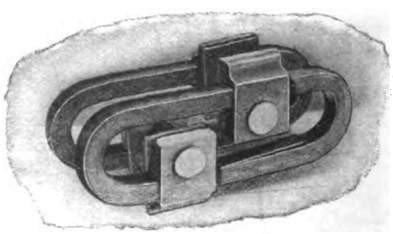


FIG. 5.—TYPE E BOND.

two parts of the bond are riveted together and to the rail, in addition to the soldering.

The *Four-Track News* for February, 1905, is a most attractive publication. The cover is adorned with a reproduction of a California palm and cactus garden, and the frontispiece shows the ice bridge and ice mountain at Niagara Falls, on the New York Central. It is hard to pick out the most attractive contribution to this number, but there is no extravagance in saying that every portion of the issue is well worth perusal.

Digitized by Google

Jandus Series Alternating Arc Lighting System.

The Jandus Electric Company, Cleveland, Ohio, manufacturer of enclosed arc lamps, has put upon the market a new system of series alternating arc lighting, which has several features of great interest.

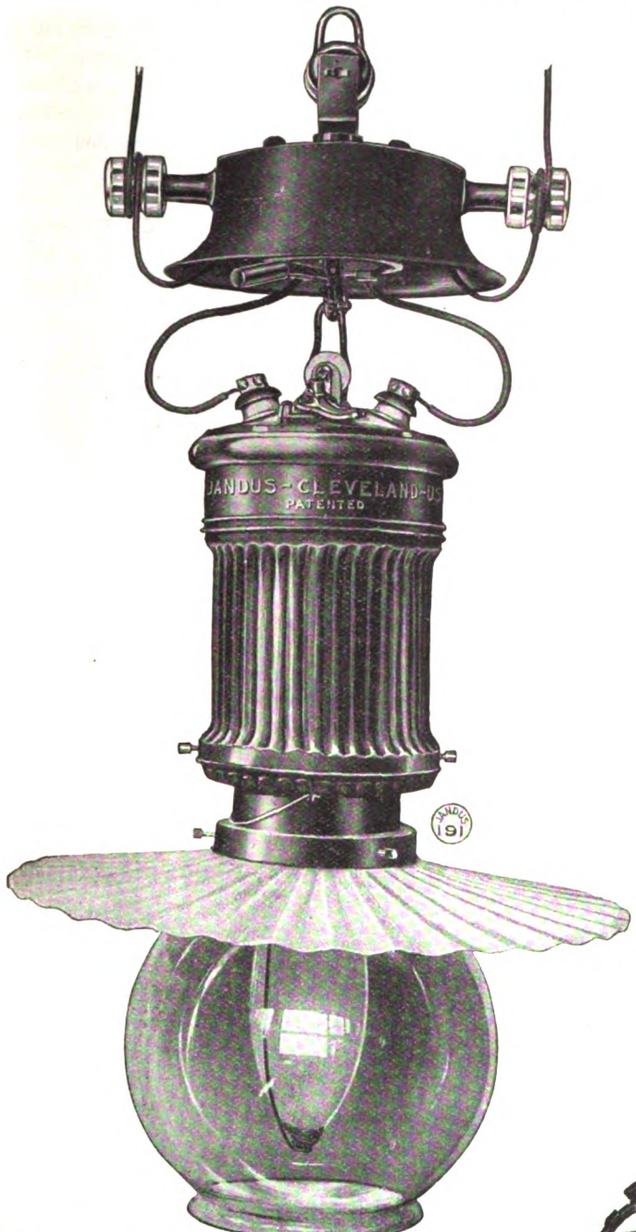


FIG. 1.—JANDUS SERIES ALTERNATING-CURRENT ARC LAMP.

The illustrations show the arc lamp, the regulator and a special arrangement of regulator and switchboard panel. These and many details relating to the system are described and illustrated in bulletin No. 21, issued by the company.

The lamp, Fig. 1, is of the widely known Jandus interchangeable type, the casing, glassware and main body being identical with Jandus lamps for all the classes of service now in use, both alternating and direct current, the integrally mounted mechanisms being interchangeable. The interchangeable feature is obviously of great value to central stations using a variety of circuits, as all lamps may be uniform in appearance and structure, with the same inner globes and carbons, and all repair parts identical excepting those forming part of the interchanged actuating mechanisms. The lamp has a differential mechanism, and the regulation claimed for it is very fine. All details are worked out with the same skill and care that have characterized the work of the Jandus company in past years. This lamp won the highest award (gold medal) at the World's Fair, at St. Louis. The long burning life of the lamp—140-175 hours—is specially notable.

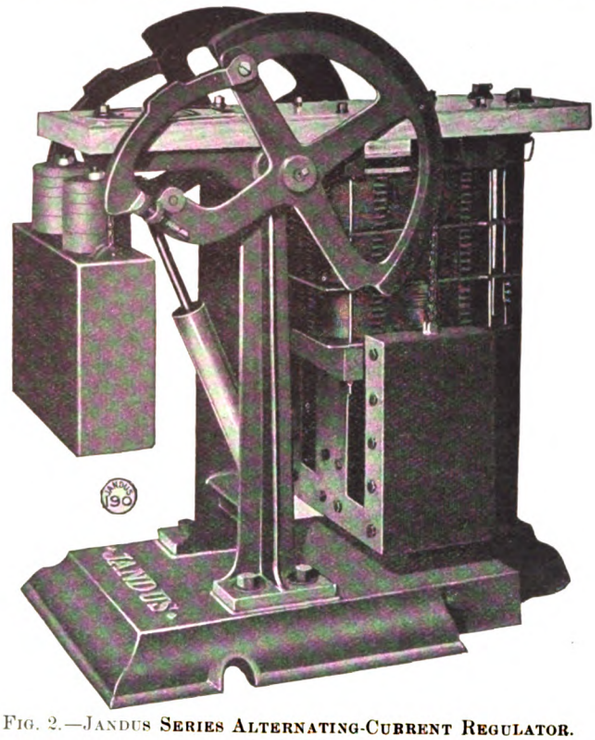


FIG. 2.—JANDUS SERIES ALTERNATING-CURRENT REGULATOR.

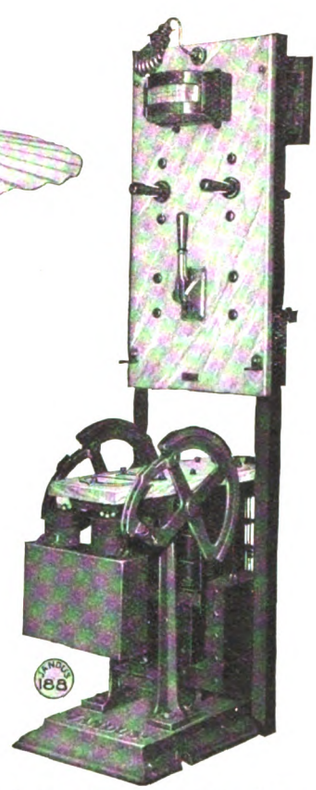


FIG. 3.—JANDUS REGULATOR AND SWITCHBOARD PANEL INSTALLED AS A UNIT.

The regulator, Fig. 2, is perhaps the most interesting feature of the system. It is of the inductive type and is designed on novel lines. It consists of a base-plate and a vertical frame upon which is mounted a heavy marble top. This top carries the terminal binding-posts and supports the inductive coil. The purpose of this construction is to insulate all the current-carrying parts thoroughly from ground. The coil is stationary so that no flexible leads are required. The core is movably mounted to operate vertically into and out of the stationary coil. A weight is connected to the movable core by means of steel chains located in grooved wheels which are mounted on finely finished ball bearings. The weight serves to counterbalance the core when the coil is not energized. Through the medium of an adjustable cam on the counterweight side of this system of forces the moment is made inversely proportional to the magnetic force which actuates the core. The coil is constructed of fine and moisture-proof wire and the insulating heads are of mica, so that the regulator

Digitized by Google

will withstand a short-circuit for an indefinite period.

Fig. 3 illustrates a special feature of the Jandus system whereby the regulator and switchboard panel are installed as a unit, which of course may be multiplied in the central station. This arrangement saves largely in floor space, but its particular advantage consists in compacting all the apparatus necessary to be observed and manipulated and in installing it within reach of the attendant. In such an installation the operator has before him and within reach every part of the regulator and every switchboard instrument, so that without changing his position he can make all necessary observations and adjustments in starting the circuit.

The following claims are made as to the advantages of the Jandus type regulator:

Current-carrying parts suspended from marble and thus thoroughly divorced from ground; elimination of frictional retardations by use of perfect ball bearings; fixed coil and movable core, this arrangement requiring no flexible connections which are frequent sources of annoyance; disposition of the counterbalancing weight within the parallelogram of the base, this saving floor space and eliminating the projecting arm, which is often in the way of the station operator; harmony of design with switchboard panel, permitting the installation of the regulator and switchboard as a unit; an indestructible coil capable of withstanding a short-circuit indefinitely.

Some New Snap Switches.

In connection with the new and very complete line of snap switches being put out by the Marshall Electric Manufacturing Company, of Boston, Mass., perhaps one of the most important devices is its

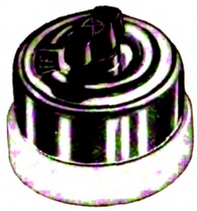
FLUSH ROTARY SWITCH.

flush rotary switch which contains many novel features.

This switch is made to fit the same box as the standard push-button switch. The face-plate is also made to the standard of the national electrical contractors.

One special feature of excellence and novelty is the fastening of the face-plate to the switch body. Heretofore in this class of switch it has been customary to depend upon the handles for holding the plates in place with the result that the plates were usually lop-sided or at an angle with the other finish, in addition to bringing the destructive weight upon the spindle of the switch.

All of these difficulties have been overcome by fastening the plate with screws directly to the back, in the same manner as push-button plates are fastened. This feature is now specified by many electrical engineers and architects. In addition to this, the handle is let into the plate sufficiently to be really flush, so that there is nothing projecting from the face of



INDICATING SWITCH.

the plate. The plates themselves are of novel construction, being cast with ribs or flanges on the back.

The mechanism is hardened steel, insulated by solid sheet mica. All switches are made indicating.

A new snap switch, which is being put in the market by the same company, is illustrated herewith.

This is one of a very complete line which this company is now making. It has several novel features, the most important being the eccentric binding-posts, which give the binding screws an exceptionally long bearing, so that the threads will not strip.

The mechanism is of hardened steel, and is entirely insulated from the circuit by solid sheet mica. The moving contacts are loosely held by the mica insulation so as to more readily adjust themselves to a good bearing in the stationary contacts.

A removable indicating dial is furnished with all 250-volt switches. The lining of the cover is novel, being formed from elastoid fibre in one piece, without seams, wrinkles or roughness of any description. It holds itself in the cover through its own elasticity.

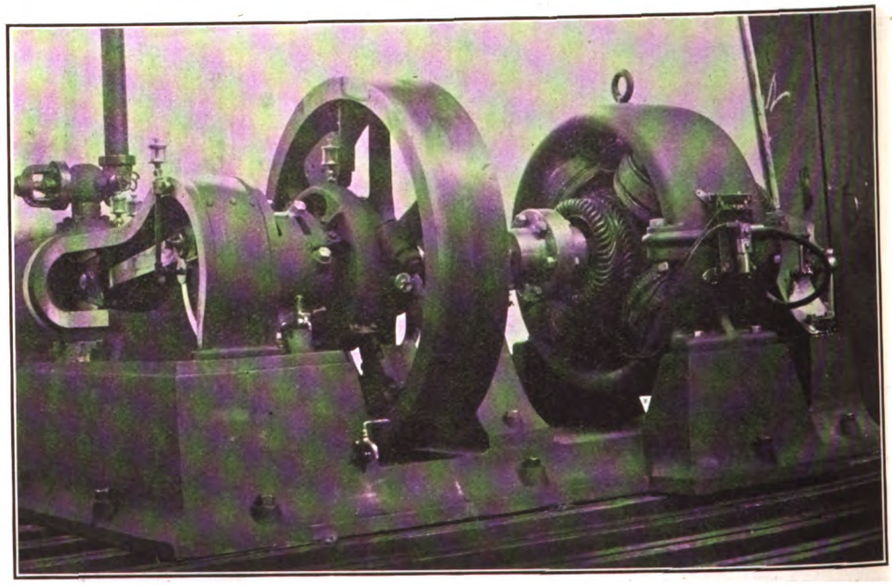
Direct-Connected Generating Set with Horizontal Engine.

The accompanying illustration shows a direct-connected generator of the regular engine type, manufactured by the Ideal Electric and Manufacturing Company, of Mansfield, Ohio. This particular unit has a capacity of fifteen kilowatts at 375 revolutions per minute. It is wound for 110 to 115 volts, and was installed for the Camden City Brewery, of Camden city, N. J.

The generator is the standard type of the company, of which the larger sizes have six poles and the smaller sizes, four poles. The magnet frame is divided horizontally to facilitate handling and ease of repairs, the joints being covered by a rib which adds to the general appearance of the machine. The joints of the pedestal covers are concealed in the same manner.

The field-poles are of wrought iron, fitted with removable pole-shoes of cast iron. The field coils are form-wound and heavily corded for their protection, presenting a neat and striking appearance.

The armature is of the ironclad ventilated type with form-wound coils. Ventilating holes are punched in the discs of the core and intersect with ventilating spaces in the core building. The armature core is built up of annealed sheet-steel discs of the highest electrical quality, the surfaces being oxidized before assembling. The commutators are of rolled copper of rigid construction and of liberal proportions.



FIFTEEN-KILOWATT DIRECT-DRIVEN GENERATOR.

The brush-holders have a parallel movement, are provided with independently adjustable springs, and copper connections between brushes and terminals ensure proper conductivity and perfect contact.

The engine end of this unit is manufactured by the Chandler & Taylor Company, Indianapolis, Ind.

Digitized by Google

Westinghouse Type K Voltmeters and Ammeters.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., offers a new line of voltmeters and ammeters for switchboard work for use in connection with small installations and in competitive work. They are known as the type K, and are for use upon either direct or

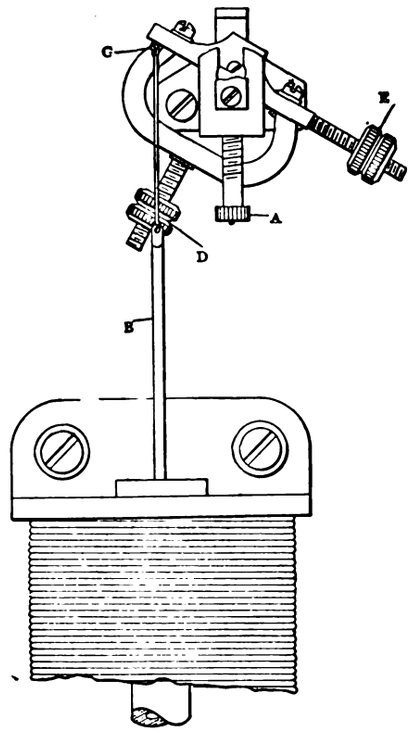
WESTINGHOUSE TYPE K VOLTMETERS AND AMMETERS.

alternating currents. This type is a development of one of the Lord Kelvin patents controlled by the Westinghouse company, and the construction is strictly modern and fulfils the most exacting requirements of present practice.

In shape, size, finish and general appearance, the type K instruments harmonize with the other round pattern switchboard types of the Westinghouse manufacture. The face has a matted surface with raised letters and a pleasing ornamental design in low relief, the entire case being finished in black enamel.

Their principal distinguishing characteristic is the simplicity of their construction. There are but few parts, none of which is complicated and the adjustments are easily made. In effect, the mechanism consists of a stationary coil, through which the measured current flows, the voltmeter measuring the current which flows through a high resistance. This coil acts on a movable core or plunger, which is connected with a steel beam mounted upon knife bearings and carrying the indicating pointer. There are no springs, the action being controlled by gravity. In the type K the core is so constructed that it is saturated with a very small amount of magnetic energy, such as that of one-twentieth full scale deflection, and thus for any load the attraction upon the plunger is directly proportional to the current, making the error due to residual magnetism commercially negligible and the scale almost uniform, commencing with zero. On alternating currents its action is not appreciably affected by changes in frequency. External fields do not influence the performance, and temperature errors are negligible.

The instruments are dead-beat in their indications, the steadying effects of a dashpot being obtained by inserting the lower end of the plunger in a glass tube filled with oil. The opening in the solenoid is made small and the plunger is a piece of fine iron wire, flexibly connected to the movement by means of a strong silk cord. The only point where friction could be looked for is at the two knife edge



WESTINGHOUSE TYPE K VOLTMETERS AND AMMETERS.

bearings which support the beam, but in fact no frictional effects are perceptible, as the weight is exceedingly light, and the controlling force very great. Movable weights shown at D and E in the accompanying illustration afford a means for adjustment.

The scale has large open divisions which are practically uniform in size, and legible at all points. The sector illustrated at A corrects inequalities by keeping the leverage the same in all positions.

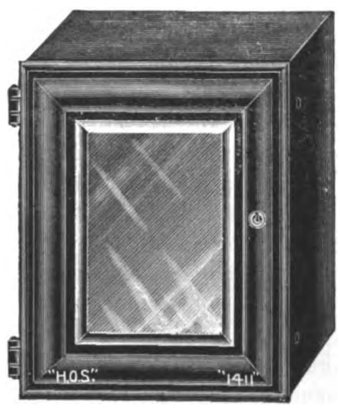
It will be seen that the simplicity of construction gives the type K instruments an unusual degree of strength coupled with exceedingly accurate performance. There is nothing in their mechanism to affect the permanence of calibration, and if by any accident they are broken they are easily repaired and adjustments can be readily made.

Ammeters are regularly made of capacities to and including 1,000 amperes, and voltmeters to 750 volts for use without transformers. For larger capacities, transformers are supplied. Switchboard builders find them of decided advantage in connection with moderate priced panels where high accuracy is desired, such as combination panels for a single generator with its feeders, and small boards for isolated plants.

Panel-Board Cabinets.

The accompanying illustration shows a cast-iron cabinet, style No. 1,411, with beveled glass plate in door, manufactured by the H. O. S. Engineering Company, of Newark, N. J. This cabinet is designed for mounting on the surface of a wall with panel-boards or cut-outs not requiring any side wiring space.

The H. O. S. Engineering Company manufactures a complete line of panel-board cabinets and covers. These are made up of different material and finish, as may be desired. The company has recently moved to a well-equipped factory at 16-22 Boyden place, Newark, N. J. Increased facilities have been secured for the production of panel-boards and panel-board cabinets. In addition to this line of goods, the company has begun the manufacture of the "Falcon" flush receptacle, in accordance with the latest re-



CAST-IRON PANEL-BOARD CABINET WITH BEVELED PLATE GLASS IN DOOR.

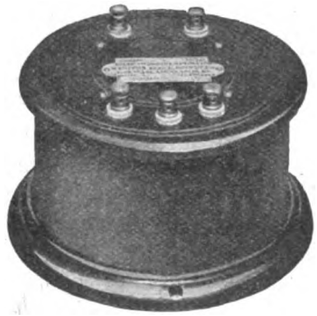
quirements of the board of underwriters. It is expected that this material will be placed on the market within a month or so. Bulletin No. 52, describing the increased line of goods manufactured by this company, is now being distributed, and bulletin No. 43 will be ready for distribution in a short time. These bulletins may be had upon request.

Digitized by Google

The Adams Secondary Generator.

The Adams secondary generator, made by the Wesco Supply Company, St. Louis, Mo., is a practical substitute for primary batteries and can be employed on all low-voltage systems when connected to the secondary side of an all-day alternating current. The amount of current consumed by it is not sufficient to operate the ordinary electric meter and it is therefore operated at practically no expense. It will operate the largest systems of factory signals and can readily be adapted to miniature incandescent lighting. Gas-lighting systems of any size are operated without the use of a spark coil except in cases of "jump" spark systems where the use of high-tension induction coils is imperative. Again, where the bell wiring is so poor or has deteriorated to such an extent that leakage exists which continually permits ordinary batteries to run down, the Adams secondary generator can be installed with the best of results.

The construction is absolutely fireproof and each instrument is tested to 2,000



ADAMS SECONDARY GENERATOR.

volts on short-circuit. It has the approval of the Underwriters' Association in regard to electrical and mechanical construction in every detail, and is pronounced suitable everywhere for use in connection with low-voltage circuits usually operated by batteries where such voltage does not exceed ten volts. Up to this voltage the class of wiring as is ordinarily used in connection with bells is permitted. The construction of generators Nos. 1 and 2 is electrically and mechanically such that it is impossible to overheat or injure the generator proper or any of the wiring of the system in connection with the secondary side in any way, should short-circuit occur from any cause. The distinguishing feature of this instrument is its inherent self-regulation by which the maximum output of the generator is automatically limited so as to prevent any possibility of harm to the instrument itself, or to the secondary wiring system in connection with it, under even extreme cases of short-circuit. Should a short-circuit occur the voltage of the machine at once drops to nearly zero, thereby restricting the amount of current flowing to a point where it is incapable of overheating any conductor whatever.

The secondary coils of each instrument are provided with three terminal posts from which three different voltages can be drawn as desired. The two posts at the left supply the lowest pressure, the middle post and the one to the right, a medium pressure equal to twice the former, and the two outside terminals supply a voltage equal to three times that of the first position. Automatic annunciators and, in general, all devices having several coils in series, and consequently being possessed of considerable self-induction, are usually operated best on alternating current when the higher voltage is made use of. In any event, with three different potentials to select from, the one most suitable for any given case is readily obtained.

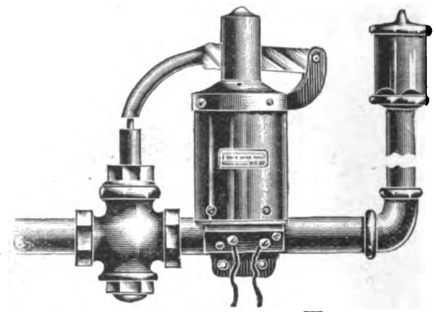
The all-day loss of this instrument represents an effective current value at 100 volts of one one-hundredth of an ampere or about the sixtieth part of the current required for a single sixteen-candle-power lamp which at once becomes a negligible quantity, since it is far from sufficient to start, or, when started, even to move a recording wattmeter.

The generator is designed to be connected to the 110-volt or secondary side of alternating currents, as shown in the connecting diagram accompanying each instrument. The installation is a simple matter requiring little work. The bells, however, require slight adjustment so that they will operate on alternating currents of either frequency.

While the generator will operate on the secondary of any alternating current, it is necessary that the generators have the same alternations as the electric current used. Bells must be wired in multiple and adjusted according to the number of bells it is intended to use, and the different voltages of the machine applied according to the resistance of the circuit.

An Electrically Operated Whistle.

The Electrical Appliance Company, 132 Longworth street, Cincinnati, Ohio, is placing on the market a device which will electrically operate a whistle situated in any position, by simply pushing a button close at hand. The whistle may be placed either indoors or outdoors, and any required distance from the operating key. The standard type of whistle for all ordinary pressures of steam is shown in the illustration. Any voltage of direct or alternating current may be provided for in the winding of the actuating solenoid. The device will operate any whistle up to three inches in diameter at 150 pounds pressure. If provided with a larger valve it will operate a six-inch whistle at the same pressure. A recently developed use for this apparatus is in connection with private branch telephone exchanges. It enables the operator to reach parties whose duties require their presence in many places remote from the office. Any number of different signals may be arranged,

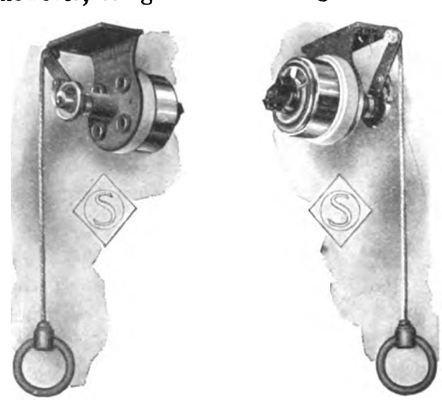


ELECTRICALLY OPERATED WHISTLE.

so as to reach as many different men. If a call comes in for any particular man, the operator presses the whistle key the requisite number of times, thus giving the signal on the whistle for that particular man. The latter then goes to the nearest telephone and calls the operator, who then connects him to the calling party. In this way no time is lost in hunting him up and bringing him to the telephone.

A New Form of Ceiling Switch.

A new form of ceiling switch has been placed on the market by P. Sorensen, 45 York street, Brooklyn, N. Y. As may be seen from the accompanying illustrations, this switch is peculiarly simple in design and construction. The switch is built with the usual snap switch rod, the rod, however, being extended through the back



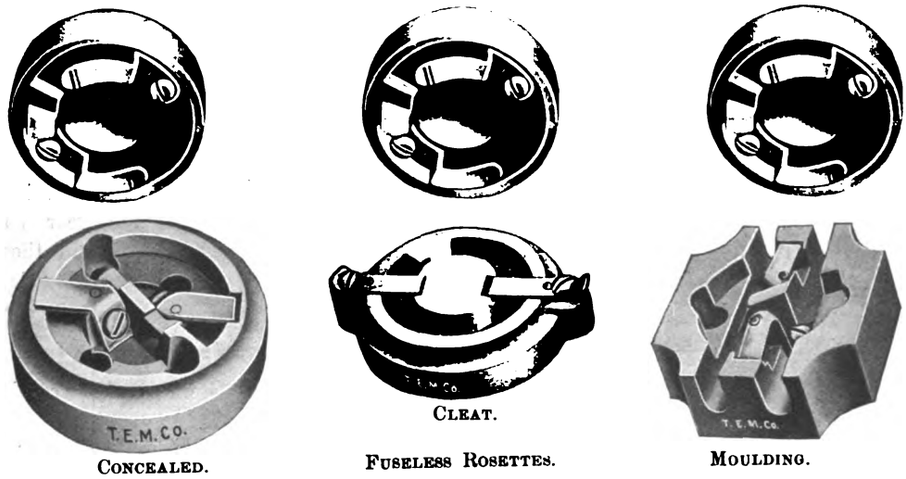
NEW FORM OF CEILING SWITCH.

of the switch case which is mounted upon a right-angled bracket. A lever with ratchet and pawl is fastened to the end of the switch rod. The pawl and lever are actuated by a cord which is made long enough to be easily reached from the floor. A spring brings a tension on the pawl, and always returns it to its normal position. The switch is opened by one pull, and closed by the next pull. The device is intended for installation in out-of-the-way places, and is a modification of the regular snap switch.

Digitized by Google

Fuseless Rosettes.

The Trumbull Electric Manufacturing Company, Plainville, Ct., manufactures the fuseless rosettes which are shown in the accompanying illustrations. The rosettes are made with spring tongues and caps, and the cord may be applied and the rosettes snapped on after the base is in position. The stop in the cap allows it to be put on in one way only. This is a particularly valuable feature for arc light work, as there is no possibility of reversing the current by taking off the cap. The caps are interchangeable and will fit any style of base.



CONCEALED. CLEAT. MOULDING.

FUSELESS ROSETTES.

The Westinghouse-Parsons Steam Turbine.

The Westinghouse-Parsons steam turbine is described and illustrated in a handsome booklet which has been issued by the Westinghouse Machine Company, of Pittsburg, Pa. The first few pages of the book are devoted to a history of the steam turbine, of its origin and development from Hero's engine about 120 B. C. to the present Westinghouse-Parsons machine. A discussion of the action of steam in the turbine, together with the principle of the turbine, follows. The construction of the turbine and of turbine generators is treated, and is illustrated by half-tones of the different parts of the machine. Half-tones of a number of recent installations are also shown. In the back of the book are some very valuable data, in the shape of results of tests of a 400-kilowatt, a 750-1,000-kilowatt and a 1,200-kilowatt turbine, under varying conditions.

Eastern Carbon Works Products.

Knowledge gained in producing high-class goods for many years is of real value. Designs and formulas, each for their special purposes that have been tested by thousands of patrons, and faults discovered and corrected, form a strong basis for confidence. It is only gradually that good batteries and carbons are evolved. That they give a maximum output is because experience has shown how to make them effective. The Eastern Carbon Works, of Jersey City, N. J., for nearly twenty years have been favorably known as manufacturers of wet and dry cells, carbon brushes and carbon products of every description. Their batteries of all kinds are standard and up to date.

Carbon brushes are made in many varieties by this concern. Besides the high grade combination wire and carbon, the different grades of graphite and regular brushes, they have recently produced and patented a brush that is designed to break up the eddy currents that work injury to the contact end of the brush. To accomplish this they use their ordinary grade of carbon in the centre, as a conductor, and integrally mould with it on each side (heel and toe) a material of high resistance which successively breaks up the useless currents. Several large manufacturers have adopted it after exhaustive tests.

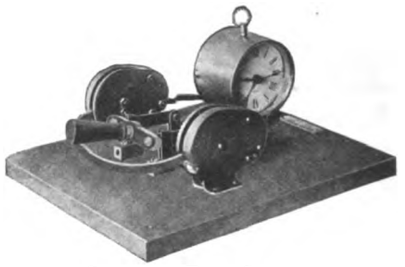
The accompanying cut shows the new Eastern battery connector, which was exhibited at the recent automobile show in New York, and for which a patent has been applied for. The rubber fastened securely to the terminal is compressed by the screwing up of the nut, and the spring in the rubber forces the nut back and jams it against the threads of the screw, so that no amount of vibration can jar it loose. It was designed originally for automobiles, but can be used to good advantage in any place where the vibration is excessive, as in automobiles, launches, steamboats, railroad trains, trolley cars, switchboards, etc. The company also furnish the terminals without the wire and make them in all sizes.

BATTERY CONNECTOR.

The Crescent Time Switch.

The Crescent Company, Chicago, Ill., has placed on the market a new form of time switch for automatically cutting out one or a series of window lights. One of the inconveniences of the merchant who does not keep his store open after dark is the necessity of making a call after the closing time to shut off the window lights. If this is not done it is a question either of leaving the lights on all night or of not having a store front and windows properly illuminated, so that the attention of buyers may be attracted during the evening hours. The new time switch is made in two sizes. The type "A" only turns off the lights, while the type "B" turns the lights both on and off.

The type "A" time switch consists of a polished slate base, upon which is mounted a high-grade Parker clock. There is also mounted upon this base a standard high-grade knife switch, which is operated by a strong, reliable spring entirely separate from the clock. The clock simply trips the spring at the specified time. The switch is thrown out of service opening the circuit. The switch is simply installed on the circuit, and is used as an automatic switch for the shop window. All that is necessary is to set the clock for the specified time, the same as for the ordinary alarm clock.



CRESCENT TIME SWITCH.

The type "B" switch is of similar design, and is made with two clocks mounted upon a slate base. With this device the user can have the lights burning for any specified time, throwing the lights on and then cutting them out as desired.

Digitized by Google

The Pease Blue-Print Washing and Drying Machine.

The accompanying illustrations show a new form of blue-print washing and drying machine manufactured by C. F Pease, 180 West Locust street, Columbus, Ohio. This machine is designed for the purpose of reducing the cost of producing large quantities of blue-prints, and to do away with the large washing tanks and drying paraphernalia usually incident to blue-print work.

The washing of the prints is accomplished by a spray of running water flowing over the treated side of the paper only. This removes the surplus ferroprussiate in the quickest time possible. The prints are not soaked through, the water coming in contact only with one side of the paper, and but for a short time. This makes possible a very much increased rapidity of drying.

The print is placed on the drying rod before washing, and remains there during the entire process of washing, wiping and drying. As the print hangs in the washing tray on the drying rod, the water flows down both sides of the doubled print —half of it on the side toward the operator, and the balance between the print and the back of the tray. When the front portion of the print in view of the operator is completely washed, the balance is always in the same condition.

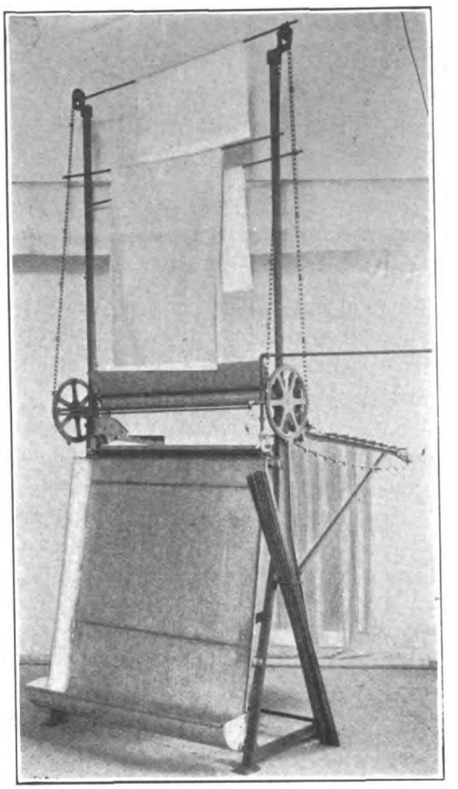
The surplus water is removed by a device which wipes the print as it is moved upward out of the way in the drying chains. As the following print is pulled through the wiping device, the previous one is carried still higher, and over the top, and finally down until it is automatically stripped from the chains of the machine and placed in a drying rack; then removed as required.

The construction of the machine is easily seen from the illustration. It is a rigid, light cast-iron framework, thoroughly braced, and supports the washing, dripping and drying devices, making it completely self-sustained and portable.

The washing tray, guard and pan are made of extra heavy galvanized iron, reenforced and supported by galvanized malleable iron fittings. The upper frame, carrying the small sprockets and chains, is of iron tubing, well braced and secured to the main frame of the machine, and provided with adjusting screws for adjusting the chain.

The spray is forced through a brass tubing properly guarded by a copper shield to direct the water where required. The drying rods are made of the best air and kiln-dried maple, and are varnished, polished, metal-tipped and provided with rubber separators. There is a sufficient number of drying rods to meet any requirement.

The machine is finished in black enamel, and the bright parts are nickel-plated. The apparatus is made in four sizes—E, F, G and H, taking maximum prints of the following sizes, respectively: twenty-four by forty-eight inches; thirty by sixty-six inches; thirty-six by eighty inches, and forty-two by one hundred inches. Size H was designed for large blue-print manufacturers, and is provided with a special racking device which keeps the prints separated and accommodates a much larger number at one time. This



BLUE-PRINT WASHING AND DRYING MACHINE WITH SPACING ATTACHMENT.

device can be applied to other sizes when required.

Quick delivery of prints can be secured by the addition of a heater, which Mr. Pease is prepared to furnish. This heater may be placed at the rear of the machine, and will accelerate the drying of the prints. The heater is constructed to use either artificial or natural gas, and may be applied at any time.

An automatic drying rack has been designed, to be applied where the size and quantity of blue-prints will not permit their drying entirely before delivery in the regular rack at the rear of the machine. This automatic drying rack can be applied to any size of machine at any time. The rack automatically removes the blue-prints from the main chains of the machine, and maintains a uniform distance between them until they reach an accumulating rack at the end of the travel of the endless chains.

Comparative Test of a Small Boring Mill with and without Maintained Cutting Speed.

The American Electric and Controller Company, 12 Dey street, New York city, recently made a test of a thirty-one-inch boring mill equipped with its new "Rheocrat" controller. The boring mill had a single pulley drive and a four-change-gear speed box. It was driven by a five-horse-power, shunt-wound, constant-speed motor. By the addition of the "Rheocrat" the mill had over 144 changes of speed. The two following tables show the relation of speeds obtained by the "Rheocrat" controller. Those obtained through the gear box are designated "mechanical," and those obtained through the "Rheocrat," "electrical" changes.

MECHANICAL CHANGES.

(Driving shaft running 270 revolutions per minute.)

Back Gears (4½ to 1) in.	Turns of Table per Minute.
First gear	3.6
Second gear	5.4
Third gear	7.2
Fourth gear	10.8
Back Gears Out.	
First gear	16.2
Second gear	24.25
Third gear	32.4
Fourth gear	48.6

One-quarter minute required to make any one of the above changes.

ELECTRICAL CHANGES.

(Driving shaft running 112 to 450 revolutions per minute.)

Back Gears (4½ to 1) in.	Turns of Table per Minute.
First gear	1.5 to 6
Second gear	2.25 to 9
Third gear	3.0 to 12
Fourth gear	4.5 to 18
Back Gears Out.	
First gear	6.75 to 27
Second gear	10.1 to 40.5
Third gear	13.5 to 54
Fourth gear	20.2 to 81

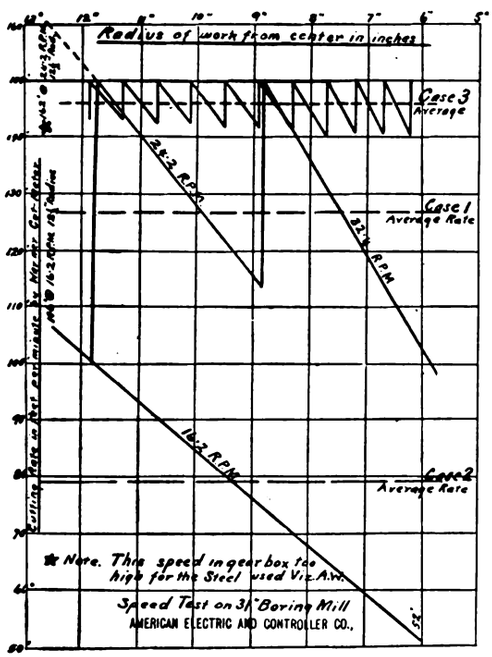
No measurable time lost making changes.

In a test made on a twelve-inch pipe flange twenty-five inches outside diameter the following figures were obtained. "A.W." steel was used, and the grade of iron was such that 150 feet per minute cutting speed was found to be the maximum with this steel. The object of the test was to keep the cutting rate as near as possible to the maximum. To finish the flange a roughing and a finishing cut were taken. In the first test the mill was operated by the motor without the use of the "Rheocrat." The shaft ran at a constant speed of 270 revolutions per minute, with the back gears out. Speed changes were made by shifting the change

Digitized by Google

gears in the speed box. The maximum cutting speed was 150 feet per minute; highest average possible, 127 feet per minute; actual time of cutting, 3.9 minutes; time lost in changing gears, 1.2 minutes for roughing cut; time lost in reversing feed, 0.5 minute; total time required to make two cuts, 10.7 minutes; time lost in taking out work and resetting another casting, five minutes, making the total time required to face a flange 15.7 minutes.

Test No. 2, mill operated by motor without the use of "Rheocrat." Shaft running at constant speed 270 revolutions per minute. Back gears out. No changes were made in the gearing on


Radius of work from center in inches
Case 3 Average
Case 1 Average Rate
Case 2 Average Rate
Note. This speed in gear box too high for the Steel used Vic. Am.
Speed Test on 3A Boring Mill
AMERICAN ELECTRIC AND CONTROLLER CO.

GRAPHIC REPRESENTATION OF TESTS.

the supposition that the average shop mechanic would not make them. Maximum cutting speed, 150 feet per minute; highest possible average, 79.11 feet per minute; actual time of cutting, 6.35 minutes for one cut; time lost in reversing feed, 0.5 minute; total time required to make the cuts, 13.2 minutes; time lost in taking out work and resetting another casting, five minutes; total time required to face a flange, 18.2 minutes.

Test No. 3, mill operated by motor and "Rheocrat." Range of speed secured on the driving shaft, 112 to 450 revolutions per minute. The back gears were out. The machine was adjusted to the proper speed by combined "Rheocrat" and change gear variation, but the "Rheocrat" variation alone was used during the cut. Maximum cutting speed, 150 feet per minute; highest possible average, 146 feet per minute; actual time of cut, 3.45 minutes; time lost in changing speeds, none; total time, 3.45 minutes, plus 0.5 minute for reversing feed, equaling 3.95 minutes; time for two cuts, 7.4 minutes; time lost in taking out work and resetting another casting, five minutes; total time required to face each flange, 12.4 minutes.

The accompanying diagram shows the above tests graphically. On a day of eight hours continuous work, with conditions as in test, the daily output will be thirty flanges, and thirty-eight flanges with conditions as in test 3. This is a gain of practically twenty-eight per cent in the output.

Comparing test No. 2 with test No. 3, and allowing eight hours continuous operation per day, the use of the "Rheocrat" shows a gain of over forty per cent, the actual number of flanges being twenty-seven and thirty-eight, respectively.

"The Insulator Book."

The Locke Insulator Manufacturing Company, Victor, N. Y., has issued a valuable catalogue entitled "The Insulator Book." In issuing this catalogue it is the idea of the company to bring before the engineering world the types of insulators which are recognized as best adapted to the service conditions of various climates. The endeavor has been to eliminate all designs which have proved to be defective, and to simplify and bring to standard form insulators for ordinary potentials of transmission. The company recently added to its equipment a laboratory for electrical and electrochemical research along the special lines required for a positive and accurate development of high-potential insulators. It is the intention to make a more thorough study than has before been attempted of insulating materials for extremely high potentials, and of insulator design.

The laboratory is of full fireproof construction, measuring twenty by forty-eight feet. The foundations and floor are of heavy concrete design, to carry the heavy machinery without communicating vibration to any delicate apparatus. The electrical equipment includes a transformer with a guaranteed capacity of 200 kilowatts at 300,000 volts. This transformer is of the core type, with approximately ten by ten inches cross-section of iron, and has a primary wound for 1,100 volts. The secondary consists of approximately forty-two miles of No. 26 wire, which, under oil, will carry a 100-per-cent overload for considerable periods of time, and at an overload potential of 400,000 volts. This transformer is the most powerful electric testing equipment in present use.

Current for the primary of the transformer is provided by a motor-generator set, power for which is obtained from a local transmission line. This set consists of a 440-volt, three-phase, twenty-five-cycle, 200-kilowatt induction motor, direct-connected by a flexible cable to a sixty-cycle, 1,100-volt, single-phase generator of similar capacity.

To facilitate measurements of secondary voltages, a spark-gap, adjustable by hand, is provided, with a scale calibration of 480,000 volts, enabling tests of any material to be made. For more accurate measurement of the high voltages a secondary voltmeter has been installed. This instrument, submerged in oil, transfers its readings by means of a mirror to a calibrated scale, which is read by means of a telescope. The very small secondary coils are measured by means of an inclined-coil instrument inserted at the point of earth potential of the secondary winding.

An experimental pole-line has been erected for some distance from the laboratory, and this is equipped with standard poles and cross-arms adapted to receive any style of pins or insulators, whose distances apart may be varied.

A simple form of dynamometer provides facilities for the testing of tensile and crushing strength of insulators and insulating materials. For the study of very refractory substances an electric furnace capable of absorbing 200 kilowatts is provided.

The catalogue describes the methods of making insulator tests, giving a table of standard sparking distances. It then describes and illustrates porcelain insulators, including strain insulators, sectional strain insulators, wall insulators, wall tube-insulators, high-voltage porcelain tubes and flare tubes. There is also described a line of flint-glass insulators and insulator pins and brackets.

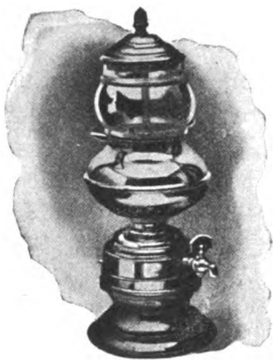
"Pointers."

The American Vitrified Conduit Company, Broadway-Maiden Lane Building, New York city, has published a handsome brochure under the title "Pointers." It is intended to give such information as may be required for preliminary estimates in laying out plans for conduit work. A diagram is given showing, approximately, construction costs for conduit work, taking into consideration, cobble or macadam, belgian blocks or brick, and asphalt pavement. This diagram is compiled from data covering a large amount of conduit work under varying conditions. The duct made by the company is described and illustrated, and lists of corporations and contractors using this material. The brochure is mailed in a heavy decorated envelope and may be secured by writing to the company.

Digitized by Google

Prometheus System of Electric Heating and Cooking.

There is, perhaps, no better illustration of the great flexibility of the electric current for commercial and domestic purposes than its use after it has been transformed into heat. The numerous advantages of electrically equipped heating and cooking apparatus, such as the riddance of smoke and soot, no vitiation of the atmosphere, instant heat at the exact place where it is wanted, no fuel or large cooking range, no labor in making or maintaining the fire, no waste of heat, perfect regulation of temperature, no danger from fires or explosions, cleanliness, etc., have all been recognized by those interested in the introduction of electricity into home and workshop for a number of years, but well-grounded causes are responsible for the somewhat limited but nevertheless



ELECTRIC COFFEE POT.

growing use of electrically equipped cooking and heating apparatus.

Primarily, the rate charged for current has been almost prohibitive, but it is being constantly reduced on account of the improvements in general machinery, the extension of the central station system of distribution, the increase in the number of water power and isolated plants and because central station managers are beginning to realize the fact that electric heating apparatus are current consumers during those hours of the day when their station load is light.

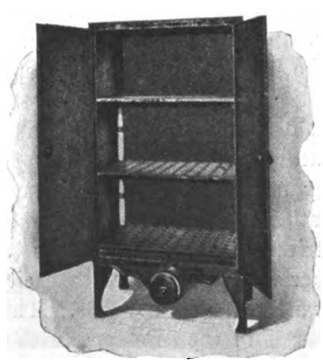
The householder also has become accustomed and attached to things electrical and is willing to supplant his gas stove by an electric stove or electrically heated pot, similarly to his willingness some years past to substitute the gas stove for the coal range. To do the requisite work with such utensils, excepting, perhaps, the iron, current costing in most cases less than one cent is consumed.

In the "Prometheus" system no wires are used. The heating device itself consists of a strip of mica on which a layer of metal has been deposited, or, more properly speaking, fired. This conducting strip is protected by another piece of

TWO TYPES OF PROMETHEUS ELEMENTS.

mica, and the whole is enclosed in a metallic casing. This unit or "heating element" can be painted to any desired resistance. The paint is an alloy composed of non-oxidizable metals, ensuring the element's life. The element may be either straight or circular according to its usage, and may be inserted into or removed from a piece of apparatus with the greatest ease by an unskilled person in case of a breakdown; an advantage heretofore denied by any other known method.

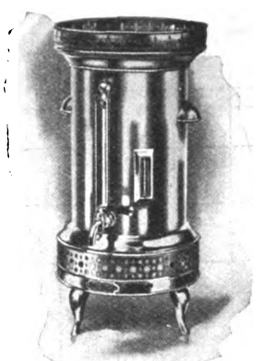
As stated above, in the "Prometheus" system, the utensils themselves are equipped with the heater, thus dispensing with a stove, which means not alone the purchase of one piece of apparatus, say, a pot or chafing-dish, instead of a pot or chafing-dish and stove on which to place it, and by actual tests it has been shown that eighty-seven per cent of the heat sent into a utensil is utilized therein for the heating of the food. This may be



ELECTRIC PLATE-WARMING CLOSET.

illustrated by the fact that a pot in which water is boiling may be held in the palm of the hand, showing that the heat does not escape, but is retained in the pot, the only place where it is wanted. This in turn means not alone a saving of time, for the greater heat ensures quicker action, but if a gain is no object, less current is required to do the same work as that done by any other method in which a stove is used. The latter, as is well known, is a very inefficient piece of apparatus, which only transmits about thirty per cent of the heat generated in it to the food in the cooking utensils. The remainder of it escapes into the surrounding atmosphere, goes up the chimney and heats up the stove itself and the air space between it and the utensils.

The system was first developed in Europe, and has been in exclusive and successful use in Germany for ten years. In Austria, the well-known Siemens & Halske Company has introduced the system, and in Switzerland, England and France it is extensively used for domestic and commercial purposes, being exploited by



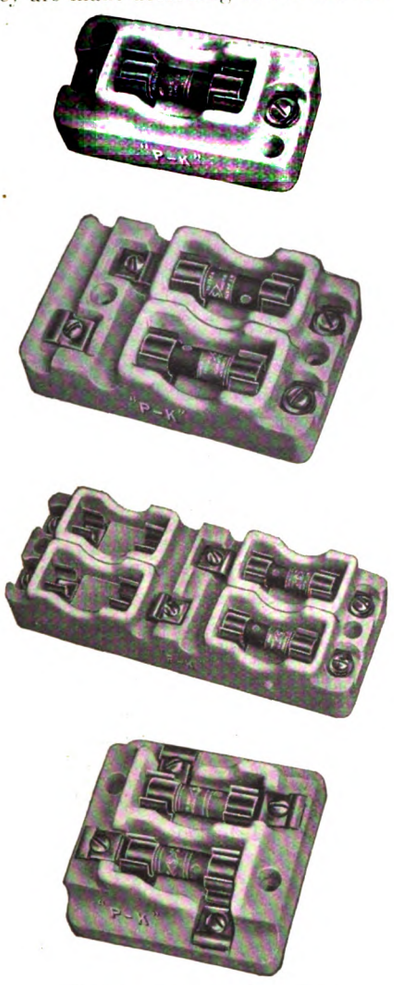
ELECTRIC COFFEE URN.

separate corporations in each country. In the United States, the Prometheus Electric Company, 41 Cortlandt street, New York, has developed during the past three years a line of apparatus suitable for this market, and a number of these are shown by the accompanying illustrations. These utensils, possessing all the merits referred to above, have found great favor everywhere and are being handled by every large supply house and central station selling apparatus. A successful demonstration is being conducted at the department store of R. H. Macy & Company, New York, which was illustrated in the issue of the ELECTRICAL REVIEW for January 14. All the ticket and toilet-room heaters in the New York subway are of the Prometheus type, and the steamships "Minnesota" and "Dakota," the Berg hat factory, and numerous other factories are equipped with this unit system of heating. The company's literature will be sent to any one on application.

Digitized by Google

Cartridge Fuse Cutouts.

A new line of cartridge fuse cutouts has been placed on the market by the H. T. Paiste Company, Philadelphia, Pa. They are made according to the new code



CARTRIDGE FUSE CUTOUTS.

standard with capacities of from three to thirty amperes, and take the new code "ferrule" type fuses.

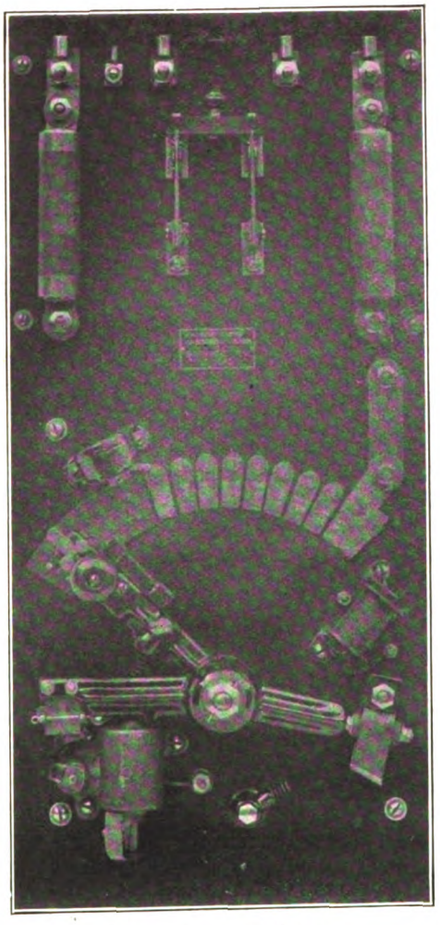
The contact clips are of special spring bronze, so formed as to make perfect contact with the fuse ends. It will be noticed in the illustration herewith how each fuse is placed safely in its own compartment, which is so designed that accidental short-circuiting across the spring clips or tl e ferrules of the fuses is impossible.

Eight styles of these cutouts are made, which correspond with similar styles of the familiar plug cutouts. The plug cutouts are numbered, but a "7" is prefixed to each one, so that the new numbers will be entirely familiar. A folder giving prices and discounts will be mailed to any person interested upon request.

Motor-Starting Panels for Constant-Speed Motors.

The Ward Leonard Electric Company, Bronxville, N. Y., is placing on the market a motor-starting panel for direct-current, constant-speed motors. Each panel consists of a marbleized slate base at least three-quarters of an inch thick. On this panel are mounted one overload and a no-voltage release, a motor starter, one double-pole, single-throw switch, and two enclosed fuses. The overload release is a circuit-breaker, and will protect the motor during the period of starting, as well as in its running position. The no-voltage release magnet responds solely to the line voltage, and is entirely independent of the field or armature current.

To prevent arcing upon the first live contact, there is furnished an independent spring-actuated renewable circuit-closing switch, which breaks the circuit with a quick break in all sizes, and with a quick break and magnetic blowout on sizes above ten horse-power. The stationary contacts are all in segmental form, and are readily removable and renewable.



MOTOR-STARTING PANEL.

The starting lever contact is of the self-aligning, renewable, skate-shoe type. The starter will stand, without injury or alteration, a current of fifty per cent in excess of the full load motor current when passed through the entire resistance when cold for one minute. It also will stand, without injury or alteration, a current which is double the full load motor current when passed through the entire resistance when cold for twenty seconds. It is so built that it is impossible for it to take fire if the resistance is burned out by overload current. This panel has been installed in the Hotel St. Regis and the Hotel Astor, New York city, and in many other hotels, machine shops and factories.

Changes in Allis-Chalmers Sales Office Organization.

The Allis-Chalmers Company, Milwaukee, Wis., announces a number of important changes in its sales office organization throughout the country. These changes are brought about because of the broadened scope of the company's operations since it acquired the Bullock Electric Manufacturing Company, Cincinnati, Ohio, which has now become the electrical department of the Allis-Chalmers Company. It will hereafter be the rule that each Allis-Chalmers district sales office will represent all the company's lines of manufacture in prime movers, as well as in sawmill, flour-mill, mining, crushing, cement and other machinery and the electrical interests. This policy involved the opening of a number of new offices by the Allis-Chalmers Company, and in many places the consolidation of Bullock offices which have heretofore been maintained in the same centres. Following out this policy, some recent changes have been made, as follows:

An Allis-Chalmers district sales office has been opened in St. Louis in the Chemical Building. The Bullock Electric Manufacturing Company's offices, formerly in the same building, have been consolidated with them. Mr. H. P. Hill, formerly district manager for the Bullock company, is the manager for the consolidated offices.

An Allis-Chalmers Company district sales office has been established in Cleveland, in the New England Building, where the Bullock offices formerly were, and the two offices have been consolidated under the new management of Mr. Franklin Wharton, formerly district manager for the Bullock company.

A Bullock office has been opened in the Frick Building in Pittsburg, and consolidated with the Allis-Chalmers office under the management of Mr. H. Wiedman Murray, who has for years represented the Allis-Chalmers Company in that district.

The Allis-Chalmers Company has established a new office in Kansas City in the Dwight Building. Mr. George W. Mattison, who has been connected with the company for a considerable time in other capacities, is in charge.

An Allis-Chalmers district office, with temporary headquarters in the Ellicott Square Building, has been opened in Buffalo under the management of Mr. George W. Pulver. Mr. Pulver is well known throughout the district of which Buffalo is the centre, having been for a number of years with the Westinghouse Electric and Manufacturing Company at its Syracuse office, and acting manager of that office until recently.

Digitized by Google

Annual Convention of the Officers and Branch Managers of the Crocker-Wheeler Company.

The annual convention of officers and branch managers of the Crocker-Wheeler Company took place at Ampere, N. J., at the main office and works, on January 26, 27 and 28. As the company has recently entered the alternating-current field, the most important topic discussed at the convention was alternating-current design and construction. Chief-engineer Gano S. Dunn and Messrs. Edward Heitmann and H. Pikler, of the engineering department, lectured to the branch managers on this subject. This was the first opportunity for some of the branch managers to discuss these matters personally with members of the engineering department. Messrs. Dunn and Heitmann also informally told of their recent trip to San Francisco, where, a short time ago, an order was closed with the California Gas and Electric Corporation for three 4,000-kilowatt-amperes alternating-current generators, the largest gas-engine-driven generators in the world.

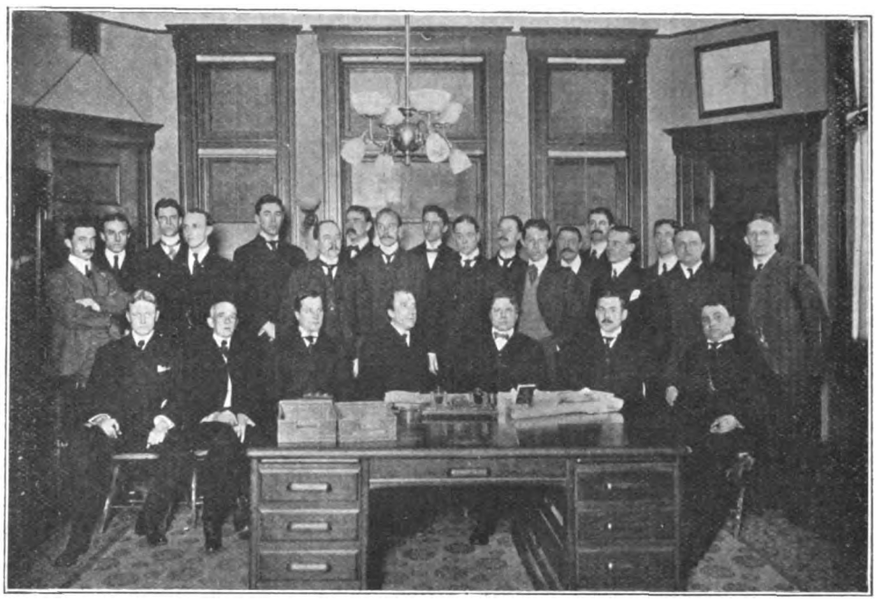
Another subject which received a good deal of attention was the new field-weakening motor, recently put on the market by the company. The office managers throughout Ohio were particularly interested in this subject, as this new motor is designed very largely for driving machine tools.

On the evening of January 27 a banquet was given at the Café Martin, in New York, at which President Schuyler Skaats Wheeler presided and Secretary A. L. Doremus was toastmaster.

In the accompanying illustration the men are as follows, beginning at the left:

Top row: Messrs. J. R. Wilson, Rodman Gilder, R. B. Treat, H. C. Baker, H. C. Petty, S. Russell, Jr., W. A. Doble, Harold Lomas, Hugh A. Brown, F. B. Degress, R. N. C. Barnes, Leonard S. Horner, H. S. Pikler, C. W. Gearhart, Louis M. Ward, H. M. Gassman, Wm. F. Sullivan and E. Heitmann.

Second row: Messrs. Henry J. Sage, W. L. Brownell, treasurer, H. L. Patteson, A. L. Doremus, secretary, Dr. Schuyler Skaats Wheeler, president, Gano S. Dunn, vice-president, and Julian Roe.



OFFICERS AND BRANCH MANAGERS OF THE CROCKER-WHEELER COMPANY.

Incandescent Lamp Filaments.

A quarter of a century ago the incandescent lamp became a practical part of an electric lighting system. In 1878, Mr. Albon Man, of Brooklyn, became associated with Mr. W. E. Sawyer, of New Hampshire, in a patented lighting system, as a part of which was described "a lamp of our invention—in which a small piece of carbon is heated to incandescence in an atmosphere with which it will not combine." In March of that year these gentlemen set up a shop in New York city for experimental purposes, and shortly afterward produced a number of lamps in which the filament was made of slips of paper carbonized by being packed in graphite and heated to a suitable temperature. Afterward the carbons were placed in flasks filled with hydrocarbon vapor and brought to a dull incandescence in a low-tension current. This process was called "treating" the filament, and continues to-day as one of the most important processes in the manufacture of an incandescent lamp.

Various substances such as cotton thread paper, and wood fibres of different kinds and from many countries were used as a basis for carbon filaments; filaments cut from the hard outside shell of a certain variety of bamboo and carbonized at a high temperature giving the best results, until later researches resulted in the production of the cellulose filament.

Cellulose, which has a chemical formula of $C_{12}H_{20}O_{10}$, exists in many forms of woody fibre, the most convenient of which for our purpose being ordinary cotton wool. A solution of this is squirted through dies having small apertures, emerging in fine threads, which after washing, drying and forming are packed in fine sawdust in crucibles which are then subjected to the intense heat of a furnace for some hours until the hydrogen and oxygen of the cellulose have been liberated, leaving the carbon in the familiar jet black springy filaments.

At this stage the filaments are as nearly uniform in diameter as mechanical skill can make them, but if subjected to a low-tension current it will be found that certain parts of the filament are of smaller diameter than the rest, and having in consequence a higher resistance will burn at a higher temperature. Now if this action be permitted to take place in an atmosphere of hydrocarbon vapor at a pressure below the normal the vapor will be decomposed, carbon in graphitic form being deposited on the surface of the filament in direct ratio to the heat generated. The points of smaller cross-section being at a higher temperature decompose the vapor more rapidly than does the rest of the filament, and so are built up by the deposited carbon, with resulting uniformity throughout its length. In addition this after-treatment gives the surface of the filament a metallic lustre resembling polished steel, which radiates heat less readily than the jet black surface of an untreated filament, and consequently for a given expenditure of electrical energy a larger amount of carbon can be kept hot with an increased efficiency of the lamp.

This process is that described as having been made use of by Sawyer and Man in treating filaments early in 1878, since developed and improved by the manufacturers of this lamp, until brought to a state of perfection where with skill in inspecting, measuring, and selecting, every lamp of a certain class sent out from the Sawyer-Man factory is absolutely uniform in characteristics with every other lamp of that class.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

THE GREAT NORTHERN POWER COMPANY—The Great Northern Power Company, Duluth, Minn., has filed articles of incorporation with a capital of $8,000,000. The company will utilize the water power of the St. Louis river. J. T. Fanning, of Minneapolis, Minn., has been retained as consulting engineer, and is associated with W. A. Breckenridge, superintendent of the Niagara Falls power plant.

ALABAMA RAILROAD TO MAKE LARGE EXTENSIONS—The Birmingham Railway, Light and Power Company, Birmingham, Ala., has authorized the expenditure of about $250,000 for improvements to its system of light, heat and power plants. Several new viaducts will be built to improve the railroad system, and at Bessemer, Ala., $10,000 will be spent on a new terminal station. This will be built for passengers and freight. The track between Powderly and Bessemer will be relaid at an expense of about $20,000. New cars will also be added to the present rolling stock.

NEW OHIO POWER PLANT—The Columbus, Delaware & Marion Electric Railway Company is shortly to erect a new power plant near Delaware, Ohio. The growth of this road has been so rapid that the demand on the existing power station is in excess of the capacity. Three new 1,500-horse-power generating units have been contracted for. An expenditure of $300,000 has been authorized, and the work is to be undertaken by the Columbus Northern Power and Equipment Company. Additional rolling stock will also be purchased to handle the increasing business.

COLORADO POWER PLANT NEARLY COMPLETED—The power plant of the Animas Canal, Reservoir, Water Power and Investment Company, located on the Animas river, between Silverton and Durango, Col., is almost ready for operation. The capital of the company is $3,000,000. Work on the plant was begun in the summer of 1902. It is expected that the company will be ready to supply power by July 1. The power station will contain two General Electric generators, each connected with a turbine water-wheel. The generators are of the three-phase, sixty-cycle, revolving-field type, of 3,000 horse-capacity each.

POWER PLANT AT POST FALLS, IDA.—A contract has been let for the construction of a power plant at Post Falls, Ida., for the Washington Water Power Company. The contract has been secured by Tacoma, Wash., contractors—Charles S. Bihler and Nelson Bennett. It is understood that about $130,000 is involved in the contract. The work contemplates the construction of dams across the Spokane river, at Post Falls, where the stream leaves Cœur d'Alene lake. The Washington Water Power Company intends to utilize the power for the generation of electricity. It is expected that 20,000 horse-power will be developed.

POWER PLANT IN GRAND RIVER CANON—The Colorado Power and Irrigation Company is about ready to begin the erection of a power plant at Glenwood Springs, Col. From the headgate at the upper end of the Grand river, known as Shoshone falls, water will be conveyed through steel flumes and tunnels to the power plant, a distance of about two and one-half miles. The flume will have a fall of four feet to the mile. Contracts have been secured sufficient to show that the company will have an ample market for all the power it can produce. It is expected that at least 40,000 horse-power will be the initial production.

NEW ELECTRIC LINE IN NEW JERSEY—The New York & North New Jersey Rapid Transit Company has filed a charter at Trenton. It purposes to run electric trains from Weehawken to Paterson in fifteen minutes. The capital stock is $200,000, but is soon to be raised to $7,000,000, and construction work will begin shortly. A tunnel will be run through the Palisades, and the line will be elevated part of the way. The incorporators include John W. Griggs, William Barbour, Marcolm R. McAdoo, John R. Lee, Henry Parmelee, E. L. B. Gardiner and Howard Sprague. The length of the line will be about thirteen and one-half miles, as against seventeen, which is the length of the shortest line at present in operation.

MUNICIPAL IMPROVEMENTS IN VIENNA, AUSTRIA—Tenders will be invited shortly by the municipality of Vienna, Austria, for the execution of the following work: extension of the tramway system, cost 6,150,000 crowns (about $1,280,000); establishment of a second water system, cost 2,900,000 crowns (about $600,000); construction of bridges, cost 900,000 crowns (about $177,000); extension of electric light system, cost 6,000,000 crowns (about $1,245,000); paving works, cost 2,697,000 crowns (about $560,000); construction of a market, cost 400,000 crowns (about $83,000); of a central abattoir, cost 500,000 crowns (about $100,000), and of a museum, cost 50,000 crowns (about $10,000); works at the central cemetery, cost 1,300,000 crowns (about $270,000).

NEW MICHIGAN POWER PLANT—The White River Power Company has been organized for the purpose of constructing a double dam across the White river, at Whitehall, Mich., with a capital of $1,500,000. The first dam will be built seven miles from Whitehall, and will develop a minimum of 4,500 horse-power. The second dam will be built directly at the back-water of the first, and will develop 3,000 horse-power. The dams, overflow walls and power-house will be built of cement bricks, which will be manufactured by the company in a mill of its own near the dam. The company contemplates the furnishing of light and power to Whitehall, Fremont, Montague and Hesperia. In connection with the building of the power-house the building of the Muskegon-Oceana electric line will be taken up, the power to be supplied by the company.

MEXICAN ELECTRICAL NOTES—Manuel Alonzo, of Vera Cruz, has been granted a concession to utilize the water power of the Antiga river for generating electric power. The electrical energy will be used to operate manufacturing establishments in the neighborhood. A large power plant is to be installed at Magdalena, Mexico, and electric power will be transmitted to a stamp mill at Cerro Prieto, Sonora, thirty-five miles distant. In the state of Coahuila the International Railway Company has finished the construction of a line of railway between Mesquite and the El Carbon coal mines. The property is being operated in the interest of the railroad company. The alcalde of Lajos, state of Jalisco, Mexico, has entered into a contract for the installation of an electric light plant. A plan is under way for the installation of a power plant in the district of Ejutla, in the state of Oaxaca. This will be a water-power development, and a concession has been requested for the use of 2,000 litres per second of the water from the river Miahuatlan.

LARGE IMPROVEMENTS ON ELECTRIC RAILWAYS IN THE NEIGHBORHOOD OF SYRACUSE, N. Y.—The various electric railway companies operating in and around Syracuse, N. Y., are contemplating improvements during the coming year, which will cost in the neighborhood of $3,000,000. The Syracuse Rapid Transit Company contemplates double-tracking a number of its lines and purchasing a large amount of rolling stock. The Auburn & Syracuse road will double-track about five miles of its lines west of Syracuse, and will develop a large park. The company will also make improvements on a recently acquired steamboat line on Skaneateles lake. The Syracuse & South Bay road will spend about $400,000 in developing its property at South Bay and on Frenchman's and Dunham's islands. The Syracuse, Lakeside & Baldwinsville road will expend about $30,000 in extending its line over a new route from Stiles to the outskirts of the town of Baldwinsville. The Syracuse & Suburban company will spend considerably over $10,000 in minor improvements. The Rochester, Syracuse & Eastern road will spend a large amount in completing its line from Syracuse to Lyons, N. Y.

REORGANIZATION OF THE MEXICAN TELEPHONE COMPANY—A circular issued by the stockholders of the Mexican

Digitized by Google

Telephone Company announces that the Mexican government has granted the company a concession for a term of thirty years. This concession is conditioned upon the company's placing all cables and wires within a prescribed area underground. This will necessitate immediate work on the new system, since failure will mean forfeiture of the franchise. The company will require $200,000 for installing the underground equipment. It is stated that the Mexican Telephone and Telegraph Company will be formed to succeed the present company. It will have a capitalization of $300,000 preferred stock, and $700,000 common stock. The new company will issue $250,000 in twenty-year five-per-cent bonds, which have already been underwritten, thus securing all the necessary cash for immediate commencement of the work. The new company will offer to the stockholders of the old company one share of preferred stock and two shares of common stock for every nine shares of the present outstanding stock. A special meeting of the stockholders, to vote on the transfer of the property to the new company, is to be held in New York city on February 23.

THE CONTROL OF WIRELESS TELEGRAPHY—Some time ago tentative plans were outlined, giving to the United States navy department the control of all wireless telegraph systems along the coast of the United States and at all outlying possessions. The possibilities of so broad a scheme of government control excited a great deal of controversy on the part of the private companies which had either installed or had in view the installation of wireless telegraph stations. The administration's latest views on this subject have been embodied in a bill draughted by the commissioner of navigation, and made public in Washington, D. C., on January 27. This bill is to be the subject of further revision by the United States cabinet. It provides that no person or corporation shall use any apparatus for wireless telegraphy in the United States or on any American vessel, except it be licensed by the secretary of commerce and labor. Persons exchanging messages or signals between points in the same state or on behalf of the American government are to be exempt from this requirement. The official license shall provide that the president in time of war or public peril may close any wireless station or authorize its use by the government. The president is empowered to establish regulations which shall prevent interference between the navy and military wireless telegraph stations and the private or commercial stations. Each licensed station is to be required to answer calls and signals from any other licensed station, and to receive all such messages or signals offered for transmission to a neighboring station, the rate to be that customarily required for such service. This requirement is to be observed regardless of the system used, on pain of revocation of the license of the offending person or corporation. Operation of any apparatus for wireless telegraphy on a foreign ship, while that ship is in American waters, shall be in accordance with the regulations prescribed by law. Government stations are prohibited from competing for commercial messages with licensed wireless stations.

TELEPHONE AND TELEGRAPH.

SONNENBURG, OHIO—The Sonnenburg Telephone Company is extending its lines to West Lebanon.

YOUNGSTOWN, OHIO—A movement is on foot in Champion and Bristol townships to organize a farmers' telephone company, having service with the Warren & Niles Telephone Company.

BESSEMER, ALA.—The Southern Bell Telephone Company has closed a contract with the Bessemer Coal, Iron and Land Company for the erection of a building to be used as an exchange.

ALTON, ILL.—The Central Union Telephone Company is rebuilding its entire system in Alton, and expects to begin using its new exchange March 1. The new instruments will be of the automatic type.

ALTON, ILL.—The Suburban Telephone Company has secured a franchise in Webster Groves, and has made arrangements to extend its service to that place. The company expects to have its system in operation in Webster, Kirkwood, Ferguson and Clayton shortly.

JOHNSTOWN, PA.—The stockholders of the Johnstown Telephone Company will meet March 21 to decide whether or not the capital stock shall be increased from $200,000 to $400,000. It is proposed to double the capital so that many improvements now planned can be completed.

BLOOMINGTON, ILL.—The National Telephone and Electric Company, of Clinton, Ill., has purchased the Clinton, Vaynesville, Farmer City, Wapella, Weldon, Mansfield and Dewitt exchanges, and a number of farmers' lines in Macon, Piatt, Dewitt, Champaign, McLean and Logan counties for $100,000.

WILLIAMSPORT, PA.—The residents of White Deer Valley will soon organize a telephone company, the lines of which will extend from Elimsport to Montgomery. About thirty-five telephones will be subscribed for. A committee has been appointed to look into the matter of the cost of installing the system.

COSHOCTON, OHIO—The name of the Farmers and Merchants' Telephone Company will in a short time be changed to the Coshocton Telephone Company, and the company will be reincorporated, and the capital stock increased from $15,000 to $30,000. A resolution to this effect was passed at the annual meeting of the stockholders at Warsaw. With the additional capital the lines are to be improved and extended during the coming year. The company is composed of 176 farmers and merchants of Coshocton County.

PITTSBURG, PA.—The annual meeting of the Pittsburg & Allegheny Telephone Company's stockholders was held recently, when the following directors were elected: R. C. Hall, J. G. Splane, H. B. Beatty, D. P. Reighard, R. H. Binns, J. M. Clapp, Ralph E. Flinn, George R. Webb, John S. Weller. The directors organized by choosing the following officers: J. G. Splane, president; John S. Weller, vice-president and general counsel; R. C. Hall, treasurer; T. G. Davis, secretary and assistant treasurer. The executive committee consists of President Splane, R. C. Hall, Ralph E. Flinn and John S. Weller. Over 5,000 additional telephones were installed in Allegheny County, which is known as the "Pittsburg District," making a total of over 15,000 telephones in this district. The most remarkable feature of the company's business is the increase in its long-distance service, which increased over three hundred per cent, compared with previous year.

OBITUARY NOTICE.

MR. GEORGE S. BOWEN died on Thursday morning, January 12, at his home in Elgin, Ill. Mr. Bowen was born at Ingham's Mill, Manheim, Herkimer County, N. Y., November 30, 1829. He was mayor of Elgin in 1872 and 1873. In 1872 Mr. Bowen assisted in organizing the Elgin Board of Trade. He was one of the organizers of the National Electric Light Association, and was made an honorary member of this body in 1890. He was nominated for Congress in the Chicago district on the Peter Cooper ticket in 1876. He served in many public capacities and in industrial, social and religious offices. He was treasurer of the Grace Methodist Episcopal Church, Chicago, Ill., for eight years, and president of the Orphan Asylum, Chicago, for two years. He was one of the principal organizers and builders of the Chicago & Pacific Railway. During the past few years he has been president of the North Pacific Trading Company, with offices in Chicago and Tokio, Japan

LEGAL NOTES.

STORAGE BATTERY LITIGATION—In the United States Circuit Court for the Southern District of New York, the Electric Storage Battery Company, Philadelphia, Pa., on February 4, 1905, filed a bill, accompanied by a motion for a preliminary injunction, against the National Battery Company, for alleged infringement of the Exide battery plate, made under the Bradbury-Stone patent, owned by the Electric Storage Battery Company.

DECISION IN THE UNDERRUNNING TROLLEY PATENT—Judge Wallace handed down an opinion on January 23, 1905, in a suit in which was involved the Van Depoele reissue patent No. 11,872, on the underrunning trolley. The opinion was filed in the United States Circuit Court of Appeals, second circuit, and reversed the decision of the lower court. The suit was brought by the Thomson-Houston Company, complainant-appellant, against the Black River Traction Company, defendant-appellee.

Digitized by Google

PERSONAL MENTION.

MR. JOHN J. CUMMINS has been elected president of the Syracuse Lighting Company, Syracuse, N. Y., to succeed Mr. Ceyton H. Lewis. Mr. Cummins was formerly vice-president and general manager of the company.

MR. E. E. DOWNES has taken charge of the Petaluma & Santa Rosa railway, as general manager, to succeed Mr. A. D. Bowen. Mr. Downes was formerly president of the Winnebago Traction Company, of Oshkosh, Wis.

MR. CHARLES S. GLEED, of Topeka, has been elected president of the Missouri & Kansas Telephone Company, which operates the Bell company in Kansas City, Mo. He succeeds Mr. Alonzo Burt, who recently resigned.

COLONEL FRANCIS V. GREENE, general manager of the Ontario Power Company, recently delivered a talk to the Buffalo Young Men's Christian Association on the subject of "The Electrical Development of Niagara Falls."

MR. FREDERICK MACKINTOSH has taken the position of manager of the panel and switchboard department with Waterbury & Company, of Brooklyn, N. Y. He has been connected with the General Electric Company, in Schenectady, for the last fourteen years.

MR. EDMUND P. ERB, local manager of the Wisconsin Telephone Company, at Racine, Wis., has been appointed district manager, with charge of all the exchanges and toll lines at South Milwaukee, Kenosha, Burlington, Elkhorn, Lake Geneva and Delavan. He will be succeeded as local manager by Mr. R. E. Browne.

MR. JOHN M. DIVEN has accepted the position of superintendent of the Charleston, N. C., Water and Lighting Company. He has resigned his position as secretary and treasurer of the Elmira, N. Y., Water, Light and Railroad Company, and a farewell dinner was recently tendered him by the officers of the latter company.

MR. CHARLES J. GLIDDEN, well known in telephone circles, is making a tour of the world in an automobile. A cablegram from him announces that he has reached the southernmost point in the world which it is possible to reach in such a vehicle, namely, Bluff, New Zealand. Mr. Glidden has already covered 21,438 miles, 1,145 of which were in New Zealand.

MR. R. A. SCHOENBERG, of the Sarco Company, New York city, was a visitor to Chicago during the past week. Mr. Schoenberg reports a brisk trade in the line of electrical specialties manufactured by the Sarco Company. The Sarco Company has recently placed on the market a number of electrical adaptations which are meeting with great success.

MR. THOMAS FITZGERALD, JR., has resigned as general manager of the Lexington Street Railway and Electric Light Company, Lexington, Ky., to accept a position with the Cincinnati, Ohio, Traction Company. He will be in the executive office, holding the position of assistant to Mr. Dana Stevens, who is head of the operating department, and also vice-president of the company.

MR. ALBERT CARR has taken charge as chief engineer of the Necaxa electric works of the Mexican Light and Power Company. He takes the place made vacant by the resignation of Mr. Hugh L. Cooper. Before his appointment, Mr. Carr was division engineer for the Interborough company, of New York city, and prior to that was identified with Mr. F. S. Pearson, who is constructing the Necaxa works.

DR. S. S. WHEELER is proposed by his friends as a suitable candidate for the presidency of the American Institute of Electrical Engineers. It is no disparagement of others who may have ambition in this direction to say that we believe Dr. Wheeler would make a strong and zealous executive of the Institute and his election would bring to its head a man of affairs and experience at a very timely period in the life of this progressive organization.

MR. H. S. REYNOLDS has resigned as general manager of the Columbus Railway Company, Columbus, Ga. It is understood that Mr. Reynolds comes to New York and will be associated with J. G. White & Company. Mr. Reynolds went to Columbus four years ago, when the Stone & Webster Company purchased the street railway lines at that place. He has since been instrumental in making many improvements in the service.

MR. FREDERIC NICHOLLS delivered an interesting address to the members of the Empire Club, of Toronto, Ontario, on January 19, 1905. His subject was "Niagara's Power: Past, Present and Prospective." Mr. Nicholls is interested in a number of large electrical enterprises, and is quite prominently known in the electrical field. He is an ex-president of the National Electric Light Association. Mr. Nicholls spent some time in New York recently on his way to Hot Springs.

ELECTRICAL SECURITIES.

One of the notable features of recent stock market dealings is the continued investment in bonds. Notwithstanding the good percentages which are being offered on many loans, and opportunities for speculation, the bond market is easily the leader in financial operations. For some time past there has hardly been a single issue which bore any resemblance to stability which has not been strongly supported. The cause of this can not merely be due to professional manipulation, and must have for its continuance a reasonable assurance that the present rate of progress in all forms of industry will not slacken. Railroad earnings are reflecting an increased business activity, and there are rumors to the effect that increased dividends will follow. If this be the case it seems unlikely that there will be any withholding of funds for the extending of present operations and the creation of new organizations. From almost every section of the country reports are received indicating a greater readiness to begin new construction than has been the case for some time.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 4.

New York:	*Closing.*
Brooklyn Rapid Transit	61⅜
Consolidated Gas	203½
General Electric	186⅝
Interborough Rapid Transit	208¼
Kings County Electric	200
Manhattan Elevated	170
Metropolitan Street Railway	117½
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	190

The output of the General Electric Company since the month preceding the presidential election has averaged something above $4,000,000 a month, or at the rate of $48,000,000 a year. It is estimated that in the calendar year 1905 the company will have an output considerably in excess of $50,000,000.

Boston:	*Closing.*
American Telephone and Telegraph	145
Edison Electric Illuminating	250½
Massachusetts Electric	59
New England Telephone	137
Western Telephone and Telegraph preferred	100

The directors of the New England Telephone and Telegraph Company have declared a regular quarterly dividend of $1.50 per share, payable February 15.

Philadelphia:	*Closing.*
Electric Company of America	10½
Electric Storage Battery common	76
Electric Storage Battery preferred	76
Philadelphia Electric	10
Philadelphia Rapid Transit	24¾
United Gas Improvement	108½

Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	155
Metropolitan Elevated preferred	64
National Carbon common	42½
National Carbon preferred	115
Union Traction common	13¼
Union Traction preferred	50

Chicago Telephone directors have reelected officers.

South Side Elevated averaged for January 84,659 passengers, a decrease of 2,942.

Digitized by Google

ELECTRIC RAILWAYS.

ITHACA, MICH.—The Alma Sugar Company has projected an electric line from Rathbone, *via* Beebe, to Alma.

KEYSER, W. VA.—The town council of South Keyser has granted a franchise to the Keyser, Burlington & Petersburg electric line.

VINELAND, N. J.—It is reported that the Central Railroad will convert its present road from Winslow, *via* Vineland, to Bay Side into a third-rail electric system, and run cars every hour.

WASHINGTON COURT HOUSE, OHIO—The Washington Court House city council has granted a franchise to the Springfield, Charleston, Washington Court House & Chillicothe Traction Company.

NEWARK, N. J.—The Millburn township committee has passed an ordinance permitting the Morris County Traction Company to construct an electric road from the Millburn station to the Springfield township line.

FORT WAYNE, IND.—The town council of Churubusco has, by a unanimous vote, granted to the proposed Fort Wayne & Goshen electric line a franchise through the streets of that town. Work on the road must begin within ten months.

YOUNGSTOWN, OHIO—The Sharpsville council has passed an ordinance granting the Shevango Traction Company a franchise through the borough. The company expects to have cars running from Sharon to Conneaut lake by June 1.

BOSTON, MASS.—James F. Shaw, the promoter and builder of the Boston & Worcester trolley road, has filed at the State House a bill for a high-speed electric railway from Boston to Providence. The bill provides that the capital shall be $1,500,000.

ROCKVILLE, MD.—The mayor and council of Rockville have agreed upon an ordinance under which the Washington & Rockville Electric Railway Company will be allowed to extend into the town its tracks, which now end at the eastern limit of the town.

BOSTON, MASS.—The plans of the Nahant & Lynn Railroad Company have been completed. The capital of the road is to be $50,000, and the directors will be W. H. Southwick, Nahant; E. E. Strout, Nahant; Clifton Coburn, Lynn; G. E. Bolonga, Lynn; J. A. Carahar, Nahant; C. C. Johnson, Nahant, and E. H. Braun, Nahant.

SHARON, PA.—Sharpsville council has granted a franchise to the Shenango Street Railway Company to lay its tracks on a number of streets of the borough. The company pays the town a bonus of $1,000, and agrees to pay two per cent of the gross receipts collected from people boarding the cars in Sharpsville should the population of the town reach 8,000.

BANGOR, PA.—Announcement has been made that the Bangor & Portland Traction Company contemplates the extension of its trolley line from Bangor, through Portland, to Delaware Water Gap and Stroudsburg. It is expected that the run from Bangor to the Gap may be made in one hour, making it possible to go from Easton, a distance of about thirty miles, to the Gap in two hours.

SPRINGFIELD, MO.—As a result of a meeting of the directors and stockholders of the Springfield Traction Company final action was taken whereby the direct management of the street railways of Springfield was taken over by Springfield men. H. B. McDaniel, W. B. Sanford and Arch McGregor were elected to take the places of the St. Louis directors, R. C. Kerens, S. W. Fordyce and L. M. Rumsey, who resigned after selling their holdings to Messrs. Sanford, McDaniel and Murray.

CLEVELAND, OHIO—The stockholders of the Cleveland, Painesville & Eastern Traction Company have reelected the board of directors for another term, as follows: C. W. Wason, president; J. A. Beidler, vice-president; C. A. Post, treasurer; H. A. Everett, E. W. Moore, Fred Storm, Thomas Merry. The shareholders of the Cleveland, Painesville & Ashtabula Railroad Company have also reelected directors and officers. The report of the treasurer shows that for the first six months of operation the receipts were enough to pay the expenses and fixed charges.

BRANTFORD, ONTARIO — The Canada-Middlesex railway, which is applying to the Dominion parliament for a charter, is to be an electric road, and it has very strong financial backing. The four principal cities on the route are St. Catharines, Brantford, Woodstock and London. From Brantford to Woodstock the road will go *via* Burford. It is not the intention of the promoters to use the highways of the various municipalities to any extent. Their object is to build from point to point in as straight a line as possible. Work will be commenced on the new road as soon as the necessary legislation can be secured.

WORCESTER, MASS.—The promoters of the new Providence & Worcester Street Railway Company have filed with the Worcester board of aldermen a petition for a double-track location from the Milbury line through Greenwood street to the present terminus of the Worcester Consolidated Street Railway Company, with which it will connect, and over whose tracks it will run cars into the centre of the city. Representatives of the company in Worcester say they have secured the right of way through all the towns between that city and Providence, and that petitions will be filed for double tracks in the large towns along the line.

TOLEDO, OHIO—The annual meeting of the Toledo, Port Clinton & Lakeside Electric Railway Company and the Toledo Interurban Construction Company, incident thereto, has been held. The election of the railway company resulted as follows: president, P. McCrory; vice-president, L. E. Flory; treasurer, H. R. Klauser; secretary, Hugh Schunck. The other directors are: Arthur Klauser, Theodore Schmidt and G. W. Luckey. In the case of the Construction company old directors were reelected, except in the case of D. H. James, who retires. The vacancy was filled by the election of G. W. Luckey. The other directors are: Herman R. Klauser, Arthur Klauser, Theodore Schmidt, Harry Thompson, L. E. Flory, J. Powers, James Pheatt and P. McCrory. The officers of the Construction company have not yet been chosen. The company will go on with the completion of the road to Lakeside as soon as the weather permits in the spring.

COLUMBUS, OHIO—The prospectus of the Cleveland, Wooster, Mt. Vernon & Columbus Railway Company has been issued by the board of directors of the company, which is composed of F. W. Jones, president and treasurer, Mt. Vernon; J. J. Vail, first vice-president, Brooklyn, N. Y.; E. F. Shelley, second vice-president, Loudonville; J. A. Tilton, secretary, Mt. Vernon, and J. B. Graham, general counsel, Mt. Vernon. The promoters of the company say that it has been incorporated for the purpose of building an electric line between Wooster and Columbus, connecting at the former city with the Cleveland & Southwestern Traction Company. The line to Columbus will be 105 miles long, with a twelve-mile branch to Mansfield, and will traverse the counties of Wayne, Holmes, Knox, Ashland, Richland, Licking and Franklin. While the capital stock is at present but nominal, the promoters say that it will be increased to $3,000,000 in a few weeks, and that an equal amount of five per cent twenty-year bonds will be issued. The officers state that work will be begun upon the line in the spring.

WASHINGTON, PA.—The annual meeting of stockholders of the Washington Railway and Electric Company and connected companies for the election of directors was held January 21. Directors and officers of the various companies were elected as follows: directors, George Truesdell, George W. Young, James B. Jackey, S. L. Schober, Jr., Allan L. McDermott, R. T. W. Duke, Jr., George H. Harries. Officers: Allan L. McDermott, president; George H. Harries, vice-president; James B. Lackey, secretary and assistant treasurer; W. F. Ham, treasurer and assistant secretary. Potomac Electric Power Company: directors, George Truesdell, S. L. Shober, Jr., George H. Harries, James B. Lackey, W. F. Ham, George W. Young, Allan L. McDermott, H. W. Fuller and R. T. W. Duke, Jr. Officers: Allan L. McDermott, president; George H. Harries, vice-president; James B. Lackey, secretary and assistant treasurer; E. S. Marlow, treasurer and assistant secretary. City & Suburban, Anacostia & Potomac, Brightwood & Georgetown and Tennallytown lines: directors, George W. Young, George Truesdell, S. L. Shober, Jr., H. W. Fuller, Allan L. McDermott, James B. Lackey, W. F. Ham, R. T. W. Duke, Jr., and George H. Harries.

Digitized by Google

ELECTRIC LIGHTING.

GRIDLEY, CAL.—The Gridley Electric Light and Power Company will erect a new two-story building.

GRIFFIN, GA.—The city is improving its light and water plant, by putting in two additional boilers.

WOODHULL, ILL.—Murdock and Field, of Galesburg, have purchased the Oneida Light and Power Company's electric light plant.

JACKSONVILLE, ORE.—A franchise has been granted to the Condor Water and Power Company to furnish electric lights for Jacksonville.

DIXON, ILL.—The plant of the Dixon Power and Lighting Company has been purchased by H. C. Higgins for the Lee County Lighting Company. The price was $200,000.

WILKESBARRE, PA.—C. H. Geist, of Chicago, and C. B. Kelsey, of Grand Rapids, Mich., have concluded to purchase the stock of the various light companies operating in the west side towns.

ALEXANDRIA, IND.—William F. Stinson, of Alexandria, has closed a deal looking to the purchase of one-half of the capital stock of the Alexandria Light and Power Company, the consideration being $10,000. The plant has a ten-year contract to supply Alexandria with light.

JEFFERSON CITY, TENN.—A movement is being made by the Jefferson City Electric Light Company to replace the plant burned a short time ago. Steam power will be used, and it is thought the city will be lighted very soon. The new plant will be within the corporate limits.

LOGANSPORT, IND.—The Fort Wayne & Wabash Valley Traction Company has proposed to the Logansport city council to supply all the electric light the city wants at a lower rate than the present municipal plant charges. The offer is to go into effect as soon as the $1,000,000 power-house is built at Fort Wayne.

PORTLAND, ME.—The South Paris village corporation is considering the matter of furnishing its own electric lights. A bill was introduced in the legislature of 1903 authorizing the village corporation to establish a municipal lighting plant, but was referred to the legislature of 1905. It was voted at a recent meeting to raise $500 to pay the expenses of this movement.

KNOXVILLE, TENN.—Reports state that J. E. Durham, representing a Philadelphia, Pa., syndicate, together with E. H. Mather, an electrical engineer, of Portland, Me., is investigating the water power of the Holston river, on which it is planned to build a power plant for supplying Knoxville with light and water. Sam. L. King, president of the Goodson Water Company, of Bristol, is also said to be interested.

BINGHAMTON, N. Y.—At a meeting of the stockholders of the Binghamton Light, Heat and Power Company the following board of directors was elected: George W. Dunn, J. J Douglas, W. B. Dinsmore, Jr., Chauncey Eldridge, C. F. Hotchkiss, J B. Hart, F. W. Jenkins, T. M. R. Meikleham and George F. O'Neil. The directors elected the following officers: president, George W. Dunn; vice-president, J. B. Hart; treasurer, W. B. Dinsmore, Jr.; secretary and attorney, F. W. Jenkins.

EBENSBURG, PA.—A reorganization of the Ebensburg Light, Heat and Power Company has been effected by means of which a number of prominent citizens not connected with the corporation in the past will hereafter participate in the management. Heretofore the board of directors has consisted of J. W. Leech and John W. Kephart, and S. L. Riggs, manager of the plant. The board membership has been increased to five, the present members being Messrs. Kephart, Leech, A. W. Buck, M. D. Kittell and C. H. Barker. Mr. Kephart remains president, Mr. Barker is made vice-president, and Mr. Buck treasurer.

BATTLE CREEK, MICH.—The Kalamazoo Valley Electric Company at present owns three large power plants on the Kalamazoo river, at Allegan, Otsego and Plainwell, and the electric current generated at these power plants is transmitted to Jackson, supplying power for the Kalamazoo & Battle Creek interurban, and the Jackson & Battle Creek interurban, and power for various establishments, besides for the Battle Creek & Kalamazoo, Battle Creek & Jackson city electric car lines. The company now contemplates the expenditure of a large amount of money for the purpose of installing more power plants in various parts of western Michigan, so as to furnish power to several new electric interurban lines contemplated in that part of the state, and also for the purpose of furnishing lighting and heating to various cities. At present the company's franchise calls simply for the running of one high-tension wire through Battle Creek for the purpose of furnishing power. The common council has, however, granted a new franchise, giving the company the use of all the streets of the city, and allowing it to furnish light and heat. It is announced that the company will absorb the present Battle Creek Electric Light Company.

NEW COMPANIES.

ANDERSON, IND.—The Perfection Magneto Company has been incorporated with a capital of $20,000 by F. G. Borden, R. E. Creighton and M. K. Creighton.

ROCHESTER, N. Y.—The Denico General Electric Company has been incorporated with a capital of $250,000, to manufacture fire-alarm, telephone and telegraph apparatus.

CLEVELAND, OHIO—The Electrical Manufacturing Company, capitalized at $5,000, has been incorporated by E. Y. Mackey, L. L. Leese, W. E. Rice, George J. Vaughn and N. Herman Thiessen.

ROCKWOOD, ILL.—The Sells, Miller, Santee Company has been organized to deal in electrical sundries. The company has a capital stock of $2,500, and was incorporated by J. Frank Sells, Harry J. Miller and Charles F. Santee.

CHICAGO, OHIO—The Guarantee Telephone and Equipment Company, of Chicago, Ill., has been incorporated by L. Anderson, Albert Duce and Donald E. Turner. The capital is $2,500. The company will manufacture telephones and electrical supplies.

ASTORIA, N. Y.—The Sunswick Company has been organized to manufacture electrical supplies. The capital stock is $25,000, and the directors are George H. Selleck, New York; James H. Thompson, Brooklyn, and George H. Hawkins, Long Island City.

LOUISVILLE, KY.—The Home Electric Company has filed articles of incorporation in the county clerk's office with a capital stock of $3,500. The concern will do a general business in electrical goods. The incorporators are Edward J. Theobald, John C. Fries, Sam. Z. Lorch, Percy Sternau.

RED BANK, N. J.—The Wheelon Company has been organized to manufacture a device for automatically replacing trolley poles on the wires when they slip. Robert T. Preston, the inventor, is secretary of the company, which is capitalized at $20,000. William A Hopping is president, and George C. Hopping, treasurer.

ROME, N. Y.—George A. Clyde has organized a stock company with a capital of $40,000, for the manufacture of insulated electrical wire, machinery and apparatus, the new company to be known as the Fort Stanwix Electrical Works. The directors for the first year are Newton H. Jones, George A. Clyde, W. R. Huntington, W. W. Parry and Thomas G. Nock.

JERSEY CITY, N. J.—The United States Portable Electric Light and Power Company has been incorporated to manufacture, install and maintain electric light plant equipments. The company has a capital of $125,000, and the following are the incorporators: Arthur D. Wright, Brooklyn; Henry W. Waldin, New York; Benjamin C. Raymond, Brooklyn; Newman H. Raymond, Jersey City.

ENGINEERING SOCIETIES.

PENNSYLVANIA STATE COLLEGE BRANCH OF AMERICAN INSTITUTE ELECTRICAL ENGINEERS—At the meeting of the Pennsylvania State College branch of the American Institute of Electrical Engineers, Wednesday evening, February 1, the following programme was given: "Train Lighting in France" was discussed by J. C. Chrisman, and the Institute paper on "The Maximum Distance to Which Power Can Be Economically Transmitted," by Ralph D. Mershon, was read and discussed by B. C. Butler and G. L. Christman.

Digitized by Google

INDUSTRIAL ITEMS.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., announces that it has taken new quarters in Memphis, Tenn., being located in Suite 302, Scimitar Building.

PASS & SEYMOUR, Solvay, N. Y., announce that they have removed their New York office to 1322 Havemeyer Building. Mr. W. Brewster Hall is in charge of this office as sales agent.

THE McROY CLAY WORKS, of Brazil, Ind., are distributing an attractive blotter. The blotter has on the back a calendar for February, and a number of sayings of Eliza Atkins Stone in *Life*.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, is distributing bulletin No. 26, describing switching stations for small or isolated exchanges, and auxiliary cord equipments for telephone work.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, in bulletin "A" reproduces the story of the coal and ash-handling equipment of the Scioto Valley Traction Company's power plant at Reese's Station, Ohio.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, is sending out a neat mailing card advertising the "Buckeye" incandescent lamps. This is part of an extensive follow-up system which the company instituted some time ago.

THE MARSHALL ELECTRIC MANUFACTURING COMPANY, of Boston, Mass., reports an exceedingly brisk demand for its new line of snap switches. It also states that it is taking care of a great number of orders for its new flush rotary switches.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Brooklyn, N. Y., is distributing a folder describing the advantages of using electric current in the store or home. The folder reminds the consumer that the rates for electric current were reduced on the first of the year.

THE GARVIN MACHINE COMPANY, New York city, is issuing a booklet describing part of the line machine tools manufactured by it. The booklet describes milling machines of various types, grinding machines, slotters, screw machines, tapping machines and drill presses.

THE EWING-MERKLE ELECTRIC COMPANY, 1106 Pine street, St. Louis, Mo., is issuing a circular, which under the title of "Just a Few Thousand Years Ago," calls attention to its line of electrical supplies. It compares the method of doing things in China in bygone times, and the method of doing things to-day.

FRANK B. COOK, 249 West Lake street, Chicago, Ill., is calling attention to his new No. 8 protector for telephone circuits. He states that a number of large orders for it have recently been placed, as well as for his older type No. 244. Another device which he is introducing is a multiple-contact test connector.

THE WYCKOFF PIPE AND CREOSOTING COMPANY, INCORPORATED, Stamford, Ct., has taken orders for one million feet of its creosoted Wyckoff Conduit for underground wires, and for one hundred thousand standard ten-foot creosoted cross-arms, to be delivered for construction work this spring and summer.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing a handsome reproduction of "The Big Reliable," the famous 5,000-horse-power Allis-Chalmers engine and 3,500-kilowatt Bullock generator which supplied current for the decorative lighting of the World's Fair, St. Louis, Mo., and for operating the electric cars of the St. Louis Transit Company.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, is issuing a catalogue describing its motors and generators. The catalogue contains sixteen pages, and gives dimensions and prices of motors from one to twelve horse-power. The company is sending with the catalogue photographic reproductions of the awards given it at the St. Louis World's Fair.

THE UTICA FIRE-ALARM TELEGRAPH COMPANY, Utica, N. Y., is distributing a catalogue descriptive of the telephone and telegraph apparatus it manufactures. House telephones and long-line telephones are described, and also desk telephone sets, wall telephones, switchboards, extension bells, transmitters, hotel annunciators and other apparatus used in telephone work.

PARTRICK, CARTER & WILKINS announce that on or about February 15 they will remove to their new factory at Twenty-second and Wood streets, Philadelphia. Their new factory will have about double their present facilities for manufacturing annunciators, bells and other specialties in house-goods supplies, for which they report a large and increasing demand.

THE KUSEL & KUSEL AUTOMATIC SWITCHBOARD AND TELEPHONE MANUFACTURING COMPANY, Chicago, Ill., is distributing a forty-eight-page catalogue descriptive of the telephone apparatus manufactured by it. The catalogue describes the "K-Clark-K" automatic telephone system and its application. Desk sets, switchboards, wall telephones and auxiliary apparatus are also described and illustrated.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., is sending out "Protection, Resistance, Durability," a handsome and interesting booklet, describing the methods of manufacture in the electric furnace and use of Acheson graphite for paint pigment. Any one interested in protecting metal surfaces from corrosion and decay can obtain this booklet by writing to the International Acheson Graphite Company.

THE APPLETON ELECTRIC COMPANY, 224 Washington street, Chicago, Ill., is calling attention to the new catalogue which it is distributing. The catalogue describes fuse blocks, lightning arresters, fuse links, etc. It desires to call special attention to its new type of fuse block, which it states is different from anything else on the market. In addition to the above articles it manufactures the Marlin cable hangers.

A. L. IDE & SONS, Springfield, Ill., have established a New York office at 11 Broadway, where all export, New England and Middle States business will be transacted hereafter, under the management of Mr. J. G. Robertson. A. L. Ide & Sons are the original manufacturers and patentees of the celebrated "Ideal" engines. These engines are being used extensively in manufacturing establishments, office buildings and for power and electric plants.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is distributing a number of reprints of papers read before the Ohio Electric Light Association, at Sandusky, Ohio, August 18, 1904. These are entitled: "Notes on Incandescent Street Lighting," by K. C. Randall; "Points for Consideration When Purchasing Series Alternating-Current Arc Lamps," by G. Brewer Griffin, and "Instrument Equipment of a Testing Department," by F. Conrad.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36-58 West Jackson boulevard, Chicago, Ill., announces that it has equipped with telephone apparatus the following places: Maysville, Mich., one 100-line switchboard; Browns, Ill., one 50-line switchboard; Rossville, Ill., one 50-line switchboard; Eldorado, Ill., one 100-line switchboard; Tilden, Ind., one 100-line switchboard; Freeport, Pa., two 100-line switchboards; Freeport, Pa., one 100-line switchboard; Freemont, Ind., two 200-line switchboards; Vassar, Mich., two 160-line switchboards.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is distributing No. 1 of vol. 1 of the "National Electrical Catechism." This catechism is destined to afford to electricians and engineers of every class a great deal of interest and instruction. Beginning with the first principles the catechism deals with the definitions of the electrical units. It is intended eventually to lead up to a very interesting series of questions and answers. A reply postal card is being sent with the first few issues, so that a regular mailing list may be made up. The catechism will be mailed to any one interested in the matter.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued a new catalogue, No. 19,053, covering motor field rheostats. These rheostats are for use in the fields of variable-speed motors, speed control being obtained by field regulation. The rheostats are necessarily high-resistance rheostats with low ampere-carrying capacities. The catalogue covers three types, FM, SM and EM, having four to one, six to one and eight to one tapers in ampere capacity, respectively. The highest catalogued resistance is 2,900 ohms. The rheostat is but eight inches in diameter, and approximately four inches deep, with twenty-four steps. The resistance is in the form of the Ward Leonard enameled resistance units.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 7. NEW YORK, SATURDAY, FEBRUARY 18, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Needed Improvements . . . 271
Electric Service During Storms . . . 271
The Tantalum Lamp . . . 272
The Electrical Operation of Textile Factories . . . 273
A Possible Danger to High-Tension Apparatus . . . 273
Single-Phase Motors on Polyphase Systems, by H. W. Doubrava . . . 274
Street Railway Conditions in Massachusetts . . . 277
BOOK REVIEWS . . . 278
The Tantalum Lamp, by Dr. W. Von Bolton and Dr. O. Feuerlein . . . 279
Application of Electricity to Steam Roads . . . 283
Electric Hoisting at a French Colliery . . . 284
The New Paris Electric Railroad, by C. L. Durand . . . 285
Car Equipment of a Single-Phase Railway System . . . 290
The Indianapolis & Cincinnati Traction Company . . . 291
Dinner of the Electrical Contractors' Association . . . 296
Incandescent Lamp Manufacturers' Meeting . . . 297
Meeting of Telephone Men . . . 297
American Electrochemical Society . . . 297
Report of the New York State Railroad Commissioners on Traffic Conditions in Greater New York . . . 297
Regular Meeting of the American Institute of Electrical Engineers . . . 297
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 298
Group Photograph Annual Dinner American Institute of Electrical Engineers . . . 300
Street Railway History and Organization . . . 301
INDUSTRIAL SECTION:
Walrath Gas and Gasoline Engines . . . 302
Westinghouse Sales Meeting . . . 303
Electro-Lifting Magnets . . . 304
Motor-Starting Panel with Circuit-Breakers . . . 305
New District Offices of the National Electric Company . . . 305
The Peerless Thawing Transformer . . . 306
The Cost of Lighting . . . 306
Central Electric Company's Plant Burned . . . 306
CURRENT ELECTRICAL NEWS . . . 307

NEEDED IMPROVEMENTS.

A plan is now before the Board of Rapid Transit Railroad Commissioners of the city of New York which provides a remedy for the intolerable condition now existing at the New York terminus of the Brooklyn bridge. It is proposed to build two four-track elevated structures connecting the Brooklyn bridge with the Williamsburg bridge. These, with the two bridges, will form a loop over which the bridge trains will circulate in both directions. When the intermediate bridge is built, it will be included in the system. This plan is the best that has yet been offered. It does away with the bridge terminals and thus makes better service possible. At the same time, it provides for the future. The plan can not be carried into execution too soon.

While on the subject of rapid transit improvement, there is another system which has attracted considerable attention. There seems to be no doubt of the inability of the Brooklyn Rapid Transit Company to deal satisfactorily with the situation as it exists to-day in Brooklyn. The service is uncertain and irregular. Delays of from twenty minutes to an hour are the rule rather than the exception. This condition is getting worse from day to day. It is impossible for an outsider to say just what is the trouble. Possibly more cars are needed, or more power at the stations. Probably it is a lack of both. The situation has now been taken in hand by the New York State Railroad Commission, and an elaborate plan of relief outlined.

ELECTRIC SERVICE DURING STORMS.

This winter, so far as it has gone, has brought its full share of severe storms. Some of these have been accompanied by high winds. The fall of snow and sleet has been exceptionally great, and, altogether, the winter promises to establish a new record for bad weather.

The effect of these storms on the electric services has been felt in all directions, but it is the country districts that suffer most. Although our overhead lines are being erected more and more substantially, they have not yet reached a point where we can bid defiance to a high wind, accompanied by sleet.

In the cities, conditions are better, for, as a general rule, the wires are underground, and are independent of the weather. Thus, during the recent severe storm there was no interruption whatever of the lighting in the city of New York.

About the same remarks apply to the railways, for on the country lines the interruptions have been the greater; but the electric roads did not suffer any more from the storms than did the steam roads. During the recent blizzard, traffic on some of the steam roads was completely interrupted for a time, and trains were hours late for several days. The conduit systems, such as those in New York city, were not troubled by breaking of lines, but a snow-storm, accompanied by a high wind, causes a good deal of trouble by partially filling the conduit with snow. It required the greatest effort to keep the lines in New York running during the blizzard—in fact, several of them were blocked for a time.

Telegraphic and telephonic communication within cities is now seldom affected by storms, and during the worst weather business can be carried on with but little inconvenience, even when the storm is so severe that few persons venture out on the street. For the country to become as independent of the weather as the cities it will be necessary either to place the wires underground or to make the lines so strong that they can defy the worst storms. The first alternative is impracticable on account of the cost, but in the latter direction much is being done. The overhead lines of electric railways are not as subject to these inconveniences as the telegraph and telephone lines, since, in general, the wires are heavier and more substantially put up. To avoid stoppages due to snow on the track, an ample equipment of plows and sweepers, with a good supply of power to keep them going, should answer all needs.

Digitized by Google

THE TANTALUM LAMP.

On another page of this issue we reprint a paper read before the Elektrotechnischer Verein, Berlin, on January 17, by Drs. W. von Bolton and O. Feuerlein, describing a new type of incandescent lamp which is about to be placed upon the market by the Siemens & Halske Company. This company has for many years past had experts at work searching for a material suitable to take the place of carbon in the ordinary incandescent lamp. As is well known, the incandescent lamp, while ideal in many ways, has a luminous efficiency much less than that of other types of electric lamps. The efficiency of an illuminant increases progressively with an increase in temperature, and by increasing the current through the carbon filament, almost any efficiency may be reached; but this greatly shortens the life of the lamp, for the carbon filament can not stand the higher temperatures.

To improve the lamp, and still obtain a satisfactory life, several lines of research have been followed. In one of these increased efficiency was sought by treating the carbon so as to enable it to withstand a high temperature, and with this object in view a coating of a carbide has been formed on the surface of the filaments. This seems not to have been successful, for the lamp was not offered for sale.

The success of the Nernst lamp and the incandescent gas lamps suggested another line of attack. It was thought that by impregnating the carbon filament with the oxides of the rare earths, a filament would be produced which would give an increased efficiency, due to the supposed selective radiation of these oxides. This attempt has not yet been successful.

A third way of approaching the problem was to seek for a material which might replace the carbon. This direction of research was the most obvious of all, but as the field was pretty thoroughly investigated at the time the incandescent lamp was first brought to a successful stage, the outlook did not seem promising. The first significant advance in this direction was the production of the osmium lamp, but this lamp has some serious disadvantages; the resistivity of osmium is comparatively low, and the material becomes soft at the high temperatures at which it is maintained. For these reasons the highest voltage for which the osmium lamp has been made is about fifty-five, and the filament is long, and, when lighted, resembles a piece of wet string, so that the lamps can only be placed in vertical positions. Another serious disadvantage of the osmium lamp is the rarity of the metal, and its consequent high price.

The tantalum lamp is the second important product of this third line of research. In it the short carbon filament is replaced by a much longer filament of the metal, tantalum. This metal has a fusing point higher than that of platinum, and it may be maintained at a temperature which gives it an efficiency greater than that of any other incandescent lamp. At the same time, a satisfactory life is obtained. To make a lamp for 110 volts, about two feet of tantalum wire approximately one-half millimetre in diameter is required. The efficiency is high, being about one and one-half watts per Hefner candle, or 1.7 watts per English candle.

Tantalum is not particularly rare, and as the amount of metal used in one lamp is exceedingly small, this item will not affect the cost of the lamp much. It is said that about 45,000 filaments can be made from one kilogramme of the metal. To make the filaments, the metal is drawn into thin wires, and this process, and that of obtaining the metal from its ores, will probably be the principal factors in determining the cost of the new lamp. Another trouble lies in the comparatively low resistivity of the metal. This makes necessary the use of a fine wire, which, as is shown in the paper, tends to draw itself up into globules when incandescent, on account of the surface tension. This action can not fail to decrease the life of the lamp, as it is probable that when once started it is progressive. As compared with the incandescent lamp, tantalum has a decided advantage, in that its resistivity increases with temperature, while that of carbon decreases. The metal filament is then self-regulating to a certain extent.

The method of supporting this comparatively long strip of wire described in the paper seems to give satisfaction. It would be interesting to know how these lamps are adjusted, as no stage of manufacture similar to that of flashing incandescent lamps is mentioned. It seems probable that the maker is depending upon securing a uniform quality of metal and a uniform size of wire, in which case no adjustment would be necessary, if the wire is cut accurately to length. Impurities have a marked effect upon the wire, increasing its resistance and decreasing its life. The purer the wire, the higher the temperature which it will withstand, and hence the higher its luminous efficiency, but the longer the filament must be. Marked progress may be expected in methods of producing the pure wire and of working it, and it is probable that the work in this direction will have the greatest effect upon the price of the new lamp.

It is instructive to notice how the new lamp is affected by conditions found most satisfactory with carbon filaments. To be commercially successful, the lamp must be suitable for at least 110 volts, and it must be of a size which will enable it to be used in our present fixtures—that is to say, about two feet of soft wire must be enclosed in a bulb little, if any, larger than that found satisfactory for protecting a few inches of carbon filament. Were this not the case, it is probable that a much larger bulb would be used. This would tend to increase the life of the lamp, and enable the wire to be spread out more, giving a more pleasant effect. With the present construction it is undoubtedly glaring and trying to the eyes.

The immediate field for the new lamp would seem to be in the lighting of large rooms and possibly for street lights. At the present time it is not practicable to make lamps of less intensity than about twenty-five English candles. This is rather large for use in small rooms. The standard in this country to-day is only sixteen candles, and even this is larger than is necessary. A lamp having half the intensity would probably give more satisfactory results.

So far as can be judged, the tantalum lamp seems to be the most important development in electric lighting since the Nernst lamp was brought out. The new lamp may be used on either direct or alternating-current systems. Its high efficiency means

Digitized by Google

practically the doubling of the available output of every electric lighting station. As experimental lamps have been in existence for about two years, it would seem that the maker is satisfied that the lamp is a commercial article. What every lighting station wants to know is, how much will these lamps cost, when can they be purchased, and in what quantities? It seems likely that it will be some years before the lamp can affect seriously the standing of the carbon filament lamp.

THE ELECTRICAL OPERATION OF TEXTILE FACTORIES.

The employment of electric driving in textile factories is not new in this country, as there are many noteworthy examples of mills which have abandoned steam or hydraulic power, pure and simple, for the electric motor. The success of the change has in all cases justified the expenditure, for the electric drive brings a great many advantages. Those who have not studied the problem closely will be likely to think that the only way in which a mill can gain by discarding the old steam system, with its ropes or belts, and putting in motors, will be by decreasing the cost of power; but this is not the only, nor chief, advantage. Indeed, it may happen that when due allowance has been made for depreciation and interest on the increased investment, the cost of power under the new will be little, if any, less than under the old system. The real gain lies elsewhere.

For a new factory a decision in favor of the electric drive gives a greater range in the choice of a site, for the mill itself is under no necessity of being immediately adjacent to the power-house, nor need it be on the water's edge, both of which conditions must be complied with if hydraulic power is adopted, and should also preferably be met when steam is used. But with the electric drive the power-house may be put wherever the best site is available, and the factory may be located elsewhere, its needs as a mill only being considered. This is a great advantage, for it may mean a considerable saving in the cost of the site, it may mean a healthier location, and it may bring immunity from stoppages due to floods.

In the factory itself the electric drive abolishes nearly all belting and ropes. The machines may then be located wherever best suits their individual requirements, they need not be placed at any particular point because the main line shaft passes over that point, nor need they all be operated with regard to the main drive, for it is usual to drive the separate machines from short lengths of shafting or by means of individual motors. As the belts are done away with, better lighting is secured, and hence better work results. At the same time there is less danger to the workers.

These are all important gains, but they do not represent the main advantages of the electrical drive; those which should have a greater influence than all the others in converting factory owners to the modern system. The most important gains from this point of view are the increased output of the factory and the improved quality of the product which are secured by the use of the electric motor. The greater steadiness of drive makes this possible through a higher average speed. At the same time the chance of breakdown is reduced. One or more sections of the factory may be run independently advantageously for special work or for overtime, and there is less loss of time in starting and stopping. Another incidental advantage of the electric drive is the possibility of future extensions, both of the power-house and of the factory, as this may be carried out with little reference to what has already been done. This is out of the question in a purely mechanically driven factory.

These advantages make a very respectable showing in favor of the electric drive, and should receive more attention than the mere question of reduction in cost of power. In fact, the cost of the power is only the smaller part of the total cost of operating a factory, though it is apt to be given undue prominence by the mill engineer, possibly because this is one item for which he is particularly responsible. The quality and quantity of the product, and the cost within the mill itself, are questions of management. As it happens, it is in these features that the effect of the electric drive is most felt.

A POSSIBLE DANGER TO HIGH-TENSION APPARATUS.

As is well known, when a brush discharge is brought about by a high electrical potential, ozone is formed, and this action has been made use of to produce ozone for commercial purposes. The formation of ozone by a brush discharge may, however, take place when it is not desired with consequent trouble. An incident of this kind is described in the London *Electrician* for January 27 by Mr. J. S. Highfield, who has had some difficulty due to the breaking down of the insulation of high-tension alternators under his charge. In the particular case mentioned the machine was designed for 10,000 volts, and was insulated with micanite tubes. Examination of the insulation showed the presence of both nitric acid and sulphuric acid, which had injured, and at some points eaten away, the insulating tape. The presence of the nitric acid is attributed to the formation of ozone, and the subsequent fixation of the nitrogen of the air; and this, uniting with the moisture held in the insulating material, formed nitric acid. The sulphuric acid was due to the action of the nitric acid upon gypsum, which was contained in the cloth insulation of the coils.

A somewhat similar trouble has been noticed in connection with high-tension cables. It has been found that the rubber of these cables deteriorates unless protected. The action is attributed to the formation of ozone, which directly affects the rubber. The formation of nitric acid under such conditions would probably not injure the rubber itself, but the acid would attack the lead sheathing, or any other metal with which it came in contact.

With an alternator conditions are different, for rubber insulation is seldom used, and ozone itself is not likely to injure the mica or cloth-insulating materials. To protect these, they must be kept free from moisture. It is probable that this is the reason why more trouble from this cause has not been experienced, for a machine under operation is heated more or less, and this tends to keep it dry. Should this drying action not be sufficient other means must be adopted, and that suggested in the paper is filling in the space around the conductor solid with some insulating material, thus excluding the air. Of course, air-blast or air-cooled transformers will be as liable to this action as alternators, while oil-insulated transformers are not.

Digitized by Google

SINGLE-PHASE MOTORS ON POLY-PHASE SYSTEMS.

BY H. W. DOUBRAVA.

The comparatively recent action on the part of a number of prominent electrical manufacturers in bringing out a line of single-phase motors of the larger sizes is but a recognition of the increasing tendency among polyphase alternating-current central stations toward the single-phase development of their power business. The growth of this tendency has been very rapid, as is evidenced by the fact that from a general ruling of but a few years ago, that motors of one horse-power or less might be single-phase if the customer so desired, the rulings have changed so that now generally it is specified that motors up to and including certain sizes must be single-phase. These limiting sizes vary among the more progressive central stations from five to thirty-five horse-power. There are a number of central stations which go even farther and rule that nothing but single-phase motors can be connected to their lines, the generating plants themselves being polyphase. A great number of these changes in rulings has taken place practically within the last year, and in all cases were not determined upon without careful comparison of the advantages of both polyphase and single-phase power distributing systems.

As a general proposition, a comparison between a polyphase and single-phase plan of power distribution itself is very much in favor of the single-phase method for the obvious reason of simplicity and consequent saving in first cost and maintenance. On the other hand, up to the present time the development of a commercial single-phase motor for general power purposes has not reached the point where motors of fifty horse-power or larger can be readily obtained, necessitating the installation of polyphase motors of fifty horse-power or greater capacity, even where the installation of single-phase motors is carried to an extreme. At the first glance it would appear that single-phase and polyphase motors are competitive in sizes smaller than fifty horse-power, and will be for large sizes, as the art of building single-phase motors progresses, but the facts of the matter are that poly and single-phase motors are not competitive, and each type of motor has a distinct place of its own in the development and operation of a central station. The field for each motor is well defined, although no hard and fast rule can be laid down covering the exact sizes of motors which should be single-phase, and which would apply to any plant irrespective of size or local condition. In general, for a station of moderate size, single-phase motors of thirty-five or forty horse-power can be considered feasible and desirable and can be operated on the regular distributing circuits without fear of effects on line regulation. In the cases of smaller central stations, where the single-phase motor is of a large per cent of the generator capacity, it would be necessary to take into consideration the overlapping of the lighting and power load and the nature of the motor load. With a constant motor load, and with separate phase regulation, ninety per cent of the entire capacity of one phase of a generator might be taken up by a single motor without effect on the balance of the load fed from that phase. In a town of about fifteen thousand inhabitants there is operated on a two-phase sixty-cycle plant a twenty-horse-power single-phase motor driving a planer. The load on this motor varies from a third of its capacity to twenty-five per cent overload. This load is carried without any serious effect on the voltage of the station, even during the time when the motor load overlaps the lighting load. Generally speaking, a plant of this kind could readily take care of a single-phase motor of twenty-five to thirty horse-power, provided, of course, that the load did not vary between wide limits, and that the motor was not situated at the end of a long light line from which a number of lighting customers was supplied. Such a case, however, would be an extreme one, and it is doubtful whether the operation of any kind of an induction motor, poly or single-phase, could be accomplished with the best satisfaction.

The maximum size of a single-phase motor which can be operated on the lines of any station is so much dependent upon local conditions that an attempt to go fully into the matter would result only in endless detail, but in the majority of cases the limitations are more imaginary than real. Central stations which are operating single-phase motors of the larger sizes are experiencing no more trouble than the central stations that are extremely cautious and limit the maximum size to four or five horse-power, so that what seem to be objectionable features in large single-phase installations are evidently only apparently objectionable or are very easily overcome.

The principal reasons for opposing the connection of single-phase motors to polyphase lines are the effects of unbalancing and upon line regulation. The question of unbalancing is not worthy of serious concern, especially if the station is equipped as it should be, with the proper phase and feeder regulators and the proper arrangement of switching devices for throwing single feeders on any phase of the generators. Similar switchboard arrangements and feeder regulating arrangements are necessary, even for the regular incandescent or arc lighting loads. It will make no difference in the effect on the coal pile whether one phase is entirely loaded and the other absolutely without load or if both phases are equally loaded, and it will make no difference to the customer as long as the voltage is kept within reasonable limits. Extreme cases of unbalancing are far from probable and it should be as easy to keep the motor load balanced between the various phases as it would be to take care of the unbalancing of the regular lighting load. In the ordinary course of events, without any special attention being given to the subject, the chances are that as many motors will be connected to one phase as to another. The question of balancing, therefore, becomes one which is not serious and which can be very easily solved.

A comparison of the effect on line regulation between single and polyphase motors while running shows these effects to be practically the same for either case, as one single-phase motor on each phase will have the same effect as one polyphase motor having a capacity equal to the sum of the single-phase motors. Where the number of motors is considerable, as in the case of actual practice, a few more single-phase motors on one phase than on the other will not make an appreciable difference. In starting, a single-phase motor affects one phase; a polyphase motor, all phases. The general supposition is that a multiphase motor in starting affects all lines, but in a smaller proportion than a single-phase motor of the same size affects one phase, the proportion being in ratio to the number of phases. Single-phase motors, however, of the self-starting commutator type can be obtained on the market, which will be provided with a non-inductive starter, and start under full load with a starting current not greater than full-load current, and owing to the fact that the starting boxes are wound non-inductive, the power-factor of the starting current is very high. A comparative test made between a ten-horse-power, sixty-cycle, single-phase motor of the Wagner type, with a non-inductive starter and a seven and one-half-horse-power, two-

Digitized by Google

phase, sixty-cycle motor with an autostarter, showed the following results: the ten-horse-power, single-phase motor caused a drop in the primary line four and one-half miles in length and consisting of four No. 00 wires of 3.8 per cent in starting. The seven and one-half-horse-power starting with autostarter connected for medium torque caused a line drop of three and one-half per cent, or practically the same amount as that caused by the single-phase motor with the difference that the two-phase motor affected twice as many customers as did the single-phase machine. The power-factor of the single-phase motor starting current at the instant of starting was eighty-five per cent, and the two-phase fifty-five per cent. This same ratio held true for all sizes tested, so it was evident that with a proper design single-phase motors, and suitable feeder regulating arrangements, the single-phase motor will cause no more general effect than, if as much as, a corresponding polyphase machine.

With the demonstrated availability of suitable single-phase motors and their satisfactory operation on polyphase lines and station equipment arises the question of the advantages to be obtained from the use of single-phase motors. The idea of two wires only for lighting and power purposes is the ideal one, no matter whether this pair extends from the station itself, or from a passing polyphase feeder. A two-wire distribution is not only ideally simple, but is economical, both in first cost and maintenance. It would be almost impossible to make a general estimate of the saving of the single-phase over that of the polyphase system, or the saving to be made by a partial single-phase development, except, perhaps, in a newly laid out installation. The natural growth of any central station with its increasing load will complicate matters very materially, especially in the more congested districts. The taking on of a new customer often means the strengthening of the primary lines by addition of more copper. If the pole line is already crowded (as is usually the case) the question of finding room for additional conductors becomes very serious. Each individual case must be given separate attention and it is often necessary to strengthen the line a mile back, and the consequent rearranging of wires, additional cross-arms, pins, insulators, to provide room for the conductors, may be the principal expense in supplying a customer with current. Every additional wire means an increased cost in making room, a greater cost of pins, insulators and cross-arms, and a directly proportional increase in chances for grounds, crosses and short-circuits. Every polyphase motor installation means one or two more wires than would be necessary were this same installation single-phase. A central station man who has given the matter careful attention finds in actual practice that the cost of making room for a three-phase circuit varies from ten to fifty per cent for labor, and 0 to 25 per cent for material more than it does in the case of an equivalent single-phase installation. A great deal of the expense in making room can be saved by zig-zagging the new line in and out among the old ones, but no central station man can afford to add in any way to the complexity of pole-line wiring. The necessity of keeping the primary lines clear, and of being able to rapidly locate trouble, is of more than enough importance to warrant the simplest and most easily traced form of construction, even at an increased first cost.

The one place in which a polyphase distributing system shows a saving is in copper. A three-phase transmission theoretically takes twenty-five per cent less copper than four wires two-phase or single-phase system. It does if the size of copper can be made to meet exactly what is required for the load. Even if the exact requirements can be met as far as the copper is concerned, a saving of twenty-five per cent in cost of the conductors can not be obtained for the reason that the insulation of the conductors themselves must enter into the calculation. Below is a table giving the relative weight of conductors to carry a given load, single-phase, and to carry the same load, three-phase, allowing twenty-five per cent less copper for the three-phase transmission. Comparative weights are also given of the bare copper itself. The figures in this table are based upon a thousand-foot transmission line:

No. of Wires.	Size of Wire. No.	Weight Triple Braid Weatherproof Wire. Lbs.	Weight of Bare Copper. Lbs.	Saving in Weight.		Per Cent Actual Saving.	Per Cent Saving Copper.
				Weatherproof T. B. Wire. Lbs.	Bare Copper. Lbs.		
2	00	980	806	...	...	....	....
3	2	804	606	172	200	17.5	24.8
2	0	800	640	...	...	....	....
3	3	630	477	170	163	21.2	25.5
2	1	612	506	...	...	....	....
3	4	492	378	120	128	19.6	25.3
2	2	536	404	...	...	....	....
3	5	435	300	101	104	18.8	25.7
2	3	420	318	...	...	....	....
3	6	336	237	84	81	20.0	25.5

From the above table it becomes very evident that while there is a saving of twenty-five per cent in copper there is not a saving of twenty-five per cent in dollars and cents. The same comparative table might be made out for a three-wire, two-phase transmission, and the figures would show up even less in favor of the polyphase line, and the comparison between a four-wire, two-phase and a single-phase transmission will show less cost for the single-phase. Again, good practice does not permit of the use of smaller wire than No. 6, and a pair of No. 6 wires is often all that is required to carry the load. Consequently, instead of there being a saving in wiring there is often actually an increase in the cost of copper of from fifty to one hundred per cent for a polyphase over that of a single-phase line answering the same purpose.

In the outlying districts where long runs must be made to pick up customers the field is distinctly that of the single-phase motor. No central station man wants to extend a long polyphase line for the purpose of picking up a small polyphase customer, much less extend an additional phase in order to supply him. These extensions in many cases make it a question as to whether it is at all advisable to take on even a desirable customer on account of the high cost of extending additional phases. The best proportion of load in the outlying districts will be for lighting purposes, which can not be connected polyphase, so that there is no question but that for the outlying or even for the intermediate districts the simplest, cheapest and most flexible arrangement would be a single-phase system of distribution.

A general comparison between the two systems in question can be summed up about as follows: for polyphase motors there is a saving incurred in copper in three-phase transmission lines where the current is larger than can be carried by a pair of No. 6 wires, and the question of phase balance is somewhat simplified. For single-phase motors, the advantages are its simplicity, less liability of grounding, savings in pins, insulators, cross-arms,

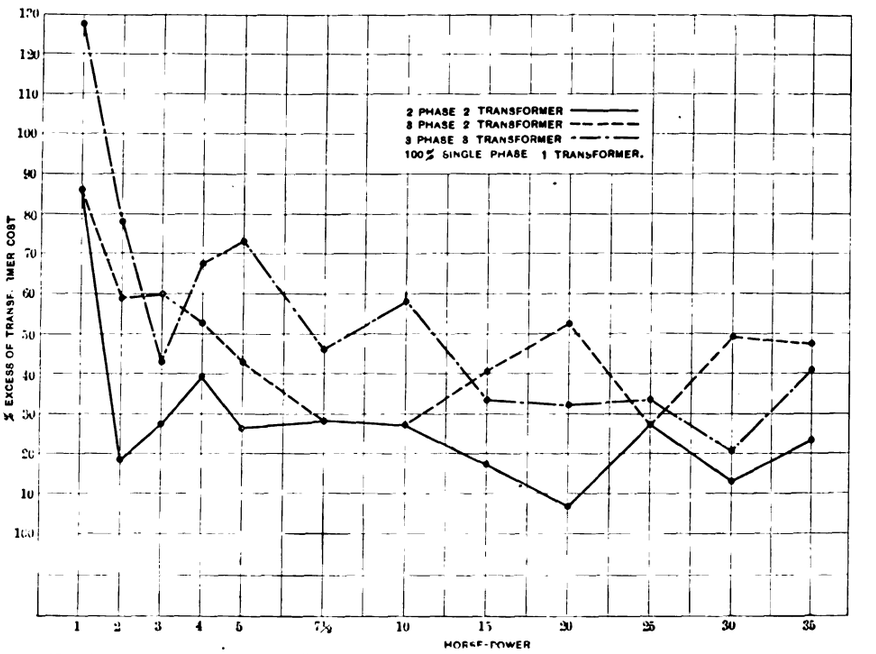
Digitized by Google

saving in cost of primary conductors where No. 6 wires are large enough to carry the current, and in the case of a two-phase, four-wire transmission line, saving in extra phase extension to take on new power customers and less depreciation.

It will often be found that the central station man will take the position that because the polyphase line runs past the door of his customer, that naturally a polyphase motor should be installed, even though the motor be no larger than ten horse-power. While it is hard to get an approximate line on the saving to be obtained by the use of single-phase motors as far as the primary line cost is concerned, it is not so difficult to get a fairly close estimate on the saving between the point at which the current is taken from the line and the motor itself. Basing calculations upon the supposition that a polyphase would take two transformers and a single-phase motor one, the cost of labor and material in connecting the primaries of the two transformers will be twice that for one. The labor of erecting two transformers would be from ten to one hundred per cent more for two converters than for one. If there is perfectly clear sailing ten per cent extra will pay for the labor. Often, however, one transformer may be hung from the cross-arm at the pole, where, if two transformers are erected at the same point, either an additional cross-arm must be put up or the original one considerably strengthened. Again, one transformer may be hung without disturbing the general arrangement of the wiring already in place, while the erecting of two may mean entire rearrangement in order to make room. Therefore the estimate of ten to one hundred per cent extra for the erection of two transformers, which is based upon actual observation, is undoubtedly quite conservative. The wiring from the transformer to the service switch, which is part of the expense that must be incurred by the central station, will be anywhere from one to fifty per cent more expensive for a polyphase motor installation. In case of a three-phase motor the saving in copper will about balance the cost of extra labor. However, where there is considerable special work to be done, such as turning corners, crossing over, etc., a great number of additional pins and brackets will in many cases increase the cost fifty per cent.

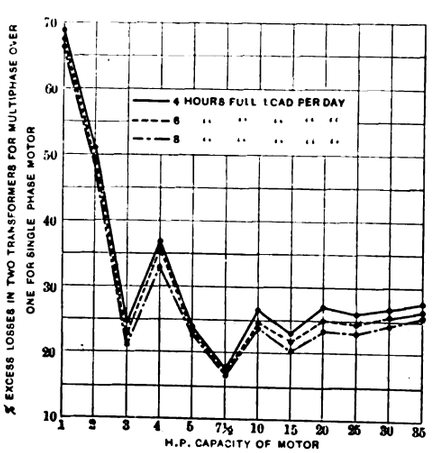
The extra cost of meters will vary according to the policy of the company. If two meters are used the extra expense of labor and meters will amount to nearly sixty per cent. If polyphase meters are used the meters themselves will cost about fifteen per cent more and labor about ten per cent, owing to the more complicated wiring and time expended in tracing out connections.

For installations of one horse-power or


2 PHASE 2 TRANSFORMER
3 PHASE 2 TRANSFORMER
3 PHASE 3 TRANSFORMER
100% SINGLE PHASE 1 TRANSFORMER.
% EXCESS OF TRANSF. IMER COST
HORSE-POWER

SHEET NO. 1.—CURVES SHOWING EXCESS OF FIRST COST FOR TRANSFORMERS FOR MULTI-PHASE AS COMPARED WITH SINGLE-PHASE.

more the extra cost for transformers themselves will vary from eighty per cent for the smaller installations to twenty per cent (see curve sheet 1) for the larger; that is, provided there are available transformers of exactly the right size in the storeroom. In addition to this, it will be necessary to keep a larger stock


4 HOURS FULL LOAD PER DAY
% EXCESS LOSSES IN TWO TRANSFORMERS FOR MULTIPHASE OVER ONE FOR SINGLE PHASE MOTOR
H.P. CAPACITY OF MOTOR

SHEET NO. 2.—CURVES SHOWING PERCENTAGE EXCESS IN TRANSFORMER LOSSES FOR MULTI-PHASE AS COMPARED WITH SINGLE-PHASE MOTORS.

of transformers of smaller, therefore more undesirable size, which means greater investment with its accompanying interest and depreciation charges. The same objection applies to meters, as either more or two kinds of meters must be carried in stock to provide for polyphase motor installations.

There is also an increased loss in transformers due to the fact that the loss in two transformers is greater than the loss in one, which is equivalent in capacity to the sum of the two. The following table based upon the advertised losses of a well-known type of transformer will show the increased losses in the transformers. Curve sheet No. 2 shows the increased loss in watts figured upon the basis of a motor running eight, six or four hours per day at full load, demonstrating that these excess losses do not depend so much on the amount of load as upon the kind of motor installed:

H. P.	Watts Excess Copper Loss.	Watts Excess Core Loss.	H. P.	Watts Excess Copper Loss.	Watts Excess Core Loss.
1	18	25	10	42	43
2	16	25	15	30	48
3	3	18	20	41	64
4	22	26	25	55	70
5	28	24	30	72	78
7½	30	14	35	94	85

For example, take the number which is opposite the horse-power of the motor that it is desired to operate, which is in the first column of figures, corresponding to copper loss, and multiply it by the average number of hours at which the motor operates daily, and divide this number by twenty-four. To this quotient add the number which is in the last column of figures, corresponding to core loss, and opposite the horse-power of the motor in question, and the resultant number will

Digitized by Google

be the watts lost by operating this particular motor polyphase instead of single-phase.

Cost per Kw.Hour.		Cost per Kw. Hour.	
$0.005	.0428	$0.0175	.1533
.0075	.0657	.02	.1752
.01	.0874	.0225	.1971
.0125	.1090	.025	.2190
.015	.1314		

Take this number of watts and multiply it by the number in the second column which is opposite the cost per kilowatt-hour of the current produced by the central station, and the amount will represent the actual extra cost of the additional losses. Divide the amount by 0.05, and the result will represent the amount of extra investment at the rate of five per cent, and should be added to the other expenses incurred in the erection of two transformers instead of one.

Taking the question as a whole, there is no place in the whole scheme of central station distribution wherein the installation of single-phase motors within the limit of the practicability will not put money in the pockets of the central station man. While polyphase circuits are necessary for large motor installation for long transmissions to substations and to rotaries, at the same time the single-phase motor has a very large place in the economy of central station development, and its importance can not be underestimated. A great many of these facts are perhaps quite familiar to the average central station man, but in a great many cases the subject is dismissed without even a partial action on their part to take advantage of the very material saving to be gained by the judicial development of single-phase installations. Single-phase motors are no longer in the experimental stage, and motors of this class, which in actual operation are the equivalent of polyphase motors in efficiency and power-factor, and which will develop very high starting torque and are amenable to the same starting current control as polyphase motors, have been on the market for seven or eight years. These machines have been in operation long enough to fully demonstrate their reliability, and single-phase power distribution is no longer a question of theory or experiment. With all its obvious advantages it can not be said that it is good business policy to make an extra investment of from twenty-five per cent to seventy-five per cent of the value of the motor itself in order to furnish power to a polyphase motor, nor can the fullest returns be expected for the money invested in power stations if advantage is not taken of every possible saving and if every development is not made with the idea of adding to the simplicity of the distributing system.

Street Railway Conditions in Massachusetts.

During the year ending September 30, 1904, of seventy-four companies operating street railways in Massachusetts, thirty failed to earn expenses and fixed charges; twenty-five paid dividends; of the twenty-five which paid dividends, fourteen earned them during the year. Five companies have been in the hands of receivers.

Very few companies besides keeping their railways in good repair reserved for depreciation what prudent management would require. Generally present necessities only have been met, the future with its inevitable expense of replacement and reconstruction being allowed to look out for itself.

The board of railroad commissioners of Massachusetts prepares a yearly list of companies which appear from its returns to have properly earned and paid a dividend of at least five per cent for the five years immediately preceding. Thirteen companies were found to be entitled to a place upon the list submitted in January, 1903; the list of January, 1904, contained the names of twelve companies; that submitted this year contains the names of ten companies.

Experience has shown that with the more expensive roadbed and equipment, the heavier rail and larger cars, there has not been the corresponding and expected development of permanent business. Operating cost, in heating cars and in repair and renewal of plant, has proved larger than was expected. With the new accommodation and the nearer approach to railroad conditions has come the increased demand of the public for expenditures in the interest and safety and comfort which had not been counted upon, as for example, in construction of double track, instalment of signal systems and establishment of waiting rooms.

Upon some railways fares have been raised, and with encouraging results, but this action is usually unpopular and is often taken at the risk of lessening the volume of business. It is, moreover, at times complicated by agreements made between companies and town officials when locations and privileges in the streets were granted.

Another incident of the present situation has been the enforcement upon certain systems of a seemingly arbitrary distinction between the long and the short-distance ride, to the provocation of the through traveler, who is loath to admit that there is any justification for it. The zone system has never been favored in Massachusetts. Instead there has been adopted the five-cent fare within city and town limits, in some cases between centres of adjoining towns. As new grants of location have been sought the five-cent fare has been made good for greater and greater distances, frequently through the use of transfer checks. This low fare promotes a better distribution of population in large communities and is now conveniently paid and collected, while the company has been enabled to reap a profit in the frequency with which cars have been filled and refilled with persons taking short rides. In one notable and exceptional instance this fare covers five cities, which were deemed to be so closely connected as to make practically one continuous community, and so to give the company the advantage of continually changing patronage from point to point. The attempt, however, upon interurban lines to maintain these local concessions and at the same time to establish a sort of mileage basis for through travel, with arbitrary fare limits, has naturally led to frequent complaints from those who think they are unjustly denied privileges which are given to others. Much study has been and is being given to the establishment of a more satisfactory system of fares upon these railways, but as yet the problem remains unsolved.

The following is a table of statistics for 1904 and the preceding year:

Year Ended Sept. 30.	1904.	Changes from 1903.	
Mileage single track.	$2,724,312	Inc.	$53,580
Gross assets	140,843,740	Inc.	1,979,525
Gross liabilities	136,049,486	Inc.	2,928,075
Capital stock	68,542,038	Inc.	137,558
Funded debt	46,674,884	Inc.	5,263,384
Current liabilities	17,434,432	Dec.	2,547,059
Surplus	3,152,868	Dec.	976,952
Gross earnings	26,207,247	Inc.	666,430
Operating expenses.	18,397,291	Inc.	877,924
Net earnings	7,809,956	Dec.	211,488
Dividends	3,214,496	Dec.	371,752
Interest, taxes and charges	6,363,830	Inc.	358,462
Surplus for year	*216,383	Dec.	233,051
Passengers carried.	520,056,511	Inc.	15,394,268

* Deficit.

A new electric railroad is soon to be constructed in Alsace, in the neighborhood of Munster. It will start from the latter town and pass by Stoswihr, with the terminus at Schlucht. Part of the road lying near the terminus passes up a steep grade, so that it is necessary to use a rack-and-pinion system over this part, which runs from Altenbach to Schlucht. It is estimated that the total distance will be covered in fifty-five minutes. The line is situated near the French frontier, so that it is expected to make connection with the railroad on the French side.

Digitized by Google

BOOK REVIEWS.

"Telephone Service." Herbert Laws Webb. New York. The Macmillan Company. Paper. 118 pages. 5½ by 8¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 40 cents.

This book describes in popular language the history and mechanism of the telephone. It deals with the troubles of the central operator, and the treatment which should be accorded central by the subscriber.

"Self-Propelled Vehicles," a practical treatise on the theory, construction, operation, care and management of all forms of automobiles. Second edition. James E. Homans. New York. Theodore Audel & Company. Cloth. 652 pages. 6 by 8½ inches. Many illustrations. Supplied by the ELECTRICAL REVIEW at $2.

Books which have heretofore appeared on this subject have been, with few exceptions, of an amateurish character, consisting largely of a compilation of trade publications, or else written with second-hand inspiration derived from some manufacturer of a particular type or class of machine. A book has at last appeared, however, that is all that, and more than it claims to be in the preface. The subject matter is well presented and the book will be a welcome volume to all those interested in automobile topics. After first giving a brief history of the self-propelled vehicle, the author takes up the general requirements common to all classes of automobiles, such as steering gear, running gear, brakes, bearings, tires, wheels, etc. A clear and comprehensive treatment of the internal combustion engine follows in which the author outlines the theory, construction and operation of this type of motor, and also gives some methods of testing. The various auxiliaries for gasoline motor carriages are then discussed, after which the author gives descriptions of some of the best known cars. In that part of the book devoted to the electric carriage, there is included an explanation of the electrical units and their relationship; the action of the storage battery is discussed and points on the care and operation of batteries are given that will be of value to the users of the electric carriage. The last part of the book is devoted to the steam car in which the author outlines the principle of the steam engine; after a short discussion on boilers a description of some of the representative types of engines is given.

"Electricity in Every-Day Life." In three volumes. Edwin J. Houston. New York. P. F. Collier & Son. Cloth. 5½ by 8 inches. 584, 566 and 609 pages, respectively. Illustrated. Supplied by the ELECTRICAL REVIEW at $5.

Dr. Houston needs no introduction to the electrical student. His writings are always clear and entertaining and, above all, accurate. In these books he has given a full discussion of the applications of electricity in all of its many uses. The style of the work is such that any one can read it understandingly. Vol. i, after calling attention to the importance of the electrical industries in an introduction, takes up the history of the science and tells practically everything the ordinary reader need know about electricity. Indeed, if any one goes through this work carefully, he may consider himself well posted in elementary electrical science. The first volume is entirely given up to the science, and this, it is a pleasure to see, has been brought up to date. Vol. ii takes up, first, electrochemistry and electrometallurgy, describing the earlier laboratory experiments and the commercial apparatus which is the product of the last few years. The telephone is then treated in the same way, the earliest work of Bell, Edison and others being given impartially. The latest systems are described. Next telegraphy is considered, including wireless systems. This is followed by a description of fire-alarm, burglar-alarm and other calling systems. Electric heating comes in for the next consideration. Under this head are described cooking appliances, electric welders and other devices of a similar nature. Vol. ii closes with a brief dissertation on electrotherapeutics. In vol. iii the theory of the dynamo and dynamo construction is discussed. This is followed by electric lighting; arc and incandescent lamps and lighting generators are described. Following this the newer types of lamps are described, and their operation explained. The volume closes with a discussion of the applications of the electric motor to general purposes, and to the operation of electric railways. There is also a discussion of the electrical transmission of energy. As will be seen from this summary, the three volumes form a very complete review of the electrical science and its applications. Throughout the volumes side-headings guide one in the search for particular information. The typographical work is good, but it is to be regretted that a better grade of paper was not used. There are many illustrations, some of the half-tones being excellent, and each of the three volumes has a frontispiece in three colors, that of vol. i being a photograph of Thomas A. Edison in his laboratory. The other cuts, however, are far from what they should be, and in many cases are distinctly bad. It is a great pity that the work was spoiled by the use of these old woodcuts and half-tones. The text is certainly worth better illustrations.

"Telephone Principles and Practice." George Walker Wilder, Ph. D., assistant professor of electrical engineering at Armour Institute of Technology. Madison. Cantwell Publishing Company. Cloth. 450 pages. 375 illustrations. Supplied by the ELECTRICAL REVIEW at $2.

Books upon telephonic subjects are numerous. Yet, strange to say, the idea is prevalent that the telephonic science is without satisfactory literature. This is true, and there are several reasons for it. The science is young, that is, freedom of expression is such a new liberty, and the old habit of silence so strong, that nothing can be expected from those who could write volumes of valuable stuff. Then the development has been rapid. However, this has proved no bar to clever and comprehensive text-books in electrical engineering. Another reason, there is as yet a scarcity of that chronic and prolific class of text-book writers known as college professors. Nearly all telephonic books up to date have attempted to reach both the beginner and the more experienced man as well. Consequently there are two classes complaining. To try to reach both reaches neither. No text-book will be successful, aside from financial considerations, until the beginner, or ordinary telephone worker, is separately guided from the widely experienced worker. The student needs a simple, concise and brief explanation, with nothing taken for granted, with things presented in logical order, so that the mind will acquire a momentum, carrying it far beyond the book. If, however, he finds too much taken for granted, explanations complex, and no logical order, he will lag, and the book will be thrown aside. It is plain that "Telephone Principles and Practice" is the work of a teacher. The book is an echo of the class work. Doctor Wilder starts in with a definite idea; that of handling the beginner. He gives the beginner brief, concise and simple explanations, the matter is presented in logical order, and at no time is there confusion. First, the fundamental ideas of telephony; second, the apparatus used in exchange service; third, the different methods of communicating between subscribers, and fourth, construction and equipment. The first and fourth parts are well presented, while the second and third, although nicely presented, strongly suggest company bulletins. On the whole the book is worthy of attention from all telephone men. For the exchange operator no other book presents as much helpful information.

Digitized by Google

THE TANTALUM LAMP.[1]

BY DR. W. VON BOLTON AND DR. O. FEUERLEIN.

PART I—BY DR. W. VON BOLTON.

While the carbon filament incandescent lamp remained for nearly two decades the sole representative of glow lamp manufacture, progress was being quietly made in this art. The firm of Messrs. Siemens & Halske has for many years been working at a solution of an economical incandescent lamp, and arrived some time ago[2] at the fundamental principle that the visible part of the radiation of an incandescent body increases progressively with its temperature. This warrants the postulate that the most economical lamp will be that whose incandescent material will withstand the highest temperature.

Messrs. Siemens & Halske had arrived at this conclusion and charged me several years ago with the task of discovering a material which should have a melting point considerably above the temperature at which incandescent lighting becomes highly economical, so that filaments made of such a material would not melt or disintegrate at that temperature. While our laboratory work, founded upon this idea, was going on, the first two advances in incandescent lighting were made public, one being the "Nernst" and the other the "Osmium" lamp.

There are certain metals the melting points of which are known to be considerably above 2,000 degrees centigrade, and the task resolved itself into finding one which, while fulfilling the above requirement, could be easily worked to form a filament, and not be very rare or difficult to procure. It was early observed that brown vanadium pentoxide, which, according to Berzelius does not conduct electricity, is, as a matter of fact, a conductor even when cold. This observation induced me to try whether vanadic acid could not be electrolytically decomposed. In this I succeeded, but the melting point of the vanadium obtained proved too low for the purpose in view. Since the metals niobium and tantalum are members of the vanadium group, niobium having an atomic weight double that of vanadium while the atomic weight of tantalum is double that of niobium, it was thought that one or both of these metals might prove to have the desired qualities. On experimenting with niobium on the lines adopted for vanadium, it appeared that this metal has a considerably higher melting point than that of vanadium, but not, however, sufficiently high; moreover, some of the niobium filaments which I made had a very strong tendency to break up when heated by the electric current.

Tantalum was tried next. I reduced potassium tantalo-fluoride in the manner prescribed by Berzelius and Rose and found that the finely divided tantalum so produced became fairly coherent on rolling, so that by this treatment metallic strips of it could be made. It was also attempted to work tantalum oxide into the shape of a filament by mixing it with paraffin and to reduce it directly into the form of a metallic thread. In these experiments there was observed for the first

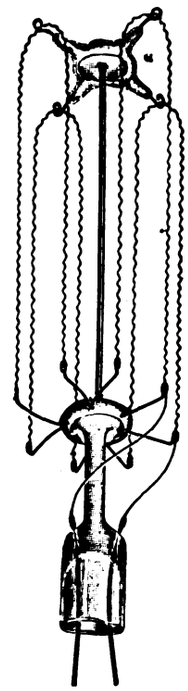


FIG. 1.

time a minute globule of molten tantalum, and this globule was of sufficient toughness to permit hammering and drawing into wire. Following out this observation, tantalum powder was melted in a vacuum, and then it was found that the highly heated metal parted with the gases it contained. In this manner I produced my first filaments of pure metallic tantalum, which were, however, very small. When these had been used in lamps with promise of good results, an attempt was made to devise a definite process of purification. The potassium tantalo-fluoride was reduced to metallic powder; this powder contains a small proportion of oxide and of hydrogen which is absorbed during the reduction. When the powder was melted in a vacuum the oxide and absorbed gas disappeared, and a reguline metal remained; on carefully remelting this it became so pure that no appreciable impurities could be detected in it.

The chemical properties of this pure tantalum are very remarkable, and some of them are of such a nature as to lead me to suppose that nobody other than myself has ever had metallic tantalum in his hands. When cold, the material strongly resists chemical reagents; it is not attacked by boiling hydrochloric acid, aqua regia, nitric acid or sulphuric acid, and it is also indifferent to alkaline solutions; it is attacked solely by hydrofluoric acid. Following the behavior of steel, when heated in the air it assumes a yellow tint at about 400 degrees centigrade, and the tint changes to dark blue when the tantalum is exposed for some time to 500 degrees centigrade, or for a shorter time to 600 degrees centigrade. Thin wires of the substance burn with low intensity and without any noticeable flame when ignited. It absorbs hydrogen as well as nitrogen with great avidity, even at a low red heat, and forms with them combinations of a metallic appearance, but rather brittle. It combines with carbon very easily, forming several carbides which, as far as they are at present known, are all of metallic appearance, but also very hard and brittle. The product which Moissan thought to be tantalum was clearly a carbide of this nature or an alloy of a carbide with pure tantalum, for Moissan himself stated that his metal still contained one-half per cent of carbon. Considering the high atomic weight of tantalum (183) it is obvious that a very small quantity of carbon suffices to carburize a relatively large quantity of tantalum. This view of the constitution of Moissan's product is confirmed by the properties he ascribed to the metal—namely, specific gravity 12.8, great hardness and brittleness. These are not properties of pure tantalum. When in the form of powder, still containing, as previously stated, oxide and hydrogen, the specific gravity of my material is about fourteen; when purified by fusion and drawn into wire it has a specific gravity of 16.8. It is somewhat darker than platinum, and has a hardness about equal to that of mild steel, but shows greater tensile strength than steel does. It is malleable, although the effect of hammering is relatively small, so that the operation must be rather long and severe to beat the metal into a sheet. It can be rolled, as well as drawn, into a very fine wire. Its tensile strength as a wire is

[1] Translation (through the courtesy of Mr. Alexander Siemens) of a paper read before the Elektrotechnischer Verein, of Berlin, on January 17. Reprinted from *Electrician*, London, January 27.

[2] *Cf.* W. Siemens in *Elektrotechnische Zeitschrift*, vol. iv, p. 107, 1883.

Digitized by Google

remarkably high, and amounts to ninety-five kilogrammes per square millimetre, while the corresponding figure for good steel is seventy kilogrammes to eighty kilogrammes, according to Kohlrausch.

The electrical resistance of the material at indoor temperature is 0.165 ohm for a length of one metre and a section of one square millimetre (specific conductivity as compared with mercury 6.06). The temperature coefficient is positive, and has a value of 0.30 between 0 degrees centigrade and 100 degrees centigrade. At the temperature assumed by the incandescent filament in the lamp at 1.5 watts per candle-power, the resistance rises to 0.830 ohm for a length of one metre and a section of one square millimetre. The coefficient of linear thermal expansion between 0 degrees centigrade and sixty degrees centigrade is 0.0000079, according

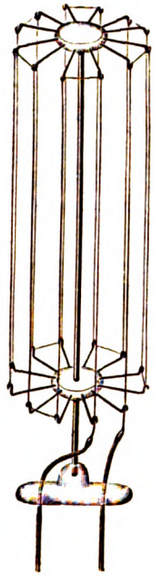


FIG. 2.

to experiments made by the Imperial Normal-Aichungs commission. Fusion is preceded by a gradual softening, which appears to extend over a range of temperature of several hundred degrees. The specific heat is 0.0365, so that the atomic heat is 6.64, which is in accord with the law established by Dulong and Petit.

PART II—BY DR. O. FEUERLEIN.

The results of the work carried out in our chemical laboratory, as described by Dr. von Bolton in the first part of this paper, were, of course, of the utmost interest to our incandescent lamp manufacturing department. As soon as Dr. Bolton's experiment showed that the originally brittle tantalum could be made ductile enough to draw into wire by the usual methods, and that this wire could be bent and coiled like a thin steel wire, it became possible to test it thoroughly as to its usefulness for incandescent lamps. The first trials with wires of about 0.3 millimetre diameter gave most promising results. They confirmed the fact that

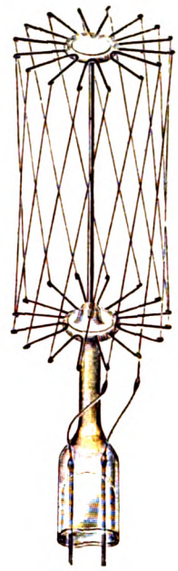


FIG. 3.

tantalum has a very high melting point, and that it is but slightly subject to disintegration in a vacuum, even when subjected to a heavy current.

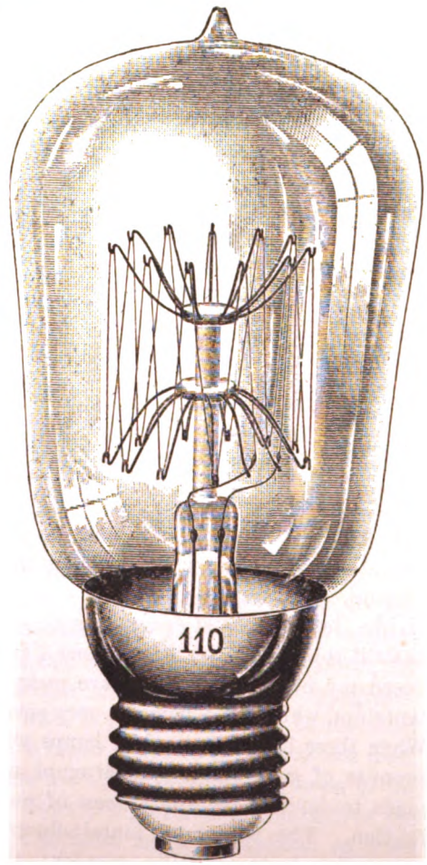


FIG. 4.

The first tantalum lamp has proved moderately satisfactory in that it admitted of an exact measurement of the electric and photometric conditions and stood a burning test for some time, was completed just over two years ago—*viz.*, on December 28, 1902. This lamp had a loop-shaped filament made of the first tantalum wire ever drawn. The diameter of the wire was 0.28 millimetre, its effective lighting length fifty-four millimetres and its electrical resistance when cold 0.29 ohm. This corresponds to a specific resistance (one metre length, one square millimetre section) of 0.331. The photometric measurements made at efficiencies of two, one and one-half and one watt per Hefner candle-power showed potential differences of 4.9, 4.95 and 5.9 volts, currents of 5, 5.46 and 6.2 amperes, and illuminating values of eleven, eighteen and thirty-seven Hefner candle-power respectively. On being burned at one watt per candle-power the lamp had a life of twenty hours, during which it blackened considerably.

As the chemical and mechanical manufacturing process developed and the material became purer and the wires more uniform, the results obtained also improved. The lamps lasted longer and

FIG. 5.

blackened less; at the same time the specific resistance decreased until it had dropped to the present figure of 0.165 for the pure metal. It is clear that the material used for the first lamps still contained a considerable quantity of impurities, probably niobium and carbides, which caused the great disintegration and the nearly double specific resistance. During these first trials we looked very carefully into the question as to what dimensions the filament of a tantalum lamp ought to have for ordinary voltages and illuminating values. From the dimensions of the filament used in the first lamp we calculated that, with this rather impure material, we should require a filament about 520 millimetres long and 0.06 millimetre diameter for a lamp for 110 volts, thirty-two Hefner candle-power and 1.5 watts per candle-power. These unusual figures increased when the specific resist-

Digitized by Google

ance of the material had diminished to the present value of 0.165, at which for a thirty-two Hefner candle-power lamp, a filament of about 700 millimetres in length by 0.055 millimetre in diameter was required; for a twenty-five Hefner candle-power lamp, a filament of about 650 millimetres by 0.05 millimetre diameter was required. Thus, in order to construct a practical and useful lamp for standard voltages and illuminating values, we had to solve the problem of drawing the tantalum wire in sufficient length down to a diameter of 0.05 millimetre to 0.06 millimetre; this we succeeded in doing after long and laborious trials.

In July, 1903, we possessed the first tantalum lamp with a filament of about 0.05 millimetre diameter. It had a loop-shaped filament fifty-four millimetres long and it took 0.58 ampere at nine volts and gave 3.5 Hefner candle-power at 1.5 watts per candle-power. On the basis of these figures a lamp having the same quality and diameter of wire and working at the same efficiency on a 110-volt circuit would have a filament 650 millimetres long and would give forty-three Hefner candle-power. The experiments thus far had proved that the task of producing lamps for 110 volts and a maximum of 25-32 Hefner candle-power was not an easy one in several respects. We had to solve the problem of suitably and reliably fixing a filament rather more than two feet long within a glass globe which should not exceed to any great extent the dimensions of the usual incandescent lamps. The first and most obvious attempt was made, of course, by adhering to the loop shape and accommodating the required length of wire by connecting several such bows in series within the lamp. However, lamps made according to this plan with two to four tantalum loops gave results which were anything but satisfactory.

It appeared that, like all other metallic filaments which have hitherto been used for incandescent lamps, tantalum wire softens sensibly at the temperature attained when worked at 1.5 watts per candle-power. To use loop-shaped or spiral filaments similar to the carbon filaments of the common incandescent lamps was, therefore, out of the question. There was no difficulty in suspending the loops, but in that case the lamps would have to be used exclusively in a vertical position, a limitation which we wished to avoid in all circumstances. Besides, such a construction would necessitate staying the loops firmly to prevent them from becoming entangled with each other during transport of the lamps. Nor did lamps made with loops of corrugated wire (Fig. 1), or of plain or corrugated metal ribbon give satisfaction; for although the loops were certainly shortened in this way, there were other drawbacks which caused us to abandon this construction. It soon became apparent that the one road to success lay in the direction of dividing the filament into a number of short straight lengths supported at their ends by insulated holders. In this manner we succeeded at last, in September, 1903, in producing the first really serviceable lamps for about 110 volts. This lamp is illustrated in Fig. 2, and it will be seen that it contains two glass discs cast to a central wire holder; each disc carries laterally twelve arms having small hooks at their ends and insulated from each other. Through these twenty-four hooks the thin tantalum wire is drawn up and down between the two discs. This is believed to be the first metallic incandescent lamp for nearly 110 volts which, like the common carbon glow lamp, can burn in any position whatsoever. This lamp supplied about thirty Hefner candle-power on a ninety-four-volt circuit at 1.5 watts per candle-power. It lasted for 260 hours and lost during that time 9.5 per cent of its illuminating power.

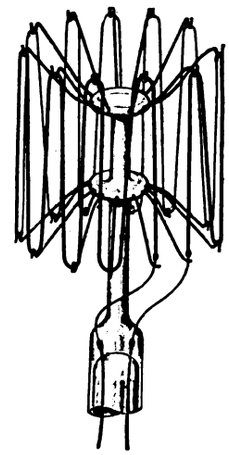


Fig. 6.

After this first practical success we redoubled our efforts to improve the lamp further. As far back as about the middle of October, 1903, we succeeded in making the first 200-volt tantalum lamp, which was of a design similar to the lamp just described, but with eighteen arms on each disc and with a greater distance between the two discs. I may add at once that it is of interest only as a curiosity, for it has served no practical purpose. The length of its filament was 1,350 millimetres and the illuminating value about sixty Hefner candle-power. In the course of further development the form of the frame of wire filament for the 110-volt lamp went through different stages, the principle of subdivision being always followed. Among other constructions we tried some in which, instead of one long filament, a number of short pieces of wire were fixed on a supporting frame; these pieces, connected in series, made up the total length required. Fig. 3 represents a lamp thus constructed, the wire being fixed obliquely in sixteen straight pieces between two insulated supporting stars. Such lamps offer the advantage that short pieces of filament can be used in the manufacture. But they are only reliable if the wires used in the same lamp are absolutely uniform in diameter and quality. In the end we arrived at the shape represented in Fig. 4, which is for 110 volts, twenty-five candle-power and 1.5 watts per Hefner candle-power. In this form, differing from most of the previous constructions, the central support consists of a short glass rod carrying two discs, into which the arms, bent upward and downward in the shape of an umbrella, are cast. The upper star has eleven, the lower twelve arms, each upper arm being in a vertical plane midway between the vertical planes in which two adjacent lower arms lie. Between these eleven and twelve arms, which are bent into hooks at their ends, the entire length of the filament is drawn in a zigzag fashion. Its extremities, held by two of the lower arms, are connected with the foot of the lamp by means of platinum strips.

The standard type for 110 volts twenty-five Hefner candle-power and 1.5 watts per candle-power has a filament 650 millimetres long and 0.05 millimetre in diameter. The weight of this filament is 0.022 gramme, so that about 45,000 lamps contain together one kilogramme of tantalum. The shape of the glass globe is adapted to the frame described above. Care has been taken to make it of a size not exceeding the usual maximum dimensions of common incandescent lamps of the same candle-power (twenty-five Hefner candle-power 110 volts). This shape offers a number of noticeable advantages. In the first instance it is very stable and will stand strong shocks without damage to the lamp. A considerable number of such lamps sent across the sea to test their ability to withstand the hardships of transport came back unhurt, although they had been packed just like common glow lamps, and no special care in any respect had been taken in their handling. The lamp burns, of course, in any position, and can therefore be held

Digitized by Google

in any kind of fitting. The light is rather white and agreeable, and its effect is particularly uniform if the lamp is provided with a ground-glass globe.

We shall now proceed to describe the electric and photometric properties of the lamp and its behavior in actual use. Numerous trials for lengthy periods of time at one to three watts per candle-power have proved the vast superiority of the tantalum lamp over the carbon filament lamp under equal electric and photometric conditions. Expressing this fact in figures, we can state that the tantalum lamp consumes about fifty per cent less current at the same voltage, with the same intensity of light and the same useful life; or that, at the same economy, its life is several times that of the carbon type. Moreover, at an initial efficiency of 1.5 volts per Hefner candle-power the tantalum lamp has an average life quite sufficient for all practical requirements, so that this rating has been standardized for the 110-volt lamp. Trials have also proved that the lamps have a life of several hundred hours at one watt per Hefner candle-power, but in that case they were very sensitive to variations of pressure and often showed an early decrease of illuminating power. The useful life of the tantalum lamp—*i. e.*, the time within which it loses twenty per cent of its initial illuminating power—averages between 400 and 600 hours at 1.5 watts per Hefner candle-power. Some specimens have proved to have a useful life of as much as 1,200 hours. The absolute life, in general, amounts to 800 to 1,000 hours under normal working conditions. Further, we have to remark that the tantalum lamp blackens but little unless it has been strongly overheated during work in consequence of partial short-circuiting of the filament.

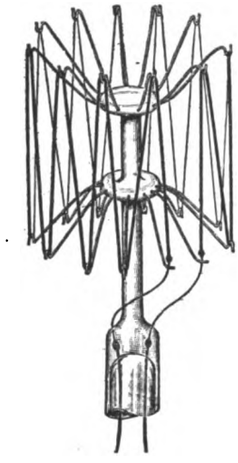


FIG. 7.

It is very interesting to observe the behavior of the tantalum lamp during the whole course of its life. The first fact worthy of note is that, like some carbon lamps, the illuminating value increases at the beginning, generally after a few hours, by fifteen to twenty per cent. In the same way the consumption of current rises by about three to six per cent, while the consumption of energy drops to 1.3 to 1.4 watts per candle-power. After that, the illuminating value gradually decreases, while a corresponding increase of the consumption of energy occurs. The average behavior of the twenty-five-candle-power lamp at 110 volts with reference to its various periods of life is shown in the following table:

Life in Hours.	Intensity of Light in Hefner C-P.	Consumption of Current in Amperes.	Watts per Hefner C-P.
0	25–27	0.36–0.38	1.5–1.7
5	28–31	0.37–0.39	1.3–1.5
150	25–27	0.36–0.38	1.5–1.6
300	22–24	0.36–0.38	1.6–1.7
500	20–22	0.36–0.38	1.9–2.0
1,000	18–20	0.35–0.37	2.1–2.2

The initial increase of illuminating value and current consumed is doubtless caused by a change in the structure of the tantalum wire, this change being accompanied by a reduction of resistance and, consequently, of the phenomena resulting therefrom. We may say at once that after a certain amount of use the filament presents a radical change in appearance when viewed with the naked eye. While the fresh filament has a perfectly smooth and cylindrical surface, it acquires a peculiarly glistening aspect as it grows old, so that a lamp having served for some time can be readily distinguished from a new lamp. When looked at under the microscope, the filament that has burned for a length of time shows a clear tendency toward contraction and formation of drops or beads. Fig. 5 is an illustration of a piece of filament in its fresh state and of the same piece after 1,000 hours of service, the specimen in each case being magnified 100 times. This gradual shortening of the filament can also be observed in the lamps themselves, and offers a further indication of the age of a lamp.

Fig. 6 represents the filament frame of a new lamp. It will be noticed that the tantalum wire is led up and down and hangs loose on the supporting frame in easy wide arches, without sharp bends. But after being used for some time the aspect of the lamp is quite different. As shown in Fig. 7, the wire has contracted, the wide arches have disappeared and sharp-pointed angles have taken their place.

The behavior of these lamps is most peculiar when the filament has burned through. While with all other incandescent lamps the burning through of the filament is tantamount to the economical death of the lamp, it may happen with tantalum lamps that they burn through several times without being rendered useless; on the contrary, each burning through is followed by an increase, often considerable, of the illuminating power. This peculiar result is due to the fact that in many cases a broken wire comes in contact with its neighbor, so that the circuit is again established. A part of the filament is thus cut out of the circuit, and the lamp consequently burns more intensely, and sometimes even too intensely, in which case, of course, only a short span of life is left to it. Yet we have had more than one lamp under observation, the filament of which broke for a first time after a short period of service and then broke repeatedly, but notwithstanding this the lamp lived more than 1,000 hours. We have often succeeded in rendering a lamp with a broken filament serviceable again by tapping it to bring the broken piece into contact with its neighbor. Fig. 8 represents the frame of a lamp in which the filament was burned through in three places, and yet continued to do service. For the sake of clearness, the back spans of the filament have been omitted in the drawing, while the front spans which were carrying the current are drawn in specially heavy lines.

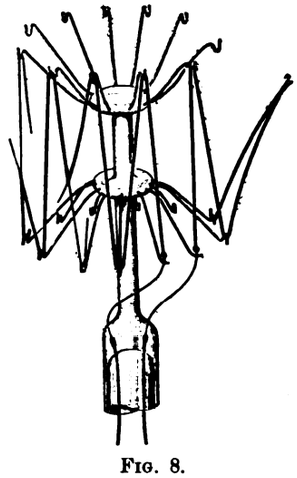


FIG. 8.

It must further be mentioned that after serving for some time, say 200 to 300 hours, the tantalum filament loses a great deal of its mechanical resistance; while, as has been stated by Dr. von Bolton, tantalum wire, when new, has a greater tensile strength than steel; it becomes brittle, and will break easily in the course

Digitized by Google

of its life as a filament. It is therefore advisable when lamps have served for some time not to remove them from their old fittings and put them into new ones, as that might easily cause the filament to break. New lamps are not very sensitive to strong shocks, even while burning, but when this alteration in the filament has occurred it is well to preserve them from shocks.

The behavior of the tantalum lamp under a very great increase of voltage is of special interest to the incandescent lamp maker. As was to be expected, the trials made in this respect have also shown the superiority of this lamp over the carbon lamp. It has been ascertained that tantalum lamps for 110 volts, twenty-five Hefner candle-power and 1.5 watts per candle-power only burn through at 260 to 300 volts if the pressure is increased slowly and gradually, while with carbon lamps designed to work under the same conditions nothing like that figure can be obtained. The superiority of the tantalum lamp over the carbon lamp with regard to blackening of the glass globe can also be proved in a few hours by means of comparative burning tests at about thirty per cent overload.

Another advantage of the tantalum lamp over the carbon lamp is that the resistance of tantalum, like that of all other metals, strongly increases with the rise of temperature, while carbon is known to diminish in resistance when it is hot. In Fig. 9 the variation of the resistance of tantalum and of carbon as a function of the voltage is graphically represented, the pressure being assumed as 100 volts and the resistance at 100 arbitrary units when the efficiency is 1.5 watts per Hefner candle-power, so that for each per cent of variation of voltage the respective percentage of variation of resistance is shown. It will be seen in the first instance that the resistance of the tantalum increases to more than five times its original value from the cold state to 1.5 watts per Hefner candle-power, while the resistance of the carbon decreases to about one-half of its initial value. It will further be noticed that even afterward the resistance of tantalum goes on rising, while the resistance of carbon keeps dropping. Therefore the increase or decrease of pressure causes the strength of current, and with it the illuminating value, to rise or fall at a quicker rate in the carbon lamp than in the tantalum lamp, and, consequently, the latter is less sensitive to variations of pressure than the former.

Having thus related the whole history of the development of the tantalum lamp, and fully entered into a critical comparison between it and the carbon filament lamp, we need scarcely add that we do not intend, of course, to be satisfied with what we have already obtained. For the time being, however, and until a larger building has been erected for the production of tantalum, our firm has resolved to keep to the type for which there is an immediate practical demand. That is the lamp for 110 to 120 volts, which supplies twenty-five Hefner candle-power at 110 volts, or will have a higher or lower illuminating value if worked at correspondingly higher or lower voltages. In conclusion, I would recapitulate the properties which

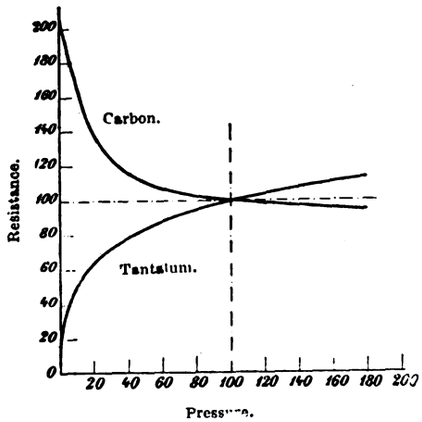


FIG. 9.

we claim as peculiar characteristics of our invention as follows:

1. The tantalum lamp has a filament made of a metallic conductor and burns at once on being connected without any previous heating.

2. The light-giving wire is prepared by melting in a vacuum and drawing; it is tough even in the cold state, and can therefore be coiled and fixed in the lamp when cold.

3. A relatively great length of wire can be placed in a simple manner within a bulb of ordinary dimensions.

4. Tantalum ore exists in considerable quantities and can be easily procured.

5. Similar principles of treatment can be adhibited to other metals of a very high melting point.

Application of Electricity to Steam Roads.[1]

The first essential requisite for the successful operation of a railroad by electricity is a continuous population requiring cheap, frequent and rapid transportation in the conduct and interchange of its daily vocations. This condition then calls for the operation of numerous small units and concentration of energy. Electricity can be used consistently for motive power on country lines when the source of supply is consolidated with an electric light plant or water-power company. Some small industrial roads are using electrical power from their manufacturing plants, but in such a case there must be a foundation to support the added cost of installation, for the electric railroad costs all that a steam line costs to perform the same service, and, in addition, the electrical installation in no case costs less than $3,000 per mile. The length of line which can be consistently equipped depends wholly upon the nature of its traffic and the density of population. Iowa will never be able to sustain numerous small electric railroads until the population in both cities and rural districts has greatly increased, and then not while the chief pursuit of the people is tilling the soil. Through the eastern states the cities are large and numerous and are made up of residents who are wage-earners in the large factories. The rural population is made up, to a great extent, of miners, gas and oil well drillers, and numerous other wage-earning pursuits. This is not true of Iowa cities. The population of Iowa cities is made up of a number of business men who have formed settlements or trading-posts throughout the state for the benefit of the Iowa farmer, who gets his income once a year when he markets his crop. He has a stable full of horses to haul himself and family to the trading-post once or twice a week; therefore the greater part of Iowa is destined to be without the rural or farmers' railroad for some time to come.

For yard work on the Waterloo, Cedar Falls & Northern road the electric locomotive is not feasible, neither is it suitable for drawing heavy freight and passenger trains, as the heavy trains would overload the power-house and no other cars would operate while they were being moved. One freight train would probably require the maximum output of the power-house, and we would be burning coal and conveying the power for miles over a conductor at a great loss in transmission, when we can burn the coal on a locomotive right at the point of service just as cheaply, considering the loss in conductivity. The amount of coal burned on our locomotives for the past eight months has been 1.4 tons per 10,000 ton-miles, while for electric service nine tons per 10,000 ton-miles have been used. This is not a fair comparison, for the reason that the coal used in the locomotives was the best screened Iowa and Illinois lump, while that burned at our power-house was the cheapest and dirtiest

[1] Abstract of a paper by Mr. S. Cass, president and general manager of the Waterloo, Cedar Falls & Northern Railroad, and read at the December meeting of the Iowa Railroad Club.

Digitized by Google

Iowa slack coal; and for the further reason that the principal part of this electric service was performed upon the city streets, where cars were stopped and started every few hundred feet, and no benefit was derived from momentum. The service engaged in by our switching locomotives comes somewhat nearer a comparison of the condition existing on most of the electric railroads. Our steam locomotives, when engaged in switching service, consume 0.3 ton of lump coal per hour, while our street cars require but 0.12 ton of slack coal per hour. The average weight of street cars is about one-third that of switching engines, so that it would be entirely fair to multiply the 0.12 ton per hour by three, making 0.36 ton per hour consumed by electric cars of steam switching engine tonnage. We should divide the 0.36 ton per hour by two, as the quality of coal used by the electric cars is not one-half as good and does not cost one-half as much as that used by the steam switching engine. We find then the result to be 0.18 ton per hour, or a saving of 0.12 ton per hour, by the concentration of energy in a central station, and, in addition, the saving of one man on the locomotive.

The cost of equipping a steam road with the necessary electrical conductors, power-house, substations, etc., of course depends upon the requirements of the line to be equipped. The minimum for small lines is $3,000 per mile. The motive power and electric coaches will cost as much as the same power and steam equipment; therefore the cost of this maintenance must be added to the present maintenance account, and the interest charged to the added cost of installation. Any one can now estimate whether trains operated by electricity will increase the revenue and decrease the operating expenses sufficiently to warrant the expenditure. All the labor saved on a train would be one fireman, and to offset this a high-salaried inspector must be kept in the locomotive house to look after the intricate electrical machinery under the cars. I do not see where any additional revenue would be derived from freight traffic, and the only way passenger traffic would be increased would be by stopping at cross-roads and entering upon the important streets of towns, as is done by purely passenger electric lines.

The present overhead system of electric railways is a menace to the safety of trainmen, whose duties require them to go on top of freight cars, and the third rail is prohibited in switch-yards on account of the danger to switchmen and other pedestrians. A short-circuit is another of the great objections to using electricity for motive power on trunk lines, for when it occurs the circuit-breaker opens at the power-house and cuts off the supply of current from each motor in the section of track affected. The greatest advantage in the application of electricity to steam roads, as applied with the present perfected electric apparatus, is summed up in four words—no smoke, no smell. There is no question but that there is a great field in which electricity can operate, and a great demand for electric transportation in the sections through which most of the trunk lines operate, but that demand should be met by providing the class of transportation which the local conditions require.

Electric Hoisting at a French Colliery.

An electric hoist of a novel type has been recently installed by the Compagnie des Mines Ligny-les-Aire, and is described in the London *Iron and Coal Trades Review*. The hoist is intended to raise 105 tons of coal per hour from a depth of 1,412 feet, at an average speed of twenty-four feet per second. Each cage has four decks, and the total load per cage is 4,800 pounds. When running at full speed about forty-eight trips an hour can be made. The hoist is mounted on a head frame directly over the shaft, at a height of sixty-nine feet above the ground.

The hoisting gear is of the Koepe type, and the main pulley is thirteen feet in diameter. In order to separate the two ends of the rope to a distance corresponding to the distance between the cage centres—three and one-half feet—a counter-pulley, also thirteen feet in diameter, is provided, and this is mounted on the lower stage of the head frame in the same vertical plane as the main pulley. The steel winding rope is one and one-eighth inches in diameter, and a balance tail rope is attached to the floor of the two cages. Each of the pulleys has two grooves—one for use in winding, the other serving as an auxiliary during the changing of the hoisting rope. The main Koepe pulley is mounted on two bearings, the shaft being coupled direct to two continuous-current motors with an aggregate maximum power of 500 horse-power. The motors are coupled direct to the two ends of the pulley shaft. In hoisting coal they run at a speed of thirty-eight revolutions per minute, producing a cage velocity of twenty-six feet per second. This speed is reduced to nineteen revolutions, or thirteen feet per second, when men are being raised or lowered, and to three-quarters of a revolution, or ten inches a second, during inspection of the shaft.

At starting, the maximum effort is about 600 horse-power, decreasing to 300 horse-power during the cage trip, and to nothing at the stops. To nullify the effect of these fluctuations at the primary station, a buffer set of motors has been installed, this set assisting at starting, governing the engine, and equalizing the load on the generating station, so that the latter is only called on to supply a constant force of about 300 horse-power, as though actuating a continuous motor. The buffer set consists of a starting dynamo, a buffer motor and supplementary motor, which are mounted on a common shaft carrying a large flywheel. When the hoisting motors are at rest, the starting dynamo—in series with the circuit—develops the same voltage as the primary station, but in the opposite direction, the consequence being that the voltage at the terminals of the winding motors is reduced to zero. At the moment of starting the cages, the excitation of the starting dynamo is lessened, so that the tension at the terminals of the winding motors is increased, and the latter begin to run, their speed increasing in proportion as the excitation of the starting dynamo diminishes. When this voltage has been reduced to zero the velocity of the rope attains to its normal value. From this point the excitation of the starting dynamo is reversed. Its voltage begins to supplement that of the circuit, and in this manner the total voltage is raised to 1,050-525 volts for each motor; whereupon the velocity of the hoisting rope attains a maximum.

The governing is effected entirely in the excitation circuit of the starting dynamo. The regulator, with its resistances, takes the form of a controller, and is mounted on the lower stage of the head frame. It is actuated by a starting lever on the upper stage. The starting dynamo is actuated by a buffer motor coupled up with the primary station circuit in the ordinary manner. The supplementary motor is in series with the buffer motor, and is fitted with a regulator in its excitation circuit. When the voltage of this latter motor supplements the voltage of the main circuit, the tension at the terminals of the buffer motor increases, and consequently this motor runs at an increased speed. If the voltage of the supplementary motor is subtracted from that of the main circuit, the speed of the buffer motor is reduced. Intermediate speeds are obtained by setting the regulator accordingly, and by this means it is possible to vary the speed of the motor, and consequently of the buffer set, by thirty per cent.—*Engineering and Mining Journal.*

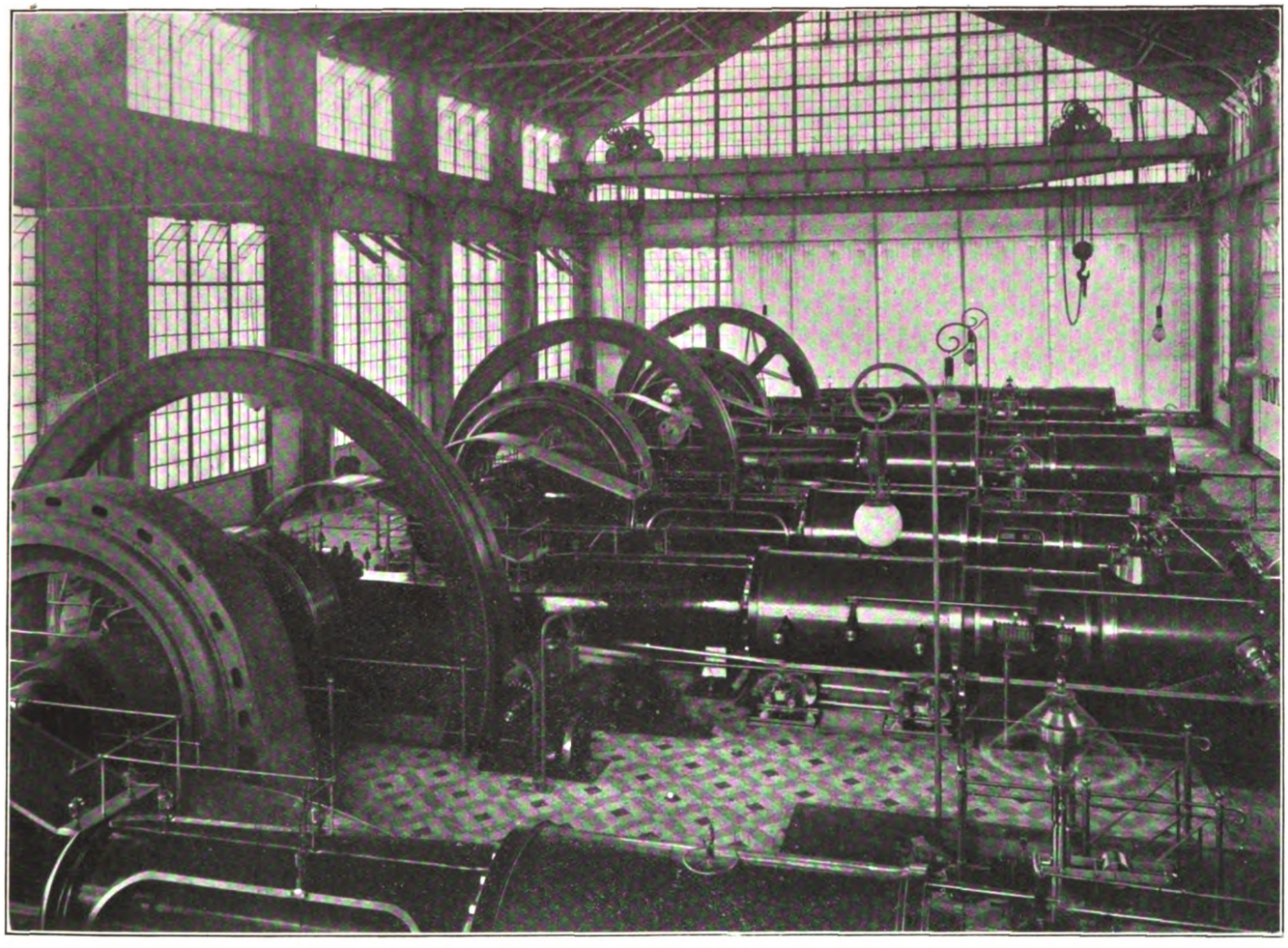
Digitized by Google

The New Paris Electric Railroad.

By C. L. Durand.

SOME years ago the Orleans Railroad Company, which operates one of the leading systems in France, decided to adopt electric traction upon a new branch of standard gauge double-track railroad which it opened up at Paris. This line was built in order to connect the Austerlitz terminal station which lies toward the eastern part of the city with a new station which should be more centrally located, so as to make it more convenient for persons having business in the central part of the city to reach the suburbs, and thus induce them to take up a residence in the districts which are traversed by the railroad. As will be remembered by a description which has been already given in a preceding issue, the electric branch runs along the Seine at the foot of the embankment or underneath the latter in tunnel. The line ends in the centre of the city at the extensive Orsay terminal station which was built a few years ago, lying entirely underground and containing a considerable number of tracks. The company found this a good occasion to test the operation of electric locomotives on standard gauge track, with a view of adopting it in the suburban part of the road should it prove all that was expected of it. The electric equipment was furnished by the Paris Thomson-Houston Company.

The first locomotives used were of a type which resembles the locomotive employed in America on the Baltimore & Ohio Railroad. As the operation of the line under these conditions gave the railroad company a favorable idea of electric traction, it decided to extend the system into the suburbs, and it has just finished the equipment of a standard gauge electric line alongside the other tracks. The new line runs as far as Juvisy, a distance of about twelve miles, in addition to the old portion between the Orsay terminus and Austerlitz or 2.5 miles, making a total of some fourteen miles. The company has added two tracks which are used exclusively for the electric line, thus keeping it separate from the other tracks. The use of the two tracks, allowing the suppression of crossings between the different tracks of the road, permitted them to reserve the two central tracks for the trains of the main lines using steam locomotives. The present arrangement thus gives a track on each side of the main line which is electrically equipped and is used for the suburban trains. Since the new electric branch started running, all the trains of the Orleans line which leave or arrive at Paris to the number of about 200 per day are drawn by electric locomotives over the portion along the Seine between the Austerlitz and the Orsay stations within the city. The suburban trains, which now number about seventy-five, still keep the electric locomotives between Austerlitz and the Juvisy suburban station, a distance of twelve miles, while the trains of



ENGINES AND ALTERNATORS, IVRY STATION, PARIS-ORLEANS ELECTRIC RAILROAD.

Digitized by Google

the main lines change over from electric to steam locomotives at Austerlitz before leaving the city.

The ensemble of the electric plant as it is now laid out for the Orleans line adheres to the same general dispositions which were adapted for the first part of the line along the Seine, namely, the production of three-phase current in the large station which was built some years ago at Ivry to the east of the city, using a number of substations along the line for changing to direct current at low voltage, by means of rotaries working in parallel with batteries of accumulators. The plant which was formerly installed for the road has been considerably modified and enlarged in capacity in order to provide for the extension of the road. The substation which was before located at Austerlitz has now been installed in the central station building at Ivry, while some changes have been made in the eight locomotives of the old type in order to adapt them for the new service. Two new substations form part of the increased plant, as well as eight new traction units comprising electric locomotives and motor-cars of a new type. The work upon the extension of the lines and enlargement of the plant was commenced in 1903 and it has now been entirely completed. This involved considerable difficulties especially as regards the construction of the tracks, as this had to be carried out without interrupting the traffic on the road.

As regards the generating and distributing part of the plant, the system which has been adopted by the Orleans company is laid out as follows: consisting in the first place of the main generating station at Ivry, where three direct-coupled units have been installed. These groups have a capacity of 1,000 kilowatts each on an average run, which can be raised to 1,500 kilowatts as a maximum. The station has an outfit of exciters, feed-pumps and different accessories. Besides the generating station, we find three groups of substations; first, a group of three substations for traction; second, a group of three substations for lighting the tracks and different buildings; third, a group of eight substations in which lighting is combined with transport of force by three-phase current.

As to the substations which are used for supplying current for the locomotives and motor-cars, the first is located at the Orsay station and comprises two rotary converters having a capacity of 250 kilowatts each, with a battery of accumulators of 290 cells, furnishing 650 kilowatts at a discharge régime of one hour. The second substation, which is located in the main station building at Ivry, is equipped with two rotary converters of 500 kilowatts each, also a third machine of 250 kilowatts and a battery of accumulators of 600 kilowatts capacity at the same régime as above. The third substation at Ablon is provided with two 500-kilowatt rotaries and one of 250 kilowatts, with a 900-kilowatt battery.

The direct current which is furnished by these substations, 600 volts on the average, is distributed on the one hand to the third rail of the track and on the other to the tracks which are used as the return circuit. The disposition of the third rail has been adapted in the present case to suit the conditions of the track, and thus between Orsay and Austerlitz, or along the old part of the line (2.4 miles), we find the third rail laid between the two tracks. Here the two conducting rails are laid side by side and close together. The return circuit is formed by the four rails of the main track which weighs thirty-eight kilogrammes per metre. On the portion of the road between the Austerlitz station and Juvisy, or 11.5 miles, the third rail which corresponds to each of the two outer or electric tracks is formed of a heavy rail of the Vignole type weighing fifty-four kilogrammes per metre. This rail is reenforced by two counter rails, each weighing twenty-eight kilogrammes per metre, thus making the total weight of the third rail 100 kilogrammes per metre for each track. In this case the return circuit is formed of eight lines of rail, taking in all four tracks, giving 8×38 kilogrammes per metre, as the rails of the two central tracks for the steam locomotives have now been connected in parallel with those of the side electric tracks.

The groups of three substations for lighting which has been previously mentioned uses a direct-current system of distribution at 500 volts, on the five-wire plan. Like the traction stations they receive three-phase current from the main plant at Ivry. In the latter case the substations employ direct-coupled motor-generator sets. The first substation, which is located at Ivry, is equipped with five groups of 100 kilowatts each. Each of the latter is formed of a three-phase synchronous motor working at 5,500 volts, coupled to a direct-current machine of 500 volts. Besides the above sets, there are three equalizing boosters of 20, 40 and 100 kilowatts capacity. The second, or Austerlitz substation, contains only two booster groups of forty kilowatts each, while the Orsay station has three 100-kilowatt direct-coupled sets, consisting of three-phase synchronous motors working at 5,500 volts and direct-current machines giving 500 volts. This plant has also three boosters of forty kilowatts each.

There are also eight substations which are used for lighting and transmission of power. They use three-phase current at twenty-five cycles. These plants include the following three substations: Chevalaret, Vitry and Choisy, which are connected on the line from the Ablon traction substation. Each of them has a normal capacity of thirty kilowatts and they are used for the lighting of the railroad stations and various buildings. The four substations of the Paris shops of the Orleans railroad each have a capacity of thirty kilowatts and are branched upon an underground high-tension cable coming from the main station. Last may be mentioned the substation of the locomotive depot of Paris which is also connected by cable with the Ivry plant. It delivers three-phase current at 220 volts for operating a number of light motors for the different operations of handling the locomotives.

The main generating plant at Ivry is illustrated in the different engravings. One of them shows a view of the boiler room. The coal is brought from the cars into the station yard and is unloaded by hand into a large bunker having a capacity of fifteen cubic yards and after sorting is taken by an inclined chain conveyer to a horizontal conveyer which distributes the coal to the boiler-feeding apparatus, which will be noticed in the engraving. The boiler outfit consists of eight boilers having 186 square metres heating surface, with a superheater of twenty-six square metres surface, and four boilers of 210 square metres surface, also provided with superheaters. The boilers are disposed so as to give about fifty degrees centigrade superheating. All of them are provided with automatic stoking and furnace appliances, with superheated steam-blast. The elevators, conveyers and stokers and grates are operated electrically and a special disposition allows of regulating the speeds of all the different parts. By properly adjusting these speeds, the coal feed and rate of combustion can be made proportional to the load on the machines of the station, and the personnel needed for operating the boiler plant is reduced to a minimum. The cinders which fall from the grates are taken off automatically by means of a horizontal conveyer and a vertical bucket conveyer and are loaded upon the cars. The water feed for the boilers is given by a set of pumps

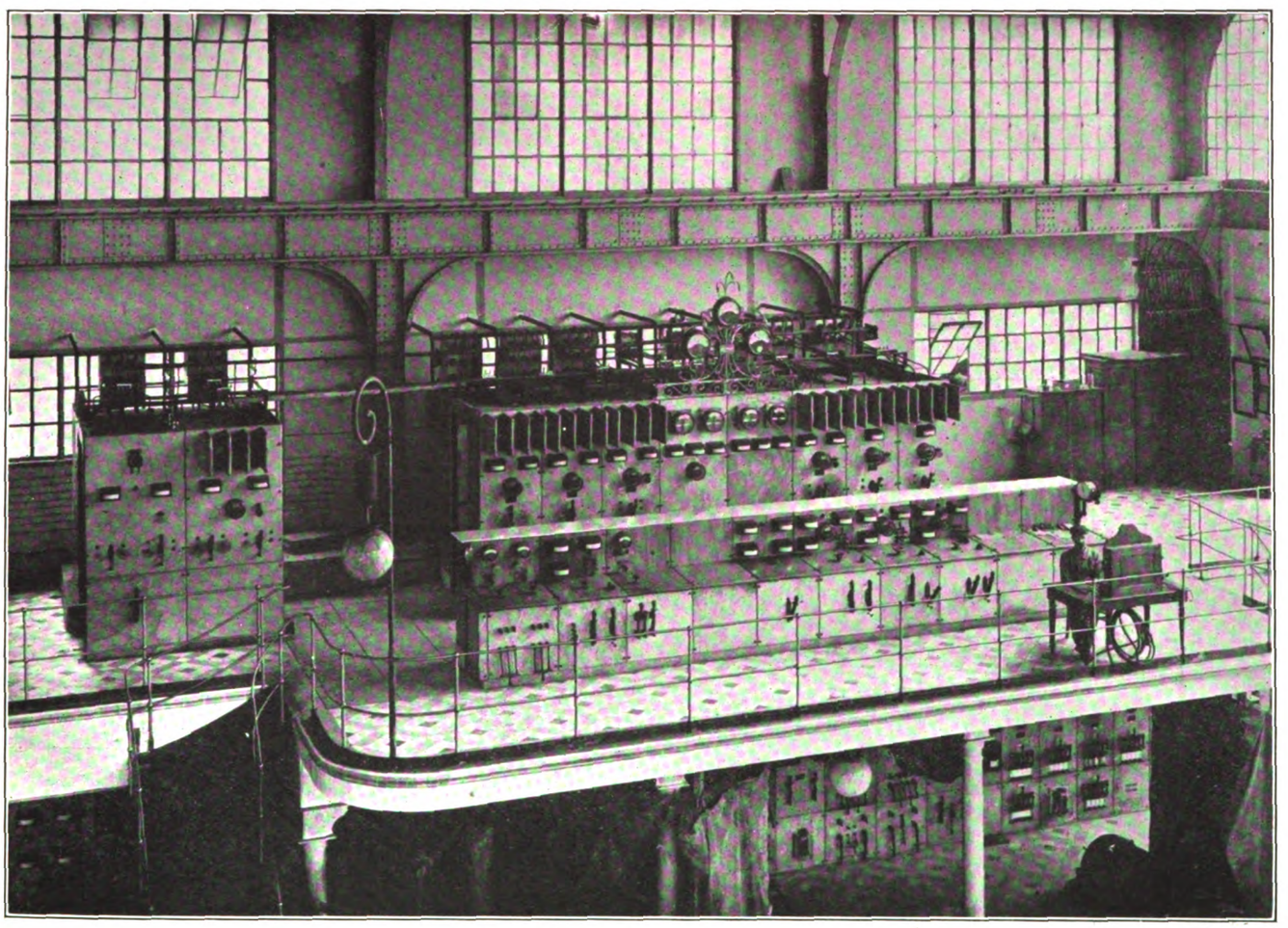
Digitized by Google

which are worked from the main steam engines of the plant, and there are four other pumps which act as a reserve. The feed water is sent through two economizers, one of which contains 400 tubes and the other 448, and comes to the boiler at a temperature varying from 80 to 110 degrees centigrade. The station has two smokestacks 250 feet high and eight feet in diameter at the top which assure an excellent draught and are equipped so as to be worked with a steam blast, if need be. Regulating vanes are placed in the stacks and in the smoke conduits of the furnaces.

which are direct-coupled to vertical high-speed engines. Current can also be furnished by a synchronous motor group, consisting of a 5,500-volt three-phase motor, direct-coupled to a sixty-kilowatt generator.

The main switchboard for the high-potential circuits is illustrated here. It occupies a gallery over the main floor. The present switchboard differs considerably from the type which has been heretofore installed by the Thomson-Houston Company. As will be noticed, the front of the gallery contains the operating switchboard which has the form of a table, the station. Lastly, in the rear of the gallery, is a series of twenty cement compartments which contain the main high-tension switches, the lowering transformers for the measuring instruments and all apparatus from which there might be danger.

The machine and feeder circuits are all connected to two sets of bus-bars for the three-phase high-tension system. The bars are disposed so as to allow all the necessary combinations of circuits, and in case of need it is possible to divide the total load of the station into two parts, one for traction and the other for lighting. This



SWITCHBOARDS, IVRY STATION, PARIS-ORLEANS ELECTRIC RAILROAD.

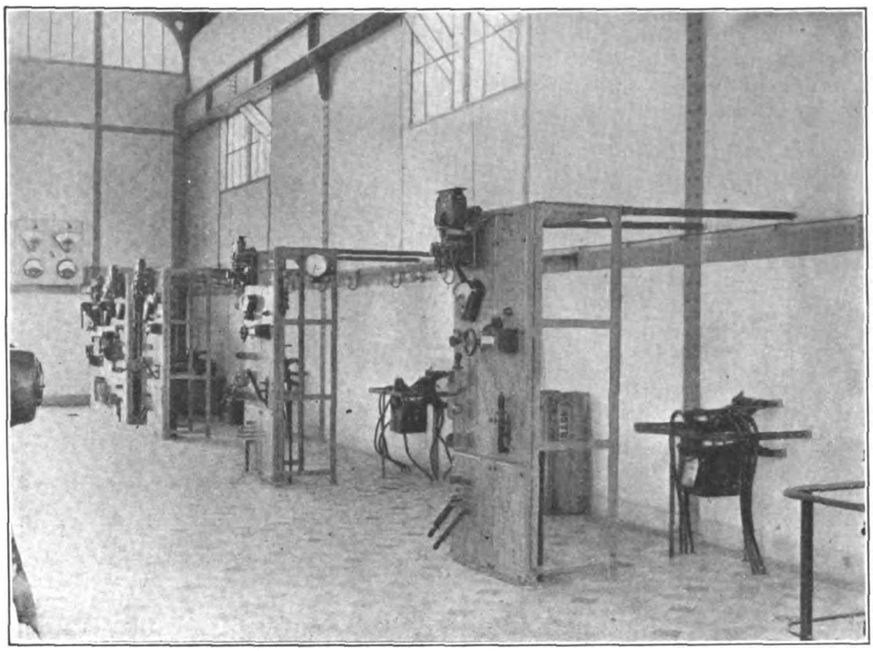
The interior of the main dynamo room is shown in one of the views. It contains three direct-coupled units of 1,500 horse-power each. The engines are of the triple-expansion six-cylinder type. In two of the engines cylindrical valves are used and straight valves in the third. These engines make seventy-five revolutions per minute. On the main shaft is mounted a forty-pole alternator which has a capacity of 1,000 kilowatts and delivers 5,500 volts, three-phase current. The exciting current is produced by two small exciters of twenty and forty kilowatts capacity, upon which are placed all the measuring and operating apparatus for the alternators and exciters. All the parts placed here have a voltage below 150 volts; the high-tension apparatus have been installed in the rear, and these are now operated from a distance.

In the middle of the gallery is the feeder switchboard, which is made up of standard panels of high-tension upon which are assembled all the protecting devices such as fuse plugs or circuit-breakers, also the measuring and working apparatus for the different feeders leaving arrangement simplifies the operation of the plant and makes it especially easy to run the alternators in parallel.

The system of high-tension lines has been well carried out. Four circuits leave the main switchboard. These lines are underground and carry 6,000 volts, three-phase current. The first three lines are used to supply the three traction substations, while the fourth circuit runs to the company's shops inside the city. The circuit from the main station to the Ivry substation is formed of two distinct cables, each of which carries three wires

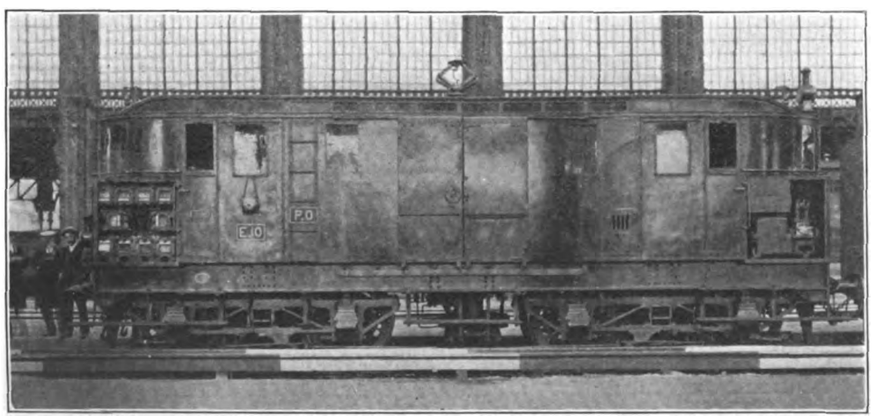
Digitized by Google

of seventy-five square millimetres section. The line running to the second substation at Ablon, 7.2 miles distant, has two cables of three eighty square millimetres wires. These cables are specially insulated by a paper covering ten millimetres thick, which is provided for a working tension of 11,000 volts. The fourteen miles of cable contained in these lines are divided into eight sections by the three transforming cabins at Vitry, Choisy and Chevalaret, where a system of high-tension switches allows of making all the necessary connections of the different cable sections. This arrangement makes it easy to localize faults in case of accident and besides it has the advantage of reducing the inactive part of the cable to one-quarter of the total length of the line. After the underground line was laid a series of tests was carried out on the entire line, using 30,000 volts during one hour, in which case its performance was very satisfactory.



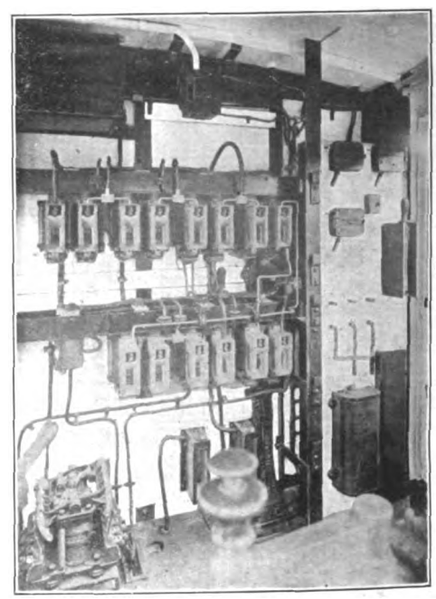
SWITCHBOARD IN THE ABLON SUBSTATION.

Two of the substations which receive the high-tension circuits and supply direct current for the traction lines are here illustrated. The disposition of these two plants as regards the capacity of the machines is practically the same. In each of them we find the following outfits: (1) one triphase rotary converter of 250 kilowatts capacity. (2) Two rotaries connected to furnish three-phase current, giving 500 kilowatts. Each three-phase outfit includes (*a*) one transformer for three-phase current, which is wound for a primary tension of 5,500 to 11,000 volts and a secondary of 440 volts; (*b*) a reactance coil for three-phase current, which is calculated so as to give a good distribution of load between the rotary converters and the storage battery, with a proper lag factor, the latter is 0.9 at the minimum; (*c*) a three-phase compound-wound rotary converter which receives 440 volts on the alternating-current side and delivers 625 volts, direct current. It has a capacity of 500 kilowatts on a continuous run. These rotaries carry a compound winding, and a switch which is placed upon the machine itself allows of connecting in shunt or in direct or inverse compound according to the requirements of running.



THE NEW ELECTRIC LOCOMOTIVE, PARIS-ORLEANS RAILROAD.

In each substation there are two motor-driven air fans which use three-phase synchronous motors of 375 volts and twenty-five cycles. These fans are used for cooling the transformers and reactances. The station contains a booster which is operated by belt from the main machines. It is employed for charging the storage battery and can furnish 800 volts for this purpose. The switchboards of the substations, two of which are illustrated in the figures, are of the standard Thomson-Houston type. The switchboard in the Ivry substation is provided with T-H oil switches and fuse plugs of the blow-out pattern. In the Ablon substation the switchboard carries oil switches of the FK type, with automatic throw. The panels of the direct-current lines are provided with the company's newly designed automatic switch for heavy currents, which can be regulated from 4,000 to 18,000-ampere loads, working at 600 volts.



IN THE CAB OF THE MOTOR-CAR.

The rolling stock which is now in use on the Orleans system includes the old locomotives which have been running on the Paris branch within the city, as well as a number of new ones which have been constructed especially for the new plant.

Digitized by Google

The latter have been running but a short time. There are eight of the old locomotives. Their construction has been described and illustrated in a preceding article. The new locomotive which the company has now adopted is shown in one of the engravings. Five motor-cars have also been built, and one of them is here represented. All the locomotives are equipped with four motors of the G-E 65 type, giving 270 horse-power. The motors are mounted two on each of the bogies. The ratio of gear reduction, which is 1 to 2.23 in all of the old locomotives except one, allows of making a speed of sixty miles an hour with the locomotive running alone, or a speed of forty-five miles an hour with a train of 200 tons on an average. Only one of the locomotives is provided with a speed reduction of 1 to 4.1. This is done in order to allow the locomotive to take a very heavy train at a slow speed, which is sometimes required.

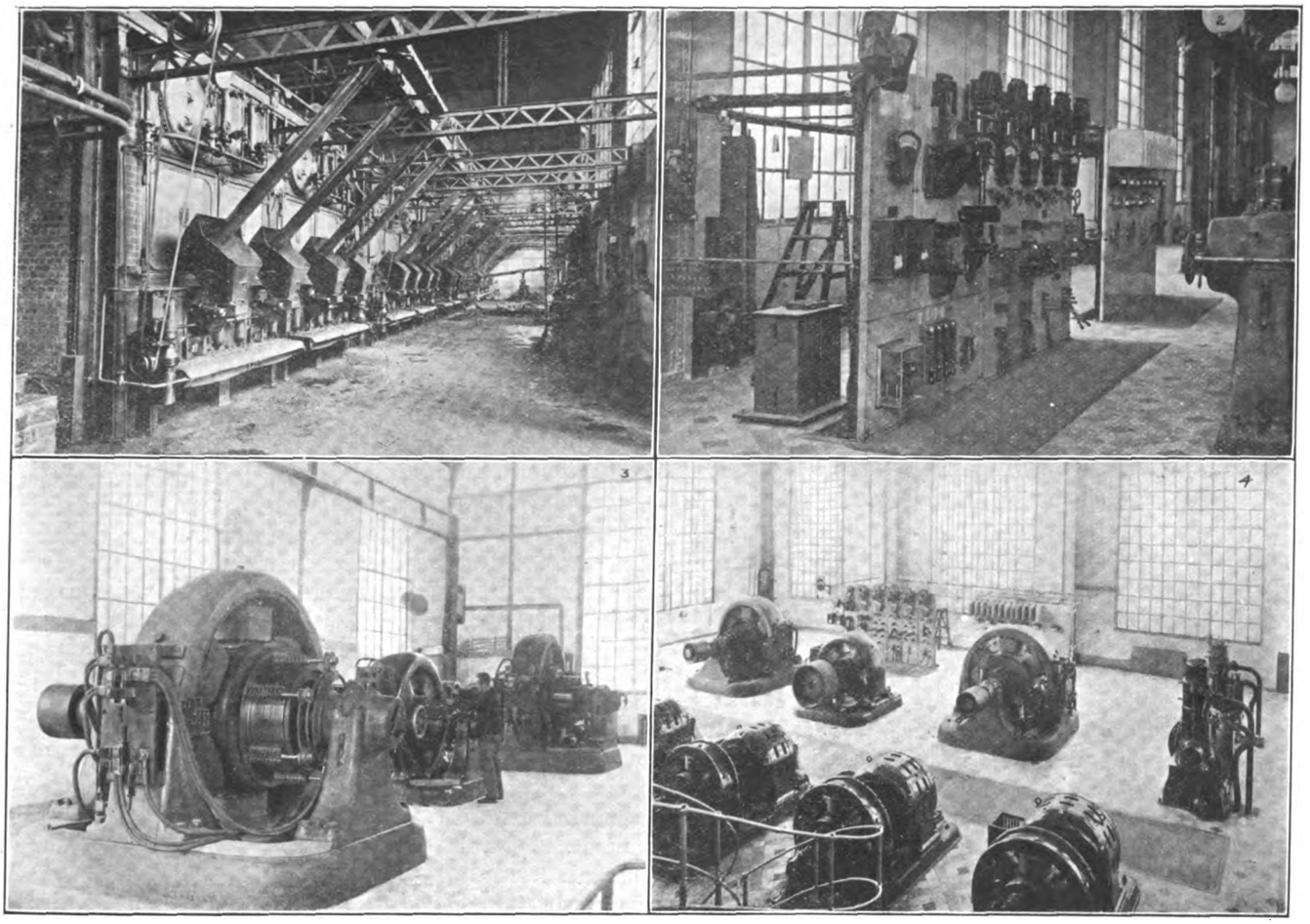
All the locomotives are provided with a special type of controller which permits of coupling the four motors, either in two groups of two motors in series or of two motors in parallel. The main controllers carry out the series parallel coupling of the two groups which are thus formed. As will be observed, the locomotive has a space in the middle which is reached by a double sliding door. Baggage or freight can be carried in this part. A door at the side gives access to the motorman's cab at each end. One feature to be noticed is the arrangement of the resistance coils and other apparatus at the side of the cabin. An exterior panel can be removed and so give ready access to the apparatus.

The principal figures for the new type of locomotive are as follows: weight when empty, fifty-five tons; length over buffers, 11.37 metres; length of car body, 10.2 metres; distance between axles of bogy, 2.39 metres; centre to centre of bogy, 5.64 metres; wheel diameter, 1.245 metres; gear ratio, 1 to 2.23.

The new motor-car is equipped with the well-known Thomson-Houston system of multiple unit control, with the addition of all the improvements in the apparatus which are the result of a long use of the system. There are four motors of the G-E 66 type per car. These motors are built for 125 horse-power. It is found that with two motor-cars per train, the total weight of 200 tons can be taken from Austerlitz to Juvisy in fifteen minutes, without stops. The train can be controlled from either one of the motorman's cabs. In each of these are placed the controllers, reversing switches, rheostats, etc., which form the equipment for controlling the train. A view in the cabin will be observed here, showing the disposition of the apparatus.

Special precautions have been taken in order to avoid fire. The cabins are entirely of metallic construction and fireproofed wood is used for building the car body. All the apparatus has been designed so as to make the operation as simple as possible with the greatest amount of automatic working. The main controllers contain many new features which render them superior to the former types. Special mention is to be made of a relay which is traversed by the current of the motors. It is used to block the controller by working a special brake, in order to prevent an accidental overload upon the motors.

The motor-cars have more than one-half the space for the passengers. The remainder of the space is taken up by a baggage compartment and by the motorman's cab at either end. The main dimensions, etc., of the motor-car are as follows: weight empty, fifty tons; length over buffers, 17.36 metres; length of car body, 16.2 metres; distance between axles of bogy, 1.98 metres; centre to centre of bogies, 12.4 metres; wheel diameter, 1.06 metres; gear reduction, 1 to 3.08.



1.—Boiler Plant at Ivry. 2.—Traction Switchboard at Ivry. 3.—500-Kilowatt Rotaries at Ablon Substation. 4.—Traction Plant at Ivry.

Digitized by Google

Car Equipment of the Single-Phase Railway System.

At the recent annual convention of the Northwestern Electrical Association, held in Milwaukee, January 18, 19 and 20, a paper entitled "The Single-Phase Railway System and Its Possibilities" was read by Mr. Clarence Renshaw. From this the following particulars of the Westinghouse car equipment are taken:

It is not in any advantage in the single-phase motor that the merit of the system lies, but to the use of alternating current. Many of the details of the car equipment are also worthy of notice as contributing their share to this same end.

In order to reduce the trolley voltage to a suitable value for use at the motors, a special form of air-cooled autotransformer has been developed. These transformers are arranged for mounting beneath the car and for being cooled by the breeze created by its motion. In some cases where railway lines are to pass through towns or cities in which a relatively low trolley voltage must be used, as well as through open country where a higher voltage may be used, the transformers are arranged so that the trolley circuit may be brought to either a high-voltage tap or a low-voltage tap by means of a double-throw switch.

Owing to the difficulty of opening circuits carrying large alternating currents, a method of voltage control without the necessity of opening the circuit in going from one voltage to another is desirable. Such a method is offered by the induction regulator. In the arrangement adopted for controlling the speed of single-phase railway motors, the secondary of such a regulator is placed in the circuit between the transformer and the motors. The transformer voltage is adjusted for an intermediate value, and by first opposing and then aiding it with the regulator, any voltage within the capacity of the apparatus can be secured. The regulator also can be stopped and held indefinitely in any given position, so that it is possible to secure a wide variation of running speed with any given condition of load or grade.

As the induction regulator may have a considerable torque, it is not turned by hand, but is rotated by a small pneumatic or electric motor and controlled by means of a master-switch.

The induction regulator, however, does not open or close the motor circuit but merely affords a means for controlling the voltage. A separate switch is therefore provided for this purpose. In order that the current handled by this switch may be as small as possible, it is placed in the primary circuit of the transformer instead of the motor circuit and the switching all done there.

For this service a special type of switch has been developed, which acts as a switch for the ordinary opening and closing of the circuit when power is turned on or off the motors and also opens automatically in case of an overload or short-circuit. The switch is closed by means of a plunger moved horizontally against a powerful spring, by the air pressure; when the air is released, the switch is forced open by the spring. As soon as the switch starts to open (and continuing until it is completely open), a jet of air at full reservoir pressure is blown between the jaws and ruptures the arc which is formed.

For the lower, such as 1,100, voltages the ordinary form of wheel trolley may be remodeled by the addition of extra insulation. For operating with trolley voltages, such as 3,000 volts or more, however, especially with multiple unit trains, it is desirable that some form of trolley be used which can be raised and lowered from inside the car and without the direct handling ordinarily required. To meet this condition, a form of bow trolley has been devised. The trolley consists of two parts, a main framework and a light contact bow hinged to it. This trolley is entirely under the control of the motorman. By admitting compressed air to a pneumatic cylinder he can raise the trolley until the contact bow strikes the wire, and by releasing the air he can allow the trolley to fall flat against the roof of the car. When the air is on, the main frame of the trolley assumes a certain angle with the top of the car, depending on the height of the wire; the contact bow then assumes a position about thirty degrees behind a vertical line from the top of the main frame. With this trolley the car can run either forward or backward with no change, the main frame remaining exactly the same and the contact bow adjusting itself in the proper direction without attention. The contact bow is very light so that it can readily follow any slight variations or irregularities in the wire.

Since the circuit of the main transformer is opened each time the car is stopped, the lights are operated from a similar auxiliary transformer similar in construction to the main transformer. The air-compressor outfit is driven by a small motor of the same type as the main motor, and this is also operated from the lighting transformer.

In equipments with induction control, the various auxiliary devices are operated by means of compressed air and controlled by electropneumatic valves. This arrangement, together with the pneumatic bow trolley, makes these equipments readily adaptable for use in trains with multiple control.

The above description refers in general to equipments aggregating 150 horsepower or more per car. For smaller capacities the method of using loops from the main transformer in connection with a controller located on the car platform is used. As such equipments might often be used on cars not having air-brakes, all of the controlling and protective devices for such equipments have been designed to operate without the use of compressed air.

WEIGHT.

In general, the weight of the single-phase alternating-current motors is approximately the same as that of direct-current motors of the same capacity. The regulator and transformer for a four-motor equipment together weigh approximately the same as a single motor. A complete equipment, including all apparatus, will weigh approximately fifteen per cent more than a direct-current equipment of the same capacity. Since the weight of an equipment usually forms only about one-fourth of the total weight of car, equipment and load; however, a car equipped with alternating-current apparatus should in general exceed the weight of one equipped with direct-current apparatus by less than five per cent.

EQUIPMENTS FOR OPERATION ON BOTH ALTERNATING AND DIRECT CURRENT.

The series alternating-current railway motor, being merely a direct-current motor with certain special features, will operate just as well with direct current at 250 volts, but the controlling and protecting devices will not. As it is usually impracticable to provide duplicate sets of auxiliary apparatus, owing to lack of space under the car in which to mount it, this means that if the car must operate on both alternating and direct current, a compromise must be made and the results on both alternating and direct current sacrificed somewhat in order to be able to operate with both. There are certain essential pieces of apparatus, such as the transformers, etc., which must be entirely cut out of circuit when direct current is used as well as various connections which must be entirely changed when alternating current is used. The switches for making these changes must be carefully interlocked so that all of the connections will be charged simultaneously. All of this add considerably to the cost and complication of the equipment.

Digitized by Google

The Indianapolis & Cincinnati Traction Company.

A Practical Application of the Single-Phase System to an Interurban Railway.

THE Indianapolis & Cincinnati Traction Company began regular service with a car equipped with single-phase motors in the city of Rushville, Ind., on December 30, 1904. It is significant that the parties principally concerned in this development have always been in the front rank of electric railway progress. To the Indianapolis & Cincinnati Traction Company and to President Charles L. Henry and his associates, and to Messrs. Sargent & Lundy, the consulting engineers, belongs the honor due the pioneer in this notable single-phase railway development.

The Indianapolis & Cincinnati Traction Company was organized on February 4, 1903, under the laws of Indiana, to construct an electric traction line from the city of Indianapolis, *via* Rushville and Connersville, Ind., to Hamilton, Ohio, and Cincinnati. The electric equipment of this system was furnished by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and installed under the direction of Sargent & Lundy, of Chicago, consulting engineers. It is interesting to note the association of these names with that of Mr. Henry, when one realizes the prominent part the same interests have taken together in other important steps in the development of electric traction; the first interurban road in Indiana, between Anderson and Alexandria, having been built by Mr. Henry in 1897, the equipment furnished by the Westinghouse company, and the installation made under the direction of Sargent & Lundy as consulting engineers.

The affairs of the company are managed by a board of directors, constituted as follows: Charles L. Henry, Indianapolis, Ind., president and general manager; Ephraim Marsh, Greenfield, Ind., vice-president; William L. Taylor, Indianapolis, Ind., secretary; Endorus M. Johnson, Indianapolis, Ind., treasurer; James W. Fesler, Indianapolis, Ind.; Theodore F. Rose, Muncie, Ind.; William M. Frazee, Rushville, Ind.

The dominant idea in the minds of the originators of this company was to build a double track through line from Indianapolis to Cincinnati, which would take care of the traffic between these two cities in a more satisfactory way than is now done by the steam roads. To this end the company has secured a most desirable private right of way. Where the land is level and there are no considerable fills or cuts, a right of way four rods wide has been purchased, but wherever a considerable fill or cut has been necessary, additional width of right of way has been secured. In all the smaller towns a private right of way has been continued through, and the road is not constructed upon streets or highways except in cities or towns of such size as to make it necessary. In all cases inconvenient curves are avoided, and such an alignment has been secured between cities and towns as will permit of very rapid running, with entire safety to passengers and equipment.

In most instances the right of way is protected by a woven wire fence erected under an agreement with the landowner, whereby the landowner maintains the fence and keeps all its gates closed. Wherever such an agreement was not secured the right of way is fenced with barbed wire. In most cases the deeds of conveyance also provide that the company has a right to cut and keep cut any timber on adjacent lands that might interfere with wires or fencing, or with the operation of the railroad.

Under the provision of the franchises of the Indianapolis Traction and Terminal Company, interurban lines are allowed to enter the city over the tracks of the city company by such routes as the city designates, upon payment to the city company of an agreed or ascertained compensation. The Indianapolis Traction and Terminal Company has made a uniform agreement with interurban roads for entrance into the city over its tracks, whereby interurban roads pay four cents for each passenger carried on the interurban cars while on the city lines, and this entitles them to all of the privileges of the terminal station where all the interurban roads centre.

The Indianapolis & Cincinnati Traction Company has franchises in all of the cities and towns in Indiana through which the line passes, giving to it the most favored franchises within the state. They uniformly run for a period of fifty years, and contain no objectionable provisions regarding the pavement of streets, the erection of iron poles, or the payment of a certain franchise tax to the state or town. The franchises of the cities of Rushville and Connersville permit of running limited cars, making only one stop in each city. In all smaller towns limited cars are not required to stop. The franchises also provide for the carrying of freight, express and mail matter under reasonable regulations of the various cities and towns, so that the company confidently expects a large income from this source. All private rights of way and franchises outside of the cities and towns run in perpetuity.

Leaving the Traction Terminal Building at Market and Illinois streets in Indianapolis, the cars of this company will pass out over Ohio and Delaware streets, Virginia avenue and Prospect street to the city suburbs, and then east until they reach the C. H. & D. Railway. In going out of Indianapolis there are no grade crossings of railroads, all crossings being run overhead or under way. Thereafter, as far as the city of Rushville, the road runs parallel to and north of the C. H. & D. Railway; from the city of Rushville the line runs alongside and to the south of the C. H. & D. Railway to a point beyond Glenwood; from there on it follows almost an air line to Connersville, avoiding the bend of the C. H. & D. Railway and shortening the distance about one and one-half miles. From the city of Connorsville the exact route has not yet been determined, but it will be almost an air line to the town of Oxford, thereby shortening the distance; from there on it follows the C. H. & D. Railway as nearly as possible to the city of Hamilton. The company will build its own line from the city of Hamilton to Cincinnati, unless a satisfactory agreement can be made with the traction companies already running between these cities.

The line has already been constructed between Indianapolis and Rushville, a distance of forty miles, and a through service between these towns has been established. At an early date the road will be extended to Connersville.

ROADWAY.

The construction of the roadway is thoroughly first class and is equal to that of any line in the country. The track is graded in accordance with the best practice for steam roads; cuts and fills being made so as to avoid excessive or frequent grades. Between Indianapolis and a point eight miles east of Rushville—a distance of nearly fifty miles—there is no grade exceeding one and one-half per cent. From that point on toward Cincinnati the country is less level and in some cases

Digitized by Google

straight lines have been preferred, even at the expense of some increase in grade; but with the alignment and grade considered together, greater speed can be obtained with comfort and safety to passengers than on any steam road now running between Indianapolis and Cincinnati. So far as the profile of the road has been as yet determined, the heaviest grade will be four per cent, and it is believed that no greater grade will be necessary on the entire line.

The roadbed is graded twenty-eight feet wide on top for a double track, with slopes on fills and in cuts of one and one-half to one, and upon a grade line that puts the track in most instances above the level of adjacent lands, so as to avoid trouble on account of snow.

BRIDGES.

The bridges across all streams are constructed in the most approved manner, either with concrete arches or steel girders with stone abutments. The upper structures are built of the very best steel construction by the Indiana Bridge Company, of Muncie, Ind., of a capacity sufficient to carry a train of cars with a gross weight of one hundred tons for each car. All abutments are built for double track; the superstructures at this time are laid for one track only. It will be noted that provision is made for the increased demand for size of cars and length of trains likely to come in the near future.

TRACK.

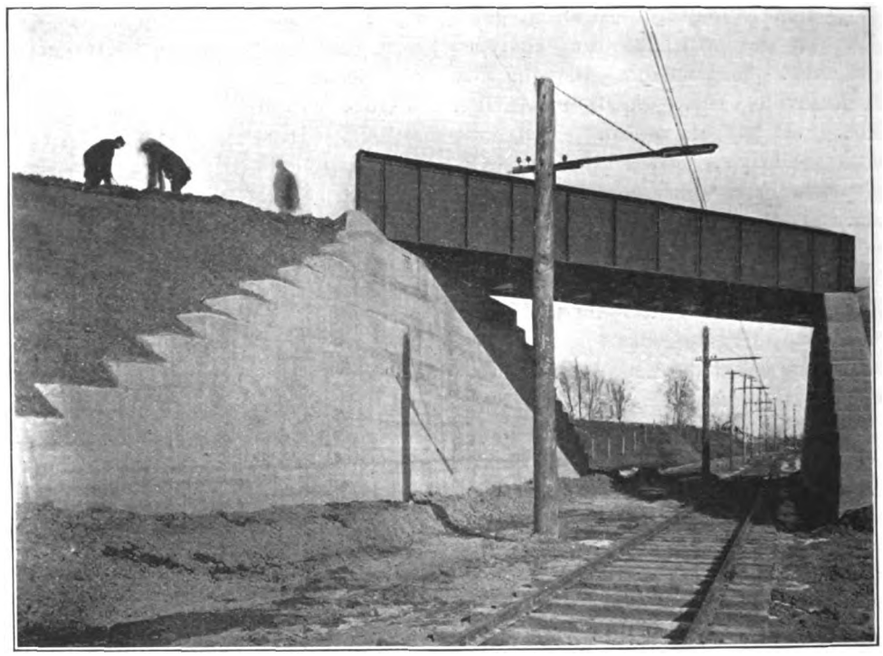
The road is laid with double track in the city of Rushville and on all highways; but on the private right of way, while the grade is prepared for double track, only one has been laid, as a second track can be more conveniently and economically put down later, when a sufficient portion of the road is in operation to require a double track. All ties used are first class (no culls or seconds); white oak, burr oak, and a few chestnuts, six inches by eight inches by eight feet long, 3,280 to the mile. The bridge ties are of long leaf yellow pine.

The track is laid with seventy-pound T-rail, in sixty feet lengths, connected with Weber rail joints, and bonded at the joints with No. 0000 ten-inch copper bonds, with seven-eighths-inch terminals under the plate so as not to be exposed. Cross bonds are put in every half mile and long bonds under all special work. The switches and other special work have been furnished by the Buda Foundry and Manufacturing Company, of Chicago, and are built according to steam railway standards. Turnouts and crossovers are constructed so as to avoid danger of open switches.

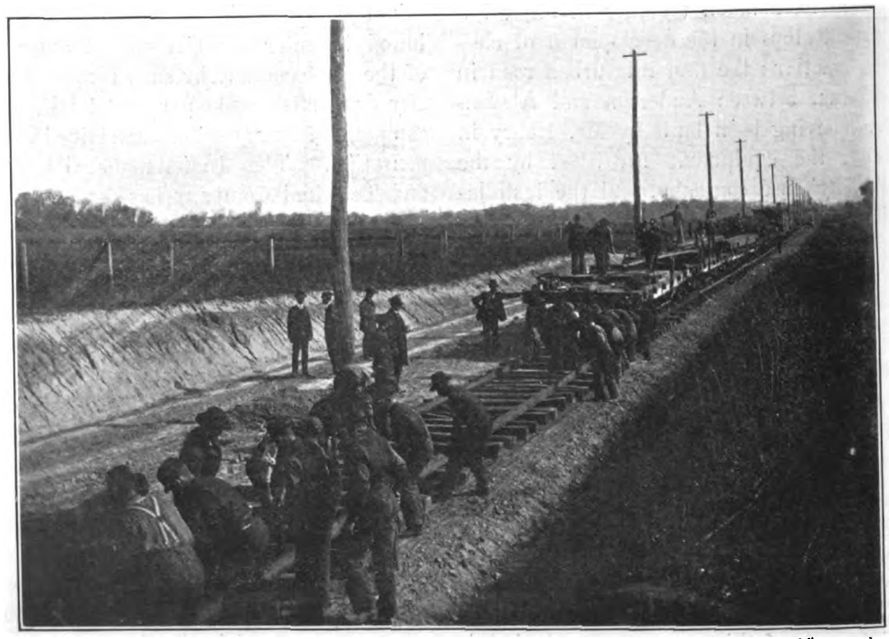
The company has secured a fine gravel pit, located within one-half mile of its main line at Morristown, Ind. The first layer of ballast has been put on the road from Rushville to Indianapolis, and the work will be completed as soon as the weather permits. The road is to be ballasted with gravel eight inches under the ties and level with the top of the rails. In the streets of Rushville, an eight-inch layer of broken stone was placed under the ties.

TROLLEY CONSTRUCTION.

The trolley wire is suspended along the private right of way from poles set in the centre of the grade one hundred feet apart, with a bracket made of angle iron looped at the end, so as to carry a large flat porcelain insulator, over the top of which is run a seven-sixteenth-inch steel strand cable or "messenger" wire. The No. 000 grooved copper trolley wire is carried eight inches under the messenger cable, to which it is attached every ten feet with specially made steel clamps, a construction known as the catenary sus-



OVERHEAD CROSSING OF C. H. & D. RAILWAY ON THE INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.

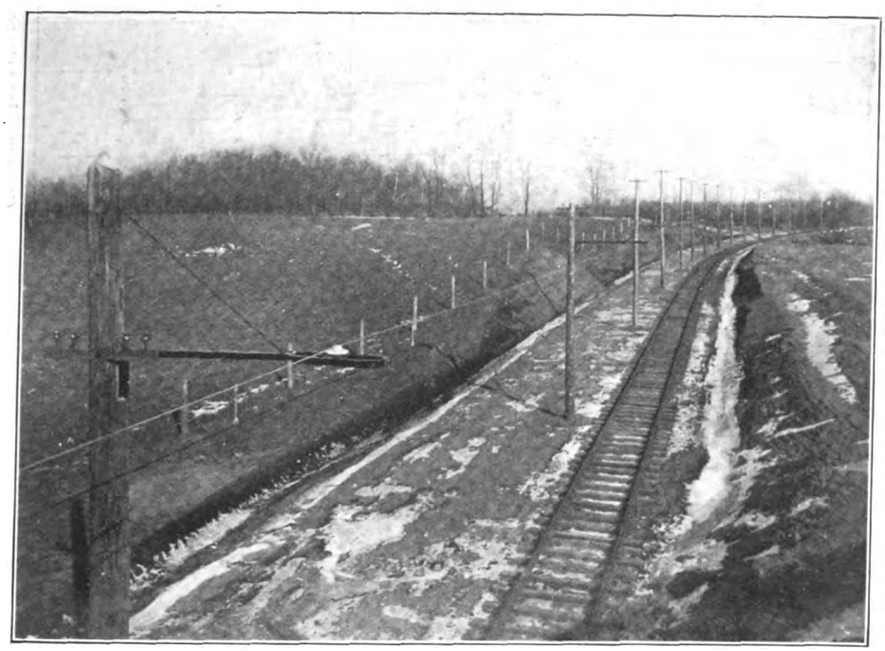


LAYING SIXTY-FOOT, SEVENTY-POUND T-RAIL, INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.

Digitized by Google

pension. The steel messenger wire is drawn tight. With this construction danger from trolley breaks is reduced to a minimum. The insulators are large and strong and are not likely to break, but if they should the steel cable would remain suspended from the top of the bracket. As the trolley is attached to the steel cable every ten feet, breaks will be very infrequent, and if one should occur not more than ten feet of the trolley would be loose. The catenary construction provides a practically level trolley with no sudden bends at the insulators as is found with the ordinary suspension, a point which is of great advantage to fast running cars. The trolley wire is suspended eighteen feet above the top of the rail.

Where the tracks are in the streets, the poles are set on the sides of the streets and the trolley is suspended from span wires. Otherwise the construction is the same as along the private right of way. The overhead material for the entire line construction was supplied by the Westinghouse Electric and Manufacturing Company, according to the design of Sargent & Lundy, consulting engineers.



OVERHEAD CONSTRUCTION, CONDUCTOR, INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.

HIGH-VOLTAGE LINES.

The system of electrical distribution requires transformer stations about ten or twelve miles apart and the alternating current is transmitted from the power-house to these transformer stations at 33,000 volts, single-phase, twenty-five cycles per second, and is reduced and fed into the trolley at a potential of 3,300 volts. The high-tension current is carried from the central power station to the transformer stations on No. 4 bare copper wires, two wires to each transformer station. They make a complete circuit and permit the placing of the circuit-breakers and switches at the central power-house, so as to do away with the necessity of attendants at the transformer stations. The high-tension lines are carried on a separate line of poles set near the edge of the right of way, provided with carefully and strongly constructed cross-arms and equipped with large porcelain insulators on iron pins.

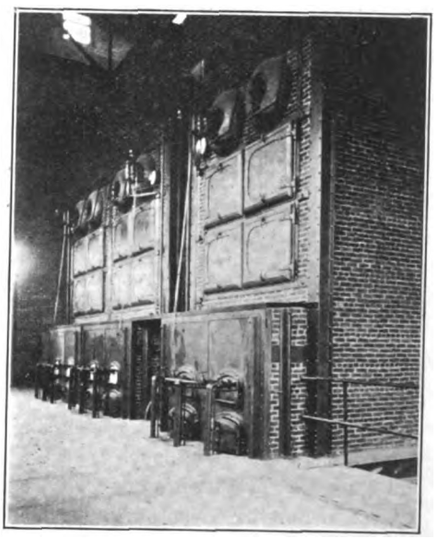
TELEPHONE LINES.

The entire system is provided with two metallic circuit (four copper wires) telephone lines, one of which is used exclusively by the train despatcher. The other line is used for general company business. Each car is provided with a telephone, by means of which the conductor can talk with the train despatcher at fixed points. Jack boxes are placed on the poles at intervals of 2,000 feet, from any of which the conductor of a car or any one else with a telephone can call up to report an accident or for any other purpose. The four telephone wires are carried by porcelain insulators on cross-arms near the top of the trolley poles, and are thus far removed from the high-tension lines. The wires are transposed every 500 feet in order to avoid disturbances from the current in the transmission lines.

POLES.

The poles are all of selected white cedar. Those for the centre trolley construction are forty feet long with seven-inch top. The side poles for the high-tension lines are thirty-five feet long, with seven-inch top. All are set six feet in the ground and are carefully tamped. Along streets on the side where there are no feed wires and the poles are used only to support the span wire, thirty-foot poles are used, while on the other side where the high-tension line runs, the poles are of varying height from forty feet to sixty feet, so as to carry the feed wires above the shade trees. All of the side poles along the streets are neatly shaved and painted and are set in concrete. The tall sixty-foot poles are of Idaho cedar, as smooth and straight as if turned in a lathe. The entire pole line was constructed under the direction of A. A. Anderson, general superintendent of the Indianapolis & Cincinnati Traction Company, and under the

TRANSFORMER STATION, INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.



BOILER PLANT IN POWER STATION OF INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.

Digitized by Google

immediate supervision of Oscar D. Emery, foreman. The work is of such excellent character throughout as to attract the attention of even casual observers, and among experienced linemen it has excited highest praise for its substantial character and artistic appearance.

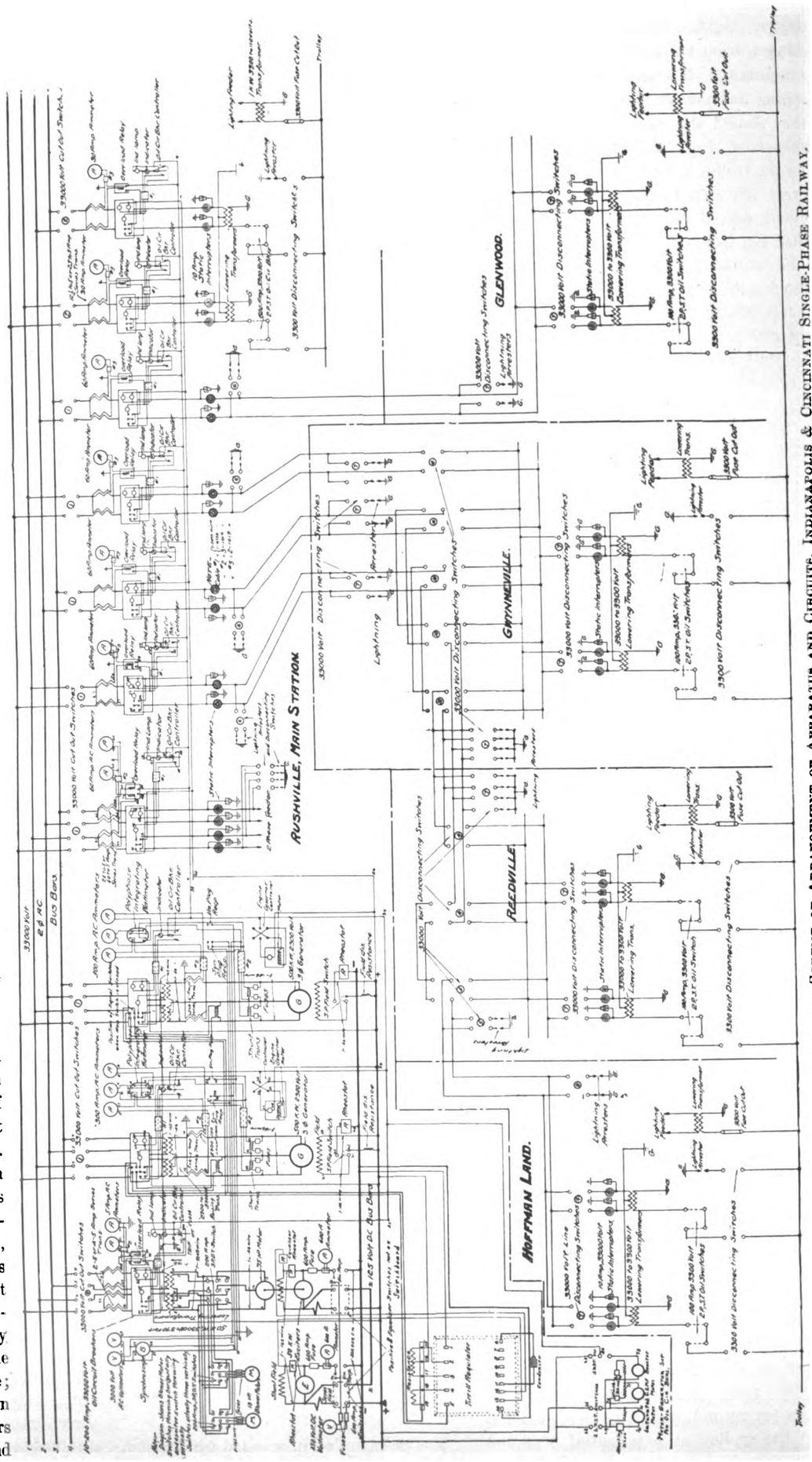
TROLLEY VOLTAGE.

Within the limits of the city of Indianapolis, a distance of approximately three miles, the cars will be run over already existing lines, and will be operated by direct current at 550 volts. Within the limits of the city of Rushville, they will be operated by alternating current at the same potential; on intervening sections the trolley will be fed by alternating current at 3,300 volts, twenty-five cycles per second, single-phase. Thus the first single-phase railway exemplifies the possibility of operating the same equipment from both direct and alternating-current lines and illustrates the voltage flexibility of the system, one of its most advantageous features.

The power station from which it is intended to operate the entire road is located at Rushville. From this plant 33,000-volt transmission circuits are run to the points of transformation and there reduced to 3,300 volts before connection to the trolley.

TRANSFORMER STATIONS.

As has been stated, the road is divided into sections of ten and twelve miles, each of which is supplied with current from a transformer station. Three such stations have been erected between Indianapolis and Rushville, by Pulse & Porter, contractors of Greensburg, Ind. The transformer houses are very small, measuring but twenty-one feet by twenty-three feet, but are carefully and substantially built. The foundations are of concrete; the walls are of brick laid in cement mortar; and the floors for both the first and second stories are of concrete upon



DIAGRAMMATIC REPRESENTATION OF THE SCHEME OF ARRANGEMENT OF APPARATUS AND CIRCUITS, INDIANAPOLIS & CINCINNATI SINGLE-PHASE RAILWAY.

Digitized by Google

steel beams. The roof is built upon concrete base. The doors and windows are provided with steel shutters, and the whole structure is made thoroughly fireproof and can be closed and left alone with safety.

In each of the transformer stations there are at present installed two 300-kilowatt, oil-insulated, step-down transformers, 33,000 to 3,300 volts. Space has been provided for an additional transformer of the same capacity. On the second floor of each transformer station there are installed the lightning arresters and disconnecting switches. There are no automatic switches of any type in these stations, as they are controlled only through the switchboard in the power station. There is nothing at the station which requires constant attention and only occasional inspection will be necessary. This does away with the expense usually incident with substations amounting to the wages of three men at each substation. The total annual saving on the ten transformer stations between Indianapolis and Cincinnati in wages alone is expected to be $21,900. In addition to this, there will be a large amount saved in the maintenance and repair of machinery.

The entire electrical equipment of the transformer stations was furnished by the Westinghouse Electric and Manufacturing Company, and was installed under the supervision of Sargent & Lundy. The disconnecting switches were made from a design specially prepared for this service by Sargent & Lundy.

The power-house serves as an additional transformer station, and contains two 300-kilowatt lowering transformers, wound for 3,300 volts primary and 550 volts secondary circuits, which are used to feed that portion of trolley included within the limits of the city of Rushville.

The accompanying diagram illustrates schematically the general arrangement of apparatus and circuits. The two-phase power circuit indicated is a provision for a four-wire power circuit, which it is proposed to run from the power-house in Rushville to the electric line between Indianapolis and Shelbyville, which is at present operated by direct current from its own power-house through rotary converter substations and direct-current railway motors. It is expected at an early date to operate this branch also from the central power station in Rushville.

POWER STATIONS.

The power-house, which is located at Rushville, Ind., is a strictly fireproof building of brick, concrete and steel, with rooms well lighted and skilfully arranged for future addition and enlargement. The site is adjacent to the C. H. & D. Railway with a connecting track from that road to the company's track alongside of the power station. The boiler room occupies one side of the building and is at present equipped with three 350-horse-power Babcock & Wilcox boilers. Natural gas is now being used for fuel, but provision is made for the burning of coal, if at any time the supply of gas becomes insufficient. The engine room occupies the other side of the building and is separated into two parts by a heavy brick partition. In the main room are installed the two generators, each of which consists of a 500-kilowatt Westinghouse revolving field alternator, twenty-five cycles per second, direct-connected to a 700-horse-power Corliss type, cross-compound, condensing engine, built by the Fulton Iron Works, of St. Louis, Mo. Both engines and generators are designed for an overload capacity of fifty per cent. Each engine is equipped with an independent jet condenser, made by the Dean Brothers Steam Pump Works, of Indianapolis, which take their water from an underground tunnel connecting to a large mill-race. Two pairs of 250-kilowatt air-blast transformers are arranged to change the current which comes from the generator at 2,300 volts, three-phase, to 33,000 volts, two-phase, for transmission to the transformer stations along the line. Air for these transformers is supplied by two motor-driven blowers. The generator field is excited by direct-current generators, one of which is direct-connected to an alternating-current, type C, Westinghouse induction motor; the other to a Westinghouse compound steam engine. The marble switchboard controlling-panels are also located in this main engine room, and the controlling apparatus is installed in the other portion of the building which is known as the high-tension chamber. The main bus-bars are located in the basement and are supported upon a masonry structure and separated by barriers of alberine stone.

The power-house was built according to plans and specifications of the consulting engineers, Sargent & Lundy, and all of the equipment was purchased under their specifications and installed under their supervision.

CAR SHOPS.

The car shops are located near the power station. The entire building is 205 feet by 104 feet, and is divided as follows: offices and waiting room for train crews, storerooms, blacksmith shop, car washroom, machine shop, truck repair shop, room for winding and drying armature and field coils and for other electrical work, paint shop and carpenter shop. Six tracks enter the building, each of which is provided with a working-pit. A transfer track runs across the centre of the building. The construction of the building is fireproof throughout, with concrete foundations and floors, brick walls and steel framing. The roofs are made of asphalt, gravel laid upon a cinder concrete base with louvers and skylights, all in steel frames. Concrete partitions are used where brick walls have not been constructed, and there is a Kinnear rolling iron door over every track. The machine shop is occupied with a full equipment of modern tools. Provision is made in the centre for a traveling crane to run the entire length of the building. The building was constructed by Angus Brothers & Company, of Chicago, Ill., and the steel structure was furnished by the Noelke Richards Iron Works, of Indianapolis, Ind., from the plans and under the specifications of Sargent & Lundy. The shop machinery was furnished by the E. A. Kinsey Company, of Cincinnati.

CARS.

The present equipment of the company consists of ten passenger cars, constructed by the St. Louis Car Company. Each car measures fifty-five feet over all, and is divided into three compartments. The first compartment is nine feet ten inches long and is intended to carry baggage. It is provided with doors opening on either side. The cars are intended for single-end operation and space for the motorman is provided in front of the baggage compartment, from which it is separated by a strong railing made of pipe. The middle compartment has a seating capacity for sixteen people and is intended for men desiring to smoke. The third compartment occupies the remaining portion of the car, and has a seating capacity for thirty-eight people.

The car is finely finished in mahogany, has plate glass in the windows and art glass in the ventilators and the upper part of the windows. The car body is mounted on Baldwin locomotive M. C. B. trucks with steel-tired wheels thirty-six inches in diameter, six-inch axle and five-inch by nine-inch journals. Each truck is equipped with two seventy-five-horse-power, single-phase, alternating-current, Westinghouse motors. Cars are equipped with the Westinghouse unit switch system of multiple control, and so may be

Digitized by Google

operated either singly or in trains. The motors are controlled by the rheostatic system and may be operated on either alternating or direct current. Both straight and automatic air-brakes are provided on each car, the straight being used when the cars are run singly, the automatic system when the cars are run in trains. The motors on the present car equipment are geared for a maximum speed of forty-five miles per hour for local service.

Each car is equipped with two trolleys; one of the Union Standard type with trolley wheel, to be used when operating from the direct-current lines in Indianapolis or from the low-voltage, alternating-current lines in Rushville; the second trolley is of the bow, high-speed type, and has been designed for service at 3,300 volts, alternating current.

It is confidently believed that with the high-voltage, alternating-current trolley wire and the sliding contact bow trolley adopted by this company that heavy freight can be hauled advantageously, without experiencing those difficulties heretofore encountered when service of this kind has been attempted on the direct-current system.

GENERAL OFFICES.

The general offices of the Indianapolis & Cincinnati Traction Company are located at Rushville. The office building is a three-story frame structure with slate roof; it is equipped with fireproof vaults, steam heat, electric light and a complete interior telephone system connected with the company's own lines and the commercial line. The building also contains waiting rooms and baggage rooms. The executive offices of the company are located in the Traction Terminal Building at Indianapolis.

OPERATION.

Local cars are operated each way every hour, making stops upon signals at all of the cities and towns and at the principal highway crossings in the country. These cars are all provided with compartments in which baggage and light express matter may be carried. They are designed to run at schedule speed of thirty miles per hour. To properly take care of the through service, additional "limited" cars will be put on the line; each of these will be equipped with four 150-horse-power motors designed to operate at a schedule speed of fifty or sixty miles per hour; as under the provisions of the various franchises they will not have to make any stops in the country or at any of the smaller towns and will only be required to make one stop at each of the larger intervening cities. It is expected that when the road is completed from Indianapolis to Cincinnati these "limited" cars will be able to make the trip from the centre of one city to the centre of the other in three hours' time.

It is the intention at a later date to run two express cars per day in each direction, taking care of the light freight and express business.

This road has been built in every detail with a view to the handling of heavy freight, even to the extent of carrying it in long trains. Whenever, in the intervening cities, short radius curves could not be otherwise avoided, the private property of the inside corner has been purchased and the sidewalks and curbs set back so as to make easy curves and permit the handling of heavy trains.

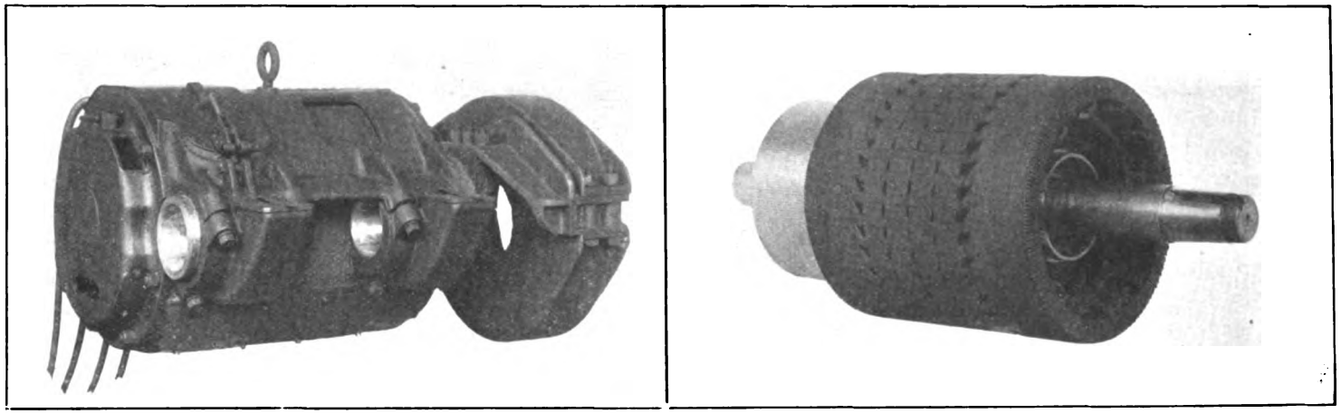
FARES.

An average fare of one and one-half cents per mile is charged by the company for carrying passengers, the road being divided into five-cent sections; no fare less than five cents is charged for any ride. A school children's ticket is issued, good for use one hour before or after school hours. A mileage or sectional ticket is also issued at a reduced rate, giving 160 five-cent rides for seven dollars, a reduction of twelve per cent from the ordinary fare. No other tickets are sold and cash fares are collected on the car.

The company now has its road completed from Indianapolis to Rushville and is arranging to extend the work as rapidly as possible, and expects the road completed at an early date. The road will be put in operation as far as Connorsville as early as possible in the present year.

The most interesting feature of the new installation is the absence of rotary transformer substations and the small amount of feeder copper used. In the trolley line, which is composed of No. 000 copper wire, no feeder circuit is necessary other than the No. 4 high-potential transmission line which carries the current from the power-house to the transforming points.

John W. Moore, chief engineer of the Indianapolis & Cincinnati Traction Company, has been particularly active in the construction of the roadway, bridges and track work. Mr. Arthur A. Anderson, general superintendent of the company, has carefully supervised the entire work of construction and operation. His past experience with the Indianapolis Street Railway and the Mahoning Valley Railway Company, of Youngstown, Ohio, has fitted him in a peculiar way for his present duties.



SEVENTY-FIVE-HORSE-POWER WESTINGHOUSE ALTERNATING-CURRENT SINGLE-PHASE, SERIES-WOUND RAILWAY MOTOR FOR ALTERNATING-CURRENT AND DIRECT-CURRENT CIRCUITS.

New York Electrical Contractors' Association.

The Electrical Contractors' Association, of New York, will hold a dinner at the Hotel Astor, Monday evening, February 27.

Digitized by Google

Incandescent Lamp Manufacturers' Meeting.

On Wednesday, February 8, a party of thirty or more manufacturers of incandescent lamps, members of the Association of Licensed Incandescent Lamp Manufacturers, left New York, *via* the Pennsylvania Railroad for Washington, where they were joined by a party from the West of about equal size. At Washington the entire party embarked on the steamer Washington for Fortress Monroe, where they arrived the following day, some hours late owing to large quantities of heavy ice in the Potomac river. Accommodations had been reserved for the entire number by Charles I. Hills, master of transportation for the association, and everything was done to make the three days' stay of the party a pleasant one, although the sessions of the meetings were carried through uninterruptedly, both morning and afternoon.

This meeting was devoted to the consideration of routine matters and was attended by nearly all of the companies operating under licenses granted by the General Electric Company for manufacturing incandescent lamps under its patents. One manufacturer said it embraced ninety-nine per cent of the entire production of lamps in the United States.

The last session was ended Saturday afternoon, in time for the members to catch the evening boat returning to Washington or to make train connections direct from Old Point Comfort.

Those present were E. E. Jackson, actuary, New York; Elmer W. Gillmer, Warren, Ohio; J. C. Fish, Shelby, Ohio; A. C. Garrison, St. Louis, Mo.; Charles Munder, Springfield, Mass.; C. J. Purdie, New York; J. Camp, Hartford; Charles I. Hills, New York; H. S. Ferguson, St. Louis; A. D. Page, Harrison, N. J.; J. B. Fay, Harrison, N. J.; H. H. Geary, Fostoria, Ohio; Joseph Insull, Pittsfield, Mass.; M. H. Nason, Cleveland, Ohio; H. B. Van Zwoll, Chicago, Ill.; E. H. Houghton, Chicago, Ill.; A. R. Hall, Denver, Col.; O. L. P. Sawyer, Cleveland, Ohio; E. T. Francke, Owensboro, Ky.; L. Lobenthal, New York; Col. E. E. Nash, Warren, Ohio; Frank A. Poor, Danvers, Mass.; D. E. W. Cushing, Boston; J. W. Holloway, Warren, Ohio; J. B. Estabrook, Ravenna, Ohio; Henry Hastings, Boston; Senator Willard Howland, Boston; George H. Smith, Boston; R. W. Morgan, New York; William Gilmore, Boston; A. H. Jackson, Harrison, N. J.; H. W. McCandless, New York; H. J. Jaeger, New York; Frank S. Terry, New York; J. Robert Crouse, Cleveland; N. L. Norris, Youngstown, Ohio; William Coale, Warren, Ohio; Glenn C. Webster, Warren, Ohio; W. D. Packard, Warren, Ohio; R. E. Pew, Warren, Ohio; J. C. Wormley, New York; Guy V. Ward, New York; A. H. Harriman, Middletown, Mass.; F. P. Wilcox, Harrison; E. Irving, Toronto; H. H. Albert, Niles, Ohio; G. F Morrison, Harrison, N. J.; H. M. Van Zwoll, New York; H. E. Plass, New York; H. A. Tremaine, Cleveland.

Several other companies having allied interests were present. Among those were A. H. Patterson, New York; Fred Bissell, Toledo; S. O. Richardson and E. J. Marshall, Toledo; H. A. Hays, New York; F. H. Manchester, Providence; A. B. Haughton, Corning, N. Y.

Also a number of representatives of the several electrical journals, through the courtesy of the association, were with the party on this trip and at the hotel.

Among the several souvenirs of the occasion, the "License Label" brand of cigars provided by the commissary, Charles I. Hills, was so successful, inasmuch as the cigars were well worthy of being consumed, that it is the purpose to have it recognized as a standard brand hereafter.

Meeting of Telephone Men.

Representatives of twenty-seven telephone companies doing business in the Rochester district of the New York State Independent Telephone Association, including the counties of Monroe, Orleans, Livingston, Wayne, Ontario and Yates, met in Rochester, N. Y., on February 2. There are about thirty independent companies in the district. The following officers were elected: chairman, George R. Fuller, Rochester; vice-chairman, H. W. Blake, Naples; secretary, F. S. Bronson, Geneva. The next meeting will be held on May 4.

American Electrochemical Society.

The programme of the annual meeting of the American Electrochemical Society, to be held in Boston and Cambridge, Mass., April 25, 26 and 27, 1905, will include papers from Dr. Henry S. Carhart, Dr. Joseph W. Richards, Dr. W. D. Bancroft, Dr. A. A. Noyes, Professor Blake, Professor H. R. Carveth, Dr. Carl Hambuechen, Arvid A. Reuterdahl and C. G. Richardson. Interesting exhibits will be shown at the convention headquarters, and a number of excursions are being arranged. The hotel headquarters will be the Lenox, Boylston and Exeter streets, Boston, Mass.

Report of New York State Railroad Commissioners on Traffic Conditions in Greater New York.

The New York State Board of Railroad Commissioners has made public its report on the hearing recently given in Brooklyn, relative to the traffic conditions along the lines of the Brooklyn Rapid Transit Company. The commissioners announce their belief that permanent relief can best be obtained by building several tunnels connecting the boroughs. The great length of time, however, necessary to complete these has directed attention to a speedier method of relieving the conditions. It is proposed, therefore, to relieve the present congestion by connecting the Brooklyn and Williamsburg bridges by an elevated structure, with ample platforms for the prompt loading and unloading of passengers, the trains to be run continuously in both directions, at least doubling the present capacity of the approaches to New York trains. From this elevated structure a connection can be made with the Manhattan bridge, when completed; and the report further states that work on the Manhattan bridge should be accelerated.

The board recommends that the city erect loops and a shelter station on the Manhattan side of the Williamsburg bridge. The board also endorses the extension of Flatbush avenue, which will provide an additional artery through the business portion of Brooklyn to the Brooklyn bridge. Commissioner Best's plans for temporary relief at the Manhattan terminals of the Brooklyn and Williamsburg bridges are commended. This work will possibly be finished in July. The board urges that the work of lengthening the platforms of elevated stations, and the enlargement of terminal facilities at the East New York loop of the Brooklyn Rapid Transit Company, be hurried.

Regular Meeting of the American Institute of Electrical Engineers.

The 194th meeting of the American Institute of Electrical Engineers will be held in the chapter room, Carnegie Hall, 154 West Fifty-seventh street, New York city, Friday, February 24, 1905, at 8.15 P. M. The following paper will be presented and discussed: "Two-Motor versus Four-Motor Equipments"; by N. McD. Crawford, general manager of the Hartfort Street Railroad Company, Hartford, Ct.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Progress in the Technology of Lighting.

In the concluding section of an article discussing recent progress in the art of illumination, Dr. W. Wedding, of Berlin, describes some interesting advances, and concludes with a comparison of the performance of different illuminants. He calls attention to the improvement in arc lamps which has made possible the burning of three lamps in series on a circuit, where, a few years ago, but two could be run. The third lamp now takes the place of the regulating resistance. A new lamp, referred to briefly, and which seems to Dr. Wedding to promise well, is the Tito Livio Carbone lamp. It employs two inclined, unimpregnated carbons, arranged as is the case in the flaming arc. By means of a magnet the arc is blown out into hemispherical form. It gives a white light with a green band around the equator. The lamp burns on a potential of ninety volts, and gives a quiet, steady light. The following table gives Dr. Wedding's comparison of the different types of illuminants now in general use: Under A are given the heat and carbon-dioxide given off by one person. In the use of this table it should be remembered that no general conclusions can be drawn. The lights most economical under certain conditions are entirely unsuitable for other purposes, but when everything is fully understood it serves as a valuable guide to the value of the different illuminants.—*Translated and abstracted from the Elektrotechnischer Anzeiger (Berlin), January* 26.

	Intensity of Light in Hefner Candles.		Hourly Consumption.	Hourly Development of Heat. Calories.	Calories per Candle. Per Hour.	Cost of Burning One Hour. Cents.		Hourly Production of Carbon Dioxide. Litres.	Energy Consumption for the Visible Rays per Candle. Watts.
	Horizontal.	Spherical.				Total.	Per Candle.		
Oil	14.8	13.2	43.6 grammes.	480.0	36.4	0.259	0.0197	70.1	0.113×10^{-4}
Gasoline	65.3	42.9	129.0 "	698.0	16 3	0.9	0.0209	119.0	0.0092×10^{-4}
Auer	73.8	52.3	112.3 "	573.0	11.0	0.33	0.0064	59.1	0.018×10^{-4}
High-pressure gas.	303.0	214.0	272.0 "	1387.0	6.48	0.92	0.0043	143.0	
Lucas	581.0	411.0	630.0 "	3210.0	7.84	1.85	0.0045	332.0	0.057
Millenium	1500.0	1060.0	1200.0 "	6120.0	5.77	3.52	0.0033	631.0	
Carbon filament, incandescent	43.8	34.6	104.0 watts.	89.8	2.4	0.99	0.0285	....	0.088
	18.3	12.8	59.1 "	51.0	3.99	0.56	0.0438	....	
Osmium	42.3	31.4	48.7 "	42.1	1.34	0.46	0.0147	....	0.077
Nernst	184.5	113.0	213.0	184.0	1.63	2.03	0.0178	....	0.127
Arc	....	400.0	440.0	380.0	0.95	4.18	0.0105	10.7	0.021 to
Flaming arc	....	1800.0	440.0	380.0	0.2	4.18	0.0021	21.4	0.0047
A	....	....	....	75.0	....	....	....	14.0	....

A New Radioactive Product from Actinium.

An investigation was made recently by Mr. T. Godlewski, to determine whether a substance similar to uranium X and thorium X obtained from uranium and thorium is given off by actinium. Having in mind the similarity of actinium and thorium, both as regards their chemical and radioactive properties, it was determined to try the method of separation used by Rutherford and Soddy for obtaining thorium X. The experiments were at once successful for when ammonia was added to a solution of actinium in hydrochloric acid, the actinium was precipitated, while a small part of very active substance was left behind in the filtrate. This substance is similar in properties to the thorium emanation, and has been designated as actinium X. The product, AcX, immediately after separation was, weight for weight, a hundred times more active than the original actinium. The activity increased on the first day after removal about fifteen per cent of its orginal value, and then decayed with time. The curve of recovery of the actinium is complementary to the curve of decay of AcX. The behavior of the product is completely analagous in all respects to that of ThX, only the constant of change has a different value which is characteristic for AcX. The product, AcX, gives out both α, β and probably γ-rays. There is an interesting point of distinction between the radioactivity of thorium and actinium. After the separation of AcX, the actinium is almost completely inactive, only four per cent of the maximum activity being observed. Thorium and radium, on the other hand, always show a non-separable activity of about twenty-five per cent of the maximum. This points to the fact that the activity of ordinary actinium is due entirely to AcX and its successive products, and that little, if any, is supplied directly by actinium itself. The change from actinium to AcX is a "rayless" change.—*Abstracted from Nature (London), January* 26.

Variable-Speed Motors.

The advantages of shunt control of variable-speed motors are here urged by Mr. C. L. Sumpter. He points out the saving in cost and the greater simplicity of this system, as compared with the multi-voltage systems. Moreover, everything considered, the total cost of operation of the shunt motor is less. The application of these motors to the driving of machine tools is then considered, special reference being made to a five-horse-power motor having a range of from 300 to 900 revolutions per minute, which was directly attached to a vertical planer. On the cutting stroke this motor runs at its slow speed, and at the end of the stroke—the length of which is easily adjusted to suit the work—the motor reverses automatically. As soon as the reversal occurs, the resistance is automatically inserted in the field winding, quickly raising the speed to 900 revolutions for the return stroke. At the end of the quick return stroke, immediately before reversal, the field resistance is short-circuited, providing a strong field for reversing it, and the motor reverses and makes its slow-cutting stroke. The speed of reversal is dependent upon the peak of current which one cares to allow, a rush of current about two and one-half times the full-load current giving an instantaneous reversal, while, if required, the current can be kept practi-

Digitized by Google

cally constant throughout by reducing the speed of reversal. Attention is drawn to the following advantages of this method. The energy in the moving parts is expended in bringing these parts to rest at each reversal. No additional power is required for this purpose. As the gearing may be eliminated and the moving parts reduced to the minimum, the efficiency approaches the maximum possible. There is no sparking at the commutator upon reversal. A smaller motor is sufficient owing to the absence of gearing and the reduced friction losses, because there is no shock upon reversal, and because the mean speed of the motor is high. The ordinary speed variation of the cutting stroke can be used to get the maximum speed of cut for different materials. The reversal of the machine is almost silent. These motors, at starting, develop the maximum torque, and have all the advantages in this respect of the series-wound motor.—*Abstracted from the Electrical Review (London), January 27.*

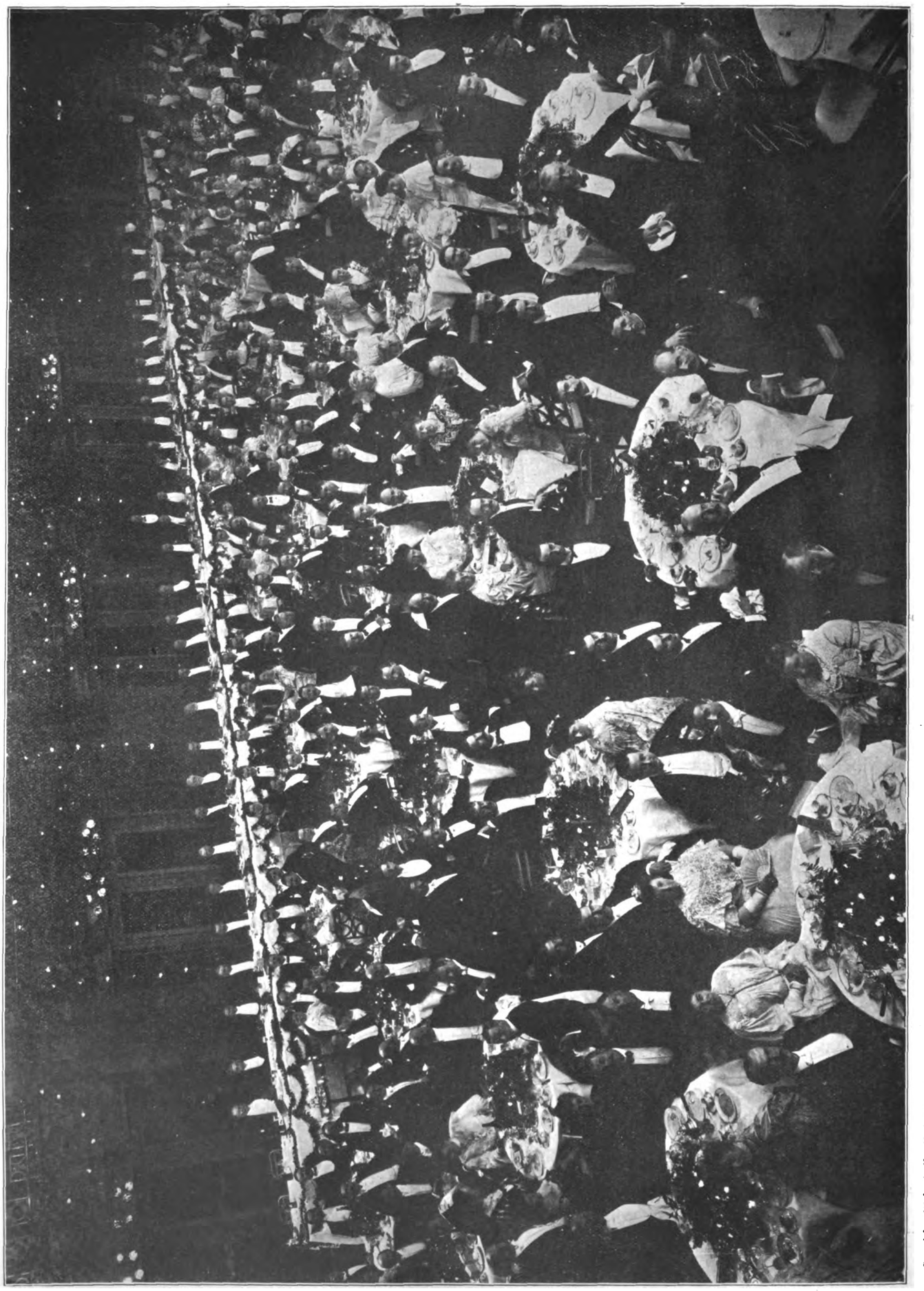
The Diesel Engine in Electricity Generating Stations.

An abstract is here given of a paper read recently by Mr. A. J. Lawson before the Glasgow Technical College Scientific Society. On the advice of the author, a Diesel engine was installed during the winter of 1902 to operate the tramways at Rothsay. During the last winter and at the commencement of the summer traffic it was constantly at work on the tramway service, except on such days in each week or fortnight as steam was got up in order to turn round the steam-engine sets, to keep them in good working order. Notwithstanding the fact that the oil fuel at Rothsay costs twenty-two dollars a ton, and the daily output of the station was only 370 kilowatt-hours, the cost per kilowatt-hour for fuel was about 0.68 cent. The engine is rated at seventy-five brake-horse-power, and is directly coupled to a fifty-kilowatt railway dynamo. Another similar engine was installed to supply the lighting for the carsheds for the Greenock and Port Glasgow tramways. This engine has been in operation since August, 1903, with a nightly output of sixty kilowatt-hours only—that is, with a fifty per cent load-factor. The total works cost for this set is given as 1.34 cents. The results of these two stations being so satisfactory, an engine of 160 brake-horse-power, directly coupled to a 100-kilowatt tramway generator, was installed by the Dudley & Stourbridge Tramways Company, to supply the outlying portion of the network. An official test of this engine gave a consumption of 0.664 pound of oil per kilowatt-hour. The friction load alone consumes 14.5 pounds of oil per hour. The mean consumption is then 0.32 pound of oil per indicated horse-power-hour on steady full load. The cost of the fuel is then 0.334 cent per kilowatt-hour. The City of Birmingham Tramways Company installed, early last year, two 160-horse-power Diesel engines, direct-coupled to 100-kilowatt generators. These sets operate in parallel on a very fluctuating railway load. Notwithstanding this, the engines govern perfectly, and use crude petroleum costing $12.50 a ton. The total works cost for these units is 1.57 cents per kilowatt-hour, which is made up as follows: for fuel, 0.44 cent; lubricating oil, 0.214 cent; engine-room stores, 0.22 cent; water, 0.06 cent; salaries and wages, 0.812 cent; repairs, 0.222 cent. If the load-factor had been twenty-five per cent, the total works cost per unit could have been reduced to 0.964 cent per kilowatt-hour. In the above figures the cost of cooling water is excessive, as the water, after passing through the jackets, was allowed to run to waste. It is now being saved and used over again.—*Abstracted from the Mechanical Engineer (London), January 28.*

Breaks in Overland Telegraphic Communication Due to Storms.

Some of the remedies proposed for preventing the interruption of telegraphic communication brought about by storms are here considered by Mr. William Maver, Jr. As early as 1849 the possibility of the collapse of telegraphic communication was brought to the attention of telegraph officials by a heavy sleet-storm which visited Tennessee, Kentucky, and other states in that vicinity, and since that time hardly a winter has passed during which the telegraph service has not been badly crippled in one section or another by sleet or snow-storms. Various remedies were proposed to avoid this, among them being the laying of underground cables. From an operating standpoint, however, an overland wire is from fifteen to twenty times more efficient than an underground or submarine cable of equal length. For example, an Atlantic cable operated with the apparatus employed in overland Morse telegraph would have a rate of transmission not exceeding two or three words per minute. On cables 400 to 500 miles in length the rate of transmission with ordinary Morse apparatus would not be more than six or eight words a minute. It is only by using the most sensitive receiving instruments that rates of twenty-five to thirty-five words per minute can be obtained in long-distance work; and if receiving apparatus of this high sensitiveness were employed on land lines it would entail using twisted and paired circuits to avoid the effects of mutual induction. It would also involve the equipping of the various offices with the necessary cable apparatus, and the keeping of a staff of expert operators. The agitation for underground telegraph lines has been carried on in Europe as well as in this country. In 1897 the British post-office department began laying an experimental underground line between London and Birmingham, a distance of 113 miles. The total cost of this was $800,000, or approximately $7,000 per mile. To give an idea of the cost of replacing existing overland wires in America with underground cables, it is stated that a conservative estimate of the expense of laying a fifty-conductor telegraph cable between New York and Philadelphia would be approximately $600,000, or $6,000 per mile. This would afford facilities for only twenty-five telegraph circuits, since two wires would be required for each circuit. At the present time there are perhaps 300 telegraph wires on the various pole lines from New York to Philadelphia, so that the suggested cable would carry but a small part of the business ordinarily transacted over overland circuits. Considering the territory traversed by the telegraph pole lines in America, the conclusion is almost inevitable that the placing of all these wires in cables underground is impracticable, owing to the enormous expenses and reduced efficiency of operation that such action would involve. The introduction of underground cables in cities lessens the efficiency of the automatic and quadruplex circuits, as well as of long-distance telephone circuits. The alternative to underground cables appears to be more substantial poles or wires, or to lay comparatively small underground cables between the principal cities of the country, over which the most important business might be transmitted during breaks in the overhead circuits. A lightly armored cable suspended on the pole line might preserve its continuity even when the poles are thrown down. Wireless telegraphy can not be considered as a remedy, for a severe storm would certainly blow down the vertical wires.—*Abstracted from Cassier's Magazine (New York), February.*

Digitized by Google



Copyright, 1906, by the New York Edison Company.

THE ANNUAL BANQUET OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, WALDORF-ASTORIA, NEW YORK CITY, WEDNESDAY, FEBRUARY 8, 1905.
PHOTOGRAPH MADE WITH COOPER HEWITT MERCURY VAPOR LAMPS.

Digitized by Google

STREET RAILWAY HISTORY AND ORGANIZATION.

TWO RESPONSES MADE AT THE RECENT DINNER OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the recent dinner of the American Institute of Electrical Engineers, held at the Waldorf-Astoria, New York city, February 8, emphasis was given to the strides made in electric traction development. In the opening address President John W. Lieb, Jr., said in part:

The past year has witnessed the inauguration of some of the most important electric traction undertakings hitherto projected; we are enjoying the triumph of one of the most important and most successful works of public utility ever constructed and in which electricity plays so important a part—the rapid transit subway. During the year, also, work has been started on the electrical equipment of the great Manhattan terminals of the New York Central and Pennsylvania railroads; the electrification of important sections of the Long Island Railroad is fairly underway; successful tests have been made with single-phase electric railways; the Zossen-Marienfeld experiments have thrown new light on high-speed electric traction; and the powerful electric locomotives of the New York Central have shown their capacity for handling the heaviest traffic at high rates of speed.

The really "ancient history" of the art, as it were, goes back a little further, to the year 1835, when Thomas Davenport, a blacksmith of Brandon, Vt., constructed a crude electric motor with which he propelled a car on a circular track, deriving the current from primary batteries mounted on the car itself.

A few years later Robert Davidson made experiments on a somewhat larger scale in Scotland with a prototype of the modern electric locomotive, while Jacobi was propelling a boat on the Neva, in Russia, with batteries in each case as the source of power. Coming back again to our own country, Professor C. G. Page, of the Smithsonian Institution, under a subsidy from Congress, experimented with electric traction, and in 1851 made a trip from Washington to Bladensberg, five and one-quarter miles, with an electric locomotive equipped with Grove primary batteries and a sixteen-horse-power motor, attaining at times a speed of nineteen miles an hour. Professor Moses G. Farmer had previously made some successful experiments with an electromagnetic locomotive, and in 1851, assisted by Thomas Hall, he exhibited a car carrying passengers at the Mechanics Fair, at Boston, the current supply taken from stationary batteries through the rails.

Passing over the experimental work of Hall, Lilly and Dr. Colton in this country, the scene again shifts to Europe, where Pinkus and Swear in England, and Major Bessole in Italy, made such progress as was possible with the expensive and limited power that batteries could supply, but in many other respects anticipating experimentally the modern trolley, taking current from a wire alongside the rails or from an insulated third rail with return through the track.

About this time one of the indefatigable workers at the problem was C. F. Green, of Kalamazoo, Mich., who made some substantial improvements over previous workers, but could not overcome the difficulties inherent in the use of primary batteries as a source of current.

In 1879, Siemens and Halske, at the Berlin Industrial Exposition, operated an electric locomotive on a circular track about one-quarter of a mile long, a third rail supplying current to the car, which carried twenty passengers, at a speed of eight miles an hour, and this road was really the starting point of modern electric traction.

Just a brief mention of these early pioneers of whom our profession is so justly proud may be appropriate. The early experimental work of Stephen D. Field with electric motors in 1878 to 1879 did not find any practical application to traction until 1880, about the time that Thomas A. Edison built the historic road at his laboratory at Menlo Park, the rolling stock consisting of a locomotive, a freight car, an open car with benches, and the so-called "Pullman." The honor of inaugurating the first commercial electric road for regular passenger service belongs to Germany, the Lichterfeld-Berlin line having been opened to the public May 12, 1881. Then followed the Portrush line in Ireland in 1885, and some years later the Brighton, Blackpool and Bessbrook roads in England; and in 1883 and 1884 the Zauckerode, Mödling and Frankfort roads on the Continent, when a halt took place and further development there absolutely ceased until 1890.

In the United States, on the contrary, this was the beginning of feverish activity; 1883 and 1884, C. J. Van Depoele, Leo Daft and then Bentley, Knight, Henry and Rae made practical application of many of the fundamental principles and characteristic features of construction which are the basis of the modern trolley systems.

Brief mention should be made in passing of the experiments abroad, in London, Brussels and Paris, with cars equipped with storage batteries, with which the names of Julian, Reckenzaum and Elieson are associated, and in this country prior to 1887-1888, in New York, Washington and Baltimore, in which Condict, Mailloux, Reckenzaum and Bagnall took a prominent part.

It is, however, to another characteristically American inventor and pioneer to whom belongs the honor to have first demonstrated that the electric railway could be made to do something more than afford an interesting demonstration of the potency of electric power and the possibilities of electric transportation—a man to whose ability, courage and perseverance we owe the demonstration on a large scale of the practicability of electric traction. I refer, of course, to our honored past-president, Frank Julian Sprague. It required indeed a rare combination of these qualities which are characteristic of American engineers and American engineering methods—audacity, skill, perseverance and a strongly developed commercial sense—to have undertaken in 1887 the contract to electrify a complete railroad system of thirteen miles of track and twenty cars, and with the natural difficulties which the Richmond road presented.

Developments from 1887 to date in the application of electricity to traction purposes were so rapid that to attempt a chronological recital would carry me too far afield, and to merely mention the names of those who subsequently cooperated in this great work would be like counting the stars.

In responding to the toast, "The Broomstick Train," Mr. H. H. Vreeland, president of the New York City Railway Company, said, in part:

Trolley transportation system, from a managerial standpoint, in and about the great city of New York, is one of the most difficult problems that has ever confronted managers of the various properties which are operated in the territory in and about the city. They are called upon, speaking of transportation facilities as a whole, to move some 700 millions of people a year in Manhattan and the Bronx, and over 1,000 millions of people a year in the territory comprised within Greater New York. The problems connected with that are vast and of the greatest importance to the well-being and the orderly conduct of affairs of Greater New York.

Transportation facilities have always been the advance agent of civilization. Stage routes, post roads, canals and railroads have their place. The trolley car has rounded up the work by carrying the best type of latter-day influence to every farmhouse along its line. Man has become accustomed to working miracles. For the nickel the poor man has to-day what the dollars of the nabob could not have secured a century ago. We represent a class of corporations which is more intimately related than any other to the comfort, convenience and success of people who live in cities and towns. Upon the operation of street railways depends substantially everything else that goes on in thickly settled communities, and its value depends generally upon the sufficiency with which the public is served. They have studied and facilitated the public interests and needs, and have put themselves in advance of the development of the territories through which their lines run. At vast expense they have introduced new methods, new machinery, swifter, more frequent and improved accommodations.

The faithful discharge of their obligations requires a continually increasing investment; the constant incurring of new risks. It is not enough that they should meet demands as they exist from time to time, but they should anticipate them. The problem of to-day is not that of ten years ago. The men who ran the property at that time usually owned a large part of its capital stock and dictated its policy with their hands on their pocketbooks. To-day the policy is dictated by men who are technically and scientifically educated in the methods of management, control and operation of these large corporations. The character of the service which is rendered throughout the country, the development which is going forward to-day, now in the hands of men who have little or nothing to to do with the financial questions, is what has perfected the electric railway enterprises.

The interurban road has created a development both from the standpoint of the city and country which is not fully appreciated. We are all prone to look upon the one side with reference to what the interurban road does for the city dweller in scattering population and taking the city person to his suburban town. It is already developed to the extent that the farmers and the suburban dweller have been brought in contact with the activities of city life.

This is the day of association, when men band together for the achievement of every great work, and while one single mind may be the directing agency, in its execution the cooperation and support of a large number is essential to the accomplishment of any great enterprise. Instead of all the luxuries of life and the treasures of art and the gifts of genius being reserved for the gratification of the few, we find that the efforts of all men, whether emperors or kings with absolute and despotic power, or the representatives of a free people, either consciously or unconsciously, are directed to the diffusion of all the benefits which our hign civilization produces and possesses among the masses of men.

In the purely material order, no factor has been more potent in the ennobling and uplifting of the masses of mankind than the development of the railway systems of the world and other means of rapid transportation, and no one agency employed in this development has been more effective than the science of electricity which is your special province, and in no one direction of its application are its results more wonderful than in the railroad world, in which I feel I have a right to take a deep and personal pride. For I may be permitted to say that my personal connection with railroad building and management has taken the widest range, commencing with the simplest tasks and ending with the management of a great system, which, while not covering a very great area of territory, vitally affects the comfort and well-being of the most important section and the most numerous traveling public in the civilized world, and all propelled by the electric energy driven along the simple trolley.

Digitized by Google

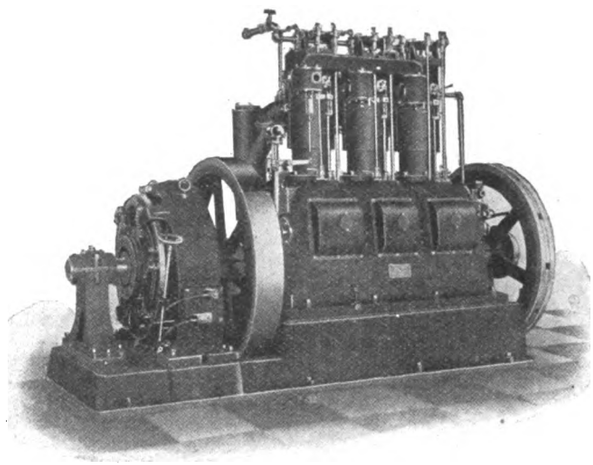
INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Walrath Gas and Gasoline Engines.

The Marinette Gas Engine Company, Chicago Heights, Ill., is the manufacturer of the Walrath gas and gasoline engines. The accompanying illustrations show a seventy-five-horse-power, three-cylinder, direct-connected engine with generator on an extended shaft.

The Walrath engine is built in three styles—one, two and three-cylinder, all of the vertical type. The three different styles embody the same mechanical construction. The base is cast in one piece, is accurately bored to receive the cylinder, crank and cam-shaft bearings, and the bottom is planed level, ensuring perfect alignment of the engine when installed. The main bearings are separate castings from the base, and are all turned up together on an arbor to fit in a corresponding part of the circular bore made to receive them in the base. These bearings are removable without disturbing the crank shaft, and are adjustable for wear. They are lined with genuine babbitt, and in special cases are lined with phosphor-bronze.



THREE-CYLINDER VERTICAL GAS ENGINE, DIRECT-DRIVEN UNIT.

The cylinders are bolted to the top of the base, and fit into a bore made to receive them. This makes possible a perfect alignment and keeps them from getting out of true. Being of the vertical type, the cylinders are free to expand, without the objection of overhanging. They are cast of a special close-grain charcoal iron, and are water-jacketed to prevent overheating. In the multiple-cylinder types the cylinders are cast separate. This is a distinct advantage in this type of engine. If one cylinder is damaged beyond repair, it does not necessitate an entire new set of cylinders.

The cylinder head is fastened to the cylinder with studs of sufficient size and number to ensure a tight joint. The cages which contain the valves are placed within the cylinder head. The company claims a special advantage from this feature, as the valve may be taken out for regrinding or cleaning without disturbing the head or any of its connections; and in the multiple-cylinder type any one of the cylinders may be cut out while the engine is running, permitting a change of valves or igniter plugs without stopping the engine.

The valves are of the poppet type, and are two in number, one for inlet or explosive mixture, and the other for the exhaust. The valves have a positive lift and work vertically. On all sizes above and including ten-horse-power, single-cylinder style, and twenty-horse-power double-cylinder, both valves are placed in cages which fit into the cylinder head. The joint between the cages and head is ground so that to remove either valve is the work of a few minutes. This is done without breaking any water joints or gaskets.

The pistons are of the open-trunk type, and are made extremely long, giving a large surface and bringing the wear on the cylinder and piston to a minimum. The piston is kept tight by six snap rings of cast iron and requires no adjusting. The wrist pin is firmly held in position, and is of case-hardened steel.

The connecting rod of the engine is a steel forging of the eye and strap type. The best quality bronze boxes are fitted at both the crank and wrist pin ends. The boxes are made so as to be easily adjusted for wear. All of the rods are made three strokes in length.

The crank-shaft is made from a solid steel forging of the best quality of open-hearth steel of high tensile strength.

The flywheels are well proportioned to ensure good speed regulation, and in all large sizes have split hubs for convenience in putting them on the shaft and ensuring an accurate fit.

Balance weights are fastened directly to the crank-shaft on the single and double-cylinder type. By placing the balance weights on the crank they are brought as near as possible to the parts to be counterbalanced.

A starting device is supplied on all engines above twenty horse-power, and will be furnished with the smaller sizes if desired. The device is simple in construction and consists of an air-compressor and tank. The compressor is driven from any convenient point—generally from a small pulley placed directly on the engine crank-shaft. It is driven to charge the tank with air pressure from 150 to 200 pounds, depending upon the size of the engine. The pressure is kept stored in the tank until desired for starting. The starter valve is simply a type of piston valve which is operated by a cam and by means of ports making communication between the tank and engine cylinder. The air pressure is transmitted to the engine piston, which moves downward. The starter valve then opens communication between the engine cylinder and atmosphere, which causes the air to be exhausted from the cylinder after doing its work. The engine is caused to go through this series of operations until an explosion from the gases takes place. The air can then be shut off, and the engine will come up to speed with its own fuel.

These engines are adapted to run on natural, artificial, illuminating or producer gas, gasoline, distillate, kerosene or crude oil. The cost of fuel for operating a Walrath engine varies from 0.002 cent to 0.015 cent per horse-power per hour, according to the quality of fuel used and the price. It has been found in practice that approximately 11,000 to 12,500 British thermal units have to be supplied

Digitized by Google

per hour to produce one brake-horse-power-hour.

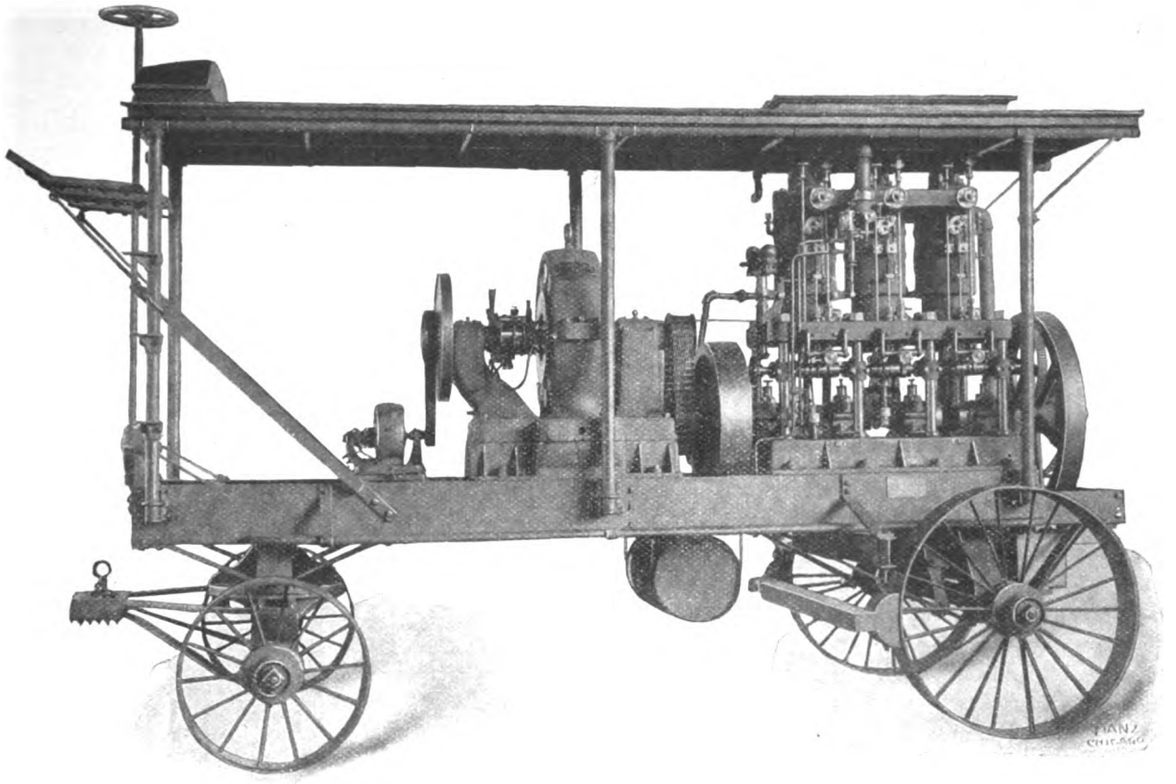
The igniter, which is of course a most vital feature of any internal-combustion engine, is considered by the manufacturer to be complete in every respect. It is compact in form and free from small parts which might break, work loose and cause trouble. The igniter is secured in place by two studs, and by the removal of the stud nuts is made easily accessible. The igniter can be removed without disturbing any other part of the engine, and on the multiple-cylinder type it may be removed and replaced without stopping the engine. This is because of the special construction, which permits of operating any one of the cylinders independent of the others. The igniter consists of a casting holding two electrodes, one of which is stationary and insulated from the main body of the casting. The other electrode is movable, and is operated by a cam which causes it to make and break contact with the insulated electrode. The contact points are of platinum wire, set in a small steel sleeve which may be removed without disturbing the electrodes in the plug if new points are required.

The well-known type of flyball governor is used. This is positive in action and is driven by means of bevel gears. It is made to operate a piston valve which regulates the exact amount of explosive mixture required for each impulse, and to maintain a steady speed under all conditions and variations of load. It controls the volume of mixture in proportion to the load it is carrying. This method of governing gives an impulse every second revolution for the one-cylinder type, and every revolution in the two-cylinder, and every two-thirds of a revolution in the three-cylinder type, irrespective of the load being driven.

The base of the engine forms a reservoir, into which the lubricating oil is placed, so that when the engine is in operation the connecting rod at its lower stroke dips into the oil. The rapid movement of the connecting rod splashes the oil over the working parts in the base, and also the inner surface of the cylinders. Besides this, oil cups are placed on the outside of the base, leading by means of pipes to all the main bearings.

These engines have been designed for general work—thrashing, pumping, sawing wood, or for ordinary power purposes, such as grain elevators, hoisting plants, railway pumping stations, irrigating plants, etc. For electric lighting or other service requiring especially close regulation of speed, the two and three-cylinder types of engine are recommended. For lighting plants of the belted type these gas engines are furnished in sizes from two horse-power to 300 horse-power, and direct-connected outfits in sizes from eight horse-power to 300 horse-power, including engines and generators.

One of the illustrations herewith shows a portable electric lighting outfit, two of which were made for a traveling circus company. These outfits have been in operation for the past two years with excellent results, lighting the circus tents entirely by electricity. The company states that during the first season the lights were out of service for but three or four hours, and during last season but a half-hour was lost by the lights being out of service. The engine is of the open-base type of design, to reduce the weight for portable service, and may be furnished for link belt drive, as is the case in this instance, or direct-connected to a direct-current generator.



PORTABLE GAS-ENGINE-DRIVEN ELECTRIC LIGHT AND POWER PLANT.

Westinghouse Sales Meeting.

The annual meeting of the traveling salesmen of the electric railway and lighting department of the Westinghouse Electric and Manufacturing Company drew about seventy-five representatives to Pittsburg during the week of January 30-February 4, one of the largest gatherings being at the dinner at the Hotel Schenley on Thursday evening. Mr. C. S. Cook, manager of the railway and lighting department, acted as chairman at the various meetings. The general sentiment of the convention was that there were busy days ahead in the electric railway field, the successful wide introduction of the electric motor into suburban traction service in the past few years having brought many of the great railroad companies to an appreciation of the great future of the electric railroad in interurban traffic. The meeting of the week, at Pittsburg, was particularly valuable in the opportunity afforded, not only for a close study of the latest shop developments in new motor types, but also for the discussion of the conditions and problems that have recently been encountered and solved in many important long-distance installations.

Digitized by Google

Electro-Lifting Magnets.

The Electric Controller and Supply Company, Cleveland, Ohio, builds electromagnets for use on cranes, etc. Some of the uses of these magnets are shown in the accompanying illustrations.

Wherever steel or iron is handled in quantities by means of cranes a magnet

ELECTROMAGNETIC LIFTING APPARATUS.

will effect economies in time and labor sufficient to pay for itself in from one to six months. This statement is borne out by experience in steel mills, jobbing houses, safe works, and is evident when the methods, chain versus magnet, are compared.

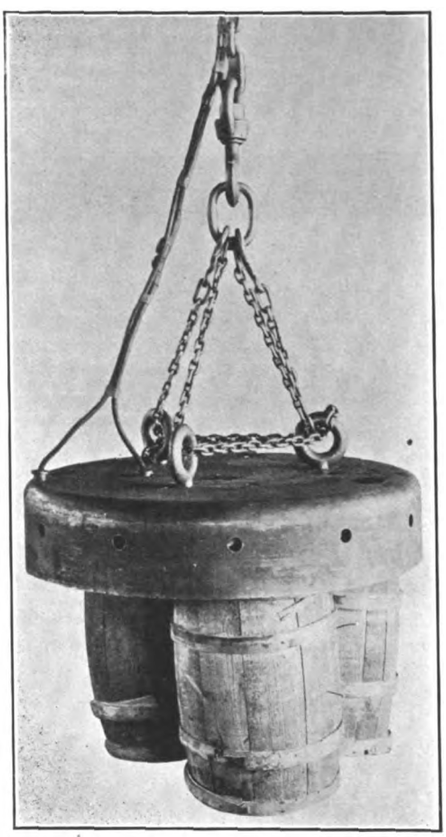
In all cases an electromagnet is used, suspended from the hook of the crane; direct current at any of the common voltages being employed to energize the magnet. A flexible twin conductor cable is used to convey the current to the magnet and a small switch operated by the crane man is usually the only additional apparatus necessary. The amount of current used is small, being from one to twelve amperes according to the service for which the magnet is designed.

In operation, the magnet is lowered upon the material to be lifted, and the switch closed, thus causing the magnet to attract and hold the material, which may then be hoisted by the crane and transported to the desired point. By simply opening the switch the material is instantly released.

Comparing this method of operation with the common methods of connecting the load to the hook of the crane with chains, hooks or clamps, the saving in both labor and time is apparent, as, in general, the attachment of the magnet to the load, as well as the release of the load, may be accomplished by the crane operator without assistance, thus saving the labor of one or more men for prying up the material, attaching hooks and chains at the point of loading and additional men at the point of delivery for unhooking the load from the crane.

Magnets can be so quickly attached to and detached from a load that by their use the work which may be done by a given crane is greatly increased, in some cases more than doubled. It frequently occurs that the attachment of lifting magnets to existing cranes so increases their capacity for handling material that the purchase of additional cranes for handling an increased output is rendered unnecessary.

Again, lifting magnets require much less headroom than hooks or chains for lifting material of considerable width,



ELECTROMAGNET LIFTING BARRELED MATERIAL.

such as plates. Therefore, by the use of magnets, material can be conveniently piled to a greater height in the storage space under a given crane than is possible when chains are used, thus increasing the capacity of a given storage space without altering the crane runway or increasing the size of the building.

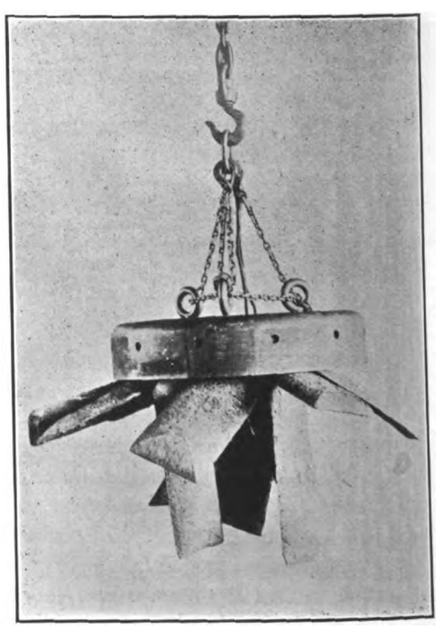
Lifting magnets may be used to great advantage in handling pig iron, scrap, rivets, bolts and similar articles in bulk, as shown in Figs. 1 and 2. Ingots, blooms, slabs, billets, bars, plates, rails, structural shapes, pipe, etc., may also be handled to advantage; Fig. 3 being an example.

The Illinois Steel Company uses fourteen magnets in its South Chicago works alone, and has found that economy in time and labor so substantial that it has decided to use them wherever possible in all its works.

A single design of magnet is not adapted to handling the full range of material above mentioned; on the contrary, the magnet must in every case be designed to meet the form of material to be handled. For instance, there is a wide difference in the design of a magnet for lifting ingots or blooms and one adapted to the handling of thin plates. A magnet which would handle five tons in the form of an ingot might not handle five hundred pounds in the form of thin plates. It is therefore necessary to understand in each case the operating conditions with special reference to the form and range of material to be handled.

The question of risk of accident rises. The Electric Controller and Supply Company, Cleveland, Ohio, reports that in its experience with scores of lifting magnets in successful operation it has yet to learn of a single accident which has occurred through their use; while, on the other hand, accidents due to the slipping and breaking of hooks and chains are known to be of very frequent occurrence.

Magnets are always built and tested to from four to five times the specified load,



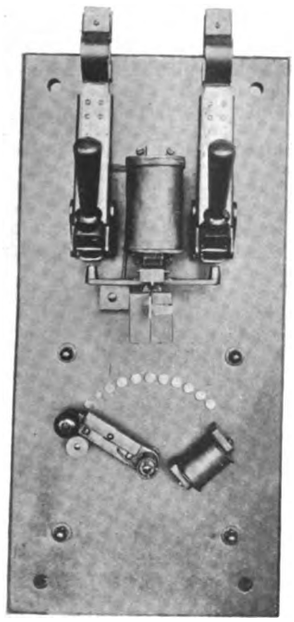
ELECTROMAGNET LIFTING BILLETS.

and in addition to its wide practical experience in the application of lifting magnets, the Electric Controller and Supply Company has at its disposal most complete and valuable data secured through the testing of some forty designs of magnets on a testing machine which it has constructed for this special purpose. Its designs are protected by the well-known Wellman, Clark and Peik patents.

Digitized by Google

Motor-Starting Panels with Circuit-Breakers.

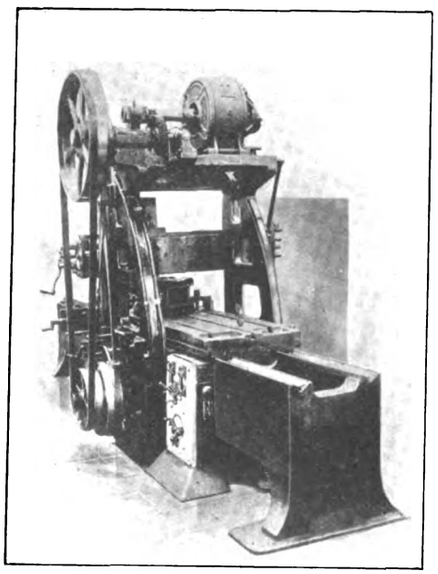
One of the recent changes in electrical practice is the general adoption of switchboard panels containing the control apparatus for individual motors. Before their introduction and in those installations where they are not yet used, controlling rheostats, line switches and protective devices have been mounted in the most convenient place available. The use of a panel ensures the proper mounting of the apparatus and provides a neat and convenient arrangement, with means for mounting in any desirable location.



MOTOR-STARTING PANEL WITHOUT FIELD RHEOSTAT.

MOTOR-STARTING PANEL WITH RHEOSTAT.

The accompanying illustrations show two of the styles of starting panels for direct-current motors designed by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and employing a two-pole type D circuit-breaker instead of the customary switch with fuses. The circuit-breaker is especially adapted for this use, as one pole is connected in each leg of the circuit, the poles closing independently but tripping simultaneously. In closing the circuit, if there is an overload upon the line, the pole first closed opens immediately upon closing the second, thus instantly interrupting the circuit and preventing damage. It is strongly built, with few parts, none of which is small. It is provided with hinged, movable contacts of the brush type, and with carbon tips to which the current is shunted when the circuit is broken, preventing sparking at the contacts. The circuit is fully broken at the contacts before there is any movement of the carbon tips. There are no springs except the strong strip of spring steel which carries the carbons, the blow of the armature tending to open the breaker and not simply to release the moving parts. The device is reliable in its action, and is adjustable for different loads.



MOTOR-STARTING PANEL APPLIED TO MACHINE TOOL.

These panels with circuit-breakers are furnished in two styles; those with field rheostats for motors requiring shunt field regulation for varying speed, and those without field rheostats for constant-speed motors. Since the field and starting rheostats accompany the motors, the price of the panel includes only the mounting of the rheostats.

A starting rheostat with minimum voltage release is generally employed with Westinghouse motors. As soon as the supply circuit is interrupted the rheostat automatically opens the circuit, making it impossible to damage the motor by restoring full line potential to the circuit when the motor is at rest.

The field rheostat ordinarily provided with Westinghouse motors is mechanically strong, and will stand continuously the field current of the machine with which it is used, in any position of the handle. No combustible material is used in its construction.

The slab is of slate, with a dull black marine finish, harmonizing with the black oxide finish of the apparatus. When ordered, brackets are supplied for wall mounting; or gas pipe frames of rigid construction (such as are used upon the Westinghouse type TB panels) are provided for mounting upon the floor. Capacities range from one-eighth to fifty horse-power 110 volts and from one-eighth to 100 horse-power 220 volts. Sizes of panels vary from eleven by twenty-three by one inch to twenty by forty-eight by one and one-quarter inches, according to the space required for the apparatus; in capacities to ten horse-power, 110 volts, and thirteen and one-half horse-power, 220 volts; panels without field rheostats are made with front connections if desired.

These panels are designed in strict accordance with government specifications and answer all requirements of the most rigid inspection.

They are especially adapted for separate machine tool drive, being so designed as to permit mounting directly on the frame of the machine tool driven by the motor, as shown in the accompanying illustrations.

New District Offices of the National Electric Company.

Mr. A. W. Wyckoff has been appointed district manager for the National Electric Company, of Milwaukee, Wis., to operate in Pittsburg and the surrounding territory. Mr. Wyckoff is well known in that section, as he was previously district manager of the Bullock Electric Manufacturing Company, having been, prior to his taking the Pittsburg office, the general superintendent of the Bullock works at Cincinnati, Ohio. He is a graduate of Cornell, and served for some time in the Bethlehem Steel Works. Mr. Wyckoff has secured for the National Electric Company an order for five 300-kilowatt, 120-revolution, engine-type generators for the Carnegie Institute.

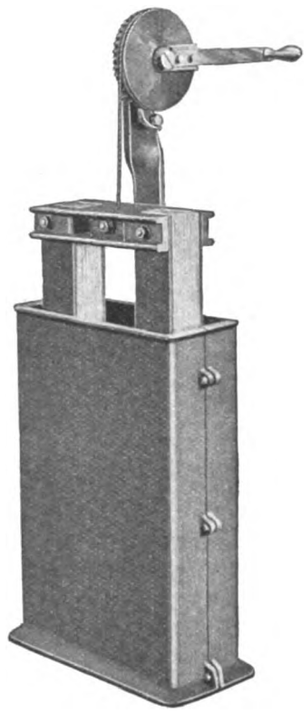
Messrs. Spranley and Reed have been made district managers of the National Electric Company for New Orleans and the surrounding country. Both Mr. Spranley and Mr. Reed are well known throughout the section of the country that they represent, and have for many years been among the most successful electrical engineers of the South.

Digitized by Google

The Peerless Thawing Transformer.

The rapid adaptation of electrical outfits for the thawing of frozen water pipes has created a demand for special transformers, in order to perform this service with the greatest facility. The Peerless Electric Company, Warren, Ohio, has designed an apparatus which eliminates the necessity of constructing a special transformer for this work. Realizing the very many central stations carrying reserve transformers for emergency requirements, the company has designed a regulating or choking coil that may be utilized with any make of standard transformer of sufficient size.

The apparatus consists of two coils of heavy copper bar, having large carrying capacity, in connection with which are two plunger cores of laminated steel. These cores are to be raised from or lowered into the coils for the purpose of either decreasing or increasing the amount of current, as desired, for various sizes and lengths of pipes. The current traversing the pipe is heavy enough to readily heat it to a degree of temperature for thawing purposes, but not heavy enough to cause injury.



TRANSFORMER REGULATOR FOR THAWING FROZEN PIPES.

The regulating coil is well made and simple in its working parts. The windings are given an insulating treatment that renders them waterproof, and they are then encased in a strong iron case. The core is raised and lowered by a simple device operated by a hand wheel with cable and ratchet attachment.

The apparatus is designed to be used with any standard 110-volt transformer, either sixty or 133 cycles, of capacities from ten to thirty kilowatts.

The choking effect of the coil is such that full normal current will flow in the secondaries of the transformer, even though the leads be short-circuited, when the plunger is inserted its full length in the regulator. The coils are equipped with heavy terminals for connecting up the cable leads.

The Cost of Lighting.

At the present time considerable attention has been attracted to New York city, because of an agitation in favor of a municipal lighting plant. Much has been written and said as to economies which might obtain with a city-owned and operated plant. The following communication, which appeared in the *New York Times,* Monday, February 6, presents the other side of the question:

To the Editor of the New York Times:

An article allowed wide circulation in the press of to-day, concerning the cost of electric lighting on the Brooklyn bridge does great injustice—unwittingly without doubt—to the electric light companies of the two boroughs. A characteristic error of municipal bookkeeping is made—the same error Mayor Carter Harrison recently fell into in publishing the cost of Chicago's municipal lighting.

The annual cost of electric light on the bridge structure is placed "in round numbers" at $20,000. But this figure represents labor only; and in this it is $3,937 less than the cost appearing in the *City Record* of September 3, 1904, where the aggregate labor charge for lighting the structure is placed at $23,937. Even this item (for labor alone much in excess of the total cost given for lighting the bridge) includes no administration expenses.

It should be understood also that the cost of fuel, estimated at more than $12,000 annually, and of labor, including firemen in the boiler room, and of removing ashes, are not included and do not appear as an element of cost in the lighting of the structure. Under an arrangement with the Brooklyn Rapid Transit Company, the steam required for operating the electric lighting plant is delivered to the engines without direct cost to the city.

The investment expenses, such as interest, depreciation and insurance, are also omitted. There is no item offsetting the taxes that would be paid by a private company, and the city is not charged with water. Corrected, at least in part, the items of expense should be as follows:

Labor	$23,937
Coal	12,740
Water	1,500
Carbons	1,350
Incandescent lamps	1,980
Repairs, electrical plant	2,000
Repairs, electrical equipment on the bridge structure	1,500
Fixed charges upon an investment of not less than $100,000 for generating plants, original and those now in use, and the electrical equipment of the bridge:	
Interest, 4 per cent	4,000
Depreciation, 7 per cent, allowing fifteen years of active life	7,000
Insurance or its equivalent in the risks assumed by the city, fire and accident, the latter for the public and the employés, 11½ per cent	1,500
Loss of taxes, 1½ per cent on half value	750
Total	$58,257

With these corrections, each arc lamp is costing the city annually $168.94; each incandescent lamp $29.

The article is subject to one further correction; the private lighting companies have offered to supply the Williamsburg bridge with arc lamps for $130; with incandescent lamps for $18 annually, not $146 and $25 respectively, as stated.

Permit me to draw to your attention that in the service of the bridge are no subway or underground costs. The system is entirely overhead. According to ex-Mayor Matthews, of Boston, who made a very careful investigation, the difference between the two methods of supply is nearly $40 annually. Thus, if these lamps were distributed over the city, their total cost would be over $200 annually, as compared with the private companies' price of $146 upon the streets and $130 on the bridges.

Mistake is also made in the statement that the system of lighting on the bridge is superior to that employed by the New York Edison Company—for the two systems are alike. The report that the Edison lamps suffered during the recent blizzard is also erroneous. A city official who was out during the storm for the special purpose of inspecting the lighting, afterward made a statement to the effect that he could not find a single lamp out of service. ARTHUR WILLIAMS.

New York, February 3, 1905.

Central Electric Company's Plant Burned.

The plant of the Central Electric Company, 264-270 Fifth avenue, Chicago, Ill., was destroyed by fire on Saturday, February 11. It is suspected that the fire was of incendiary origin, and an investigation is now under way. The company is having little difficulty, however, in filling all of its orders, its arrangements for reserve supplies being highly efficient and meeting all demands at the present time at its temporary quarters, 209 East Jackson Boulevard.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW SOUTH CAROLINA WATER-POWER PLANT—The Oconee Light and Power Company is to utilize the lower White river falls, at Walhalla, S. C., for the generation of electricity for lighting Walhalla and other towns, and supply manufacturing plants in the vicinity. It is expected that 1,200 horse-power can easily be obtained.

NEW STORAGE BATTERY COMPANY—The Adams Storage Battery Company has filed articles of incorporation at Camden, N. J., with a capital stock of $4,000,000. The company is authorized to purchase and combine various storage battery companies. The incorporators are Henry F. Stockwell, Joseph Tyler and E. G. C. Blakely, of Camden.

NEW ENGLAND TELEPHONE COMPANY ENLARGEMENT—On February 7, in the general assembly at Hartford, Ct., a resolution was offered empowering the Southern New England Telephone Company, of New Haven, Ct., of which Morris F. Tyler is president, to increase its capital stock from $5,000,000 to $10,000,000. It is said that the company is making provision for future development of the telephone business, and is planning for extensions.

ST. LOUIS ROADS IN LARGE CONSOLIDATION—Negotiations are under way between the North American Company and Brown Brothers & Company, for the purchase by the former company of all the street railway systems in St. Louis. The North American Company already has extensive interests in St. Louis, both in street railway and electric and gas lighting plants. It is understood that some $90,000,000 is involved in the purchase price.

NEW HYDROELECTRIC PLANTS IN ITALY—Application has been made by L. M. Ciurlo, a civil engineer of Genoa, Italy, for a concession to use 450 litres of water per second from the Laccio waterfall, in the commune of Tarriglia. He proposes establishing a power plant there for industrial purposes and electric traction. The estimated cost of the works and machinery is $125,000. A similar project is advanced by Curletti and Erba, of Milan, for the appropriation of sufficient water from the Val Paghera and Val Pallobia falls, in the district of Brescia, to produce 7,840 horse-power. The cost of the works and machinery incidental to this concession is estimated at $155,000.

NEW MEXICAN ELECTRIC RAILWAY—A company has recently been organized in Mexico for the purpose of constructing and operating an electric railway from the city of Guadalajara to the town of Patzcuaro, in the state of Michoacan. The company is designated as the Ferrocarril, Jalisco and Michoacan, and is composed of some of the wealthiest Mexicans in the state of Michoacan. The proposed road will be about 200 miles long, the concessions for its construction having been obtained some time ago from the Mexican government. The road will handle freight as well as passenger traffic. The company has a capital stock of $1,500,000.

MISSISSIPPI RIVER POWER PLANT—The Keokuk & Hamilton Water Power Company has been authorized to construct a dam across the Mississippi river at Hamilton, Ill. It is estimated that the cost of the dam, lock and electric power plant that will be installed will be about $5,000,000. The promoters hope to furnish power not only to Keokuk and Hamilton, but to various cities within a radius of seventy-five to one hundred miles. The company is required to build a dam and put in locks sufficient for the present commerce of the river, and to furnish the government drydock facilities. Five years are allowed for the company to begin the work, and it must be completed in ten years.

CHANGE OF OWNERSHIP OF SCHENECTADY RAILWAY COMPANY—The negotiations for the sale of the Schenectady, N. Y., Railway Company to New York Central and Delaware & Hudson interests have been consummated. The formal transfer of the entire property was made a few days ago. It is understood that the purchase price was about $2,000,000, in addition to assuming the bonded indebtedness. The board of directors has been changed so as to make room for some of the new owners. Messrs. Parsons and Peck, of the old board, still remain in the new directorate. Mr. Edward F. Peck remains general manager of the company. The local officials report, it is understood, to Vice-President Culver, of the Delaware & Hudson, at Albany.

THE MUNICIPAL LIGHTING PLANT IN NEW YORK CITY—At the meeting of the New York Board of Estimate, held on February 10, the preliminary report of the commission appointed by Mayor McClellan to prepare plans for a municipal lighting plant was presented. The members of the commission are Dr. Cary T. Hutchinson, Professor George F. Sever and Nelson P. Lewis. The report deals only with plants for lighting the streets, parks and public buildings. The estimated cost of building plants for providing 6,000 arcs and 250,000 sixteen-candle-power incandescent lamps is $4,100,000, exclusive of the cost of real estate. The sites have been decided upon for power-houses, but the locations were not made public, in order that private conferences might be had with the comptroller of the city, and options obtained on the sites. The report states that the total cost of a power station having a capacity of 10,000 kilowatts, exclusive of the real estate, will be $1,250,000. The cost of high-pressure cables, substations and other details for 6,000 arc lights and 250,000 incandescent lamps is $2,850,000. The estimated cost per year of arc lights, including interest on bonds and depreciation of plant, is placed at $75.40. The cost per year of sixteen-candle-power incandescent lamps is fixed at $5.15. The total annual cost of operating the proposed plants is estimated in the report at $906,000. The estimates do not include any cost for the construction of ducts or rental for them. The contention is made that the city has the right to use the ducts of the private subway companies. The general plan suggested in the report provides for a power station for Manhattan and the Bronx, one for Brooklyn and Queens, and a third for Richmond. No reference is made to extending the system for the provision of light for private consumers.

NEW PUBLICATIONS.

COMMERCIAL RELATIONS OF THE UNITED STATES—The department of commerce and labor, Washington, D. C., has issued the second volume of "Reports on the Commercial Relations of the United States with Foreign Countries." This covers the year 1903, and contains consular reports from North America, Central America, the West Indies, South America, Asia, Australia, Oceania and Africa.

ENGINEERING SOCIETIES.

THE FARADAY SOCIETY—The transactions of the Faraday Society for January, 1905, contain the following papers and discussions which they provoked: "Measurement of the Potential of the Electrodes in Stationary Liquids. The Determination of Changes of Concentration at the Cathode During Electrolysis," by H. J. S. Sand; "Electrolytic Oxidation of Hydrocarbons of the Bunsen Series, the Methyl Group," by H. D. Law and F. Mollwo-Perkin; "Recent Investigations Bearing on the Theory of Electrolytic Dissociation," Louis Kahlenberg; "Potential of the Hydrogen-Oxygen Cell," by F. J. Brislee; "The Electric Furnace, Its Origin, Transformations and Applications," by Adolphe Minet; "The Electrolytic Analysis of Cobalt and Nickel," by F. M. Perkin and W. C. Prebble. This is the first issue of the transactions as an independent publication.

Digitized by Google

TELEPHONE AND TELEGRAPH.

EUSTIS, FLA.—The Eustis Telephone Company will increase the capacity of its switchboard.

LINCOLN, NEB.—The Nebraska Telephone Company has just completed a short line north of Havelock.

BUTLER, PA.—The new telephone line between Butler and Pittsburg has been opened for regular business.

LEWISBURG, TENN.—The citizens of Chapel Hill have decided to establish a telephone exchange at that place.

MEXICO, MO.—The Mutual Telephone Company, of Rowena, has arranged to build a telephone line from Rowena to Centralia.

KNOXBORO, N. Y.—The Richmond, Brewer & Madison Mutual Telephone Companies will build a line from Knoxboro to Oriskany Falls.

ACKERMAN, MISS.—The Cumberland Telephone Company has been granted a charter, and will put in a telephone system in Ackerman.

AVALON, CAL.—Direct communication has been established between Santa Catalina Island and Los Angeles by the Pacific Wireless Telegraph Company.

QUINCY, ILL.—The Quincy city council has unanimously voted for an ordinance requiring that in the future all telegraph and telephone wires shall be placed underground.

CONCORDIA, KAN.—The Concordia telephone system has passed into the hands of a new company, of which F. W. Daugherty is president and general manager, and F. J. Hannum, secretary-treasurer.

SPOKANE, WASH.—The Pacific States Telephone and Telegraph Company will install improved telephones throughout the city of Spokane. On December 31, 1904, there were 7,230 telephones in use.

GENEVA, N. Y.—The Clifton Springs Telephone Company has been purchased by the Consolidated Telephone Company, of Buffalo. The Clifton Springs exchange has at present about 100 telephones. The new owner will rebuild the entire system in Clifton Springs.

MIDDLETOWN, N. Y.—At an adjourned special meeting of the directors of the Orange County Telephone Company a contract was signed with the Hudson River Telephone Company, and the Orange County company is no longer affiliated with the independent companies of Orange and Sussex counties.

NASHVILLE, ILL.—The Nashville Rural Telephone Company has been organized. The officers are: president, J. J. Randall; secretary, Christ Buhrmeister; treasurer, Samuel T. McKelvey. The company will erect a system for the benefit of the farmers. Over eight miles of lines have been planned for, and poles, wires, telephones and other equipment have been contracted for.

PORT TOWNSEND, WASH.—The general opening of the Port Townsend-Seattle branch of the Pacific Wireless Telegraph Company's system took place on January 14. The formal opening of the system took place October 17, 1903, when the stations at Port Townsend and Fort Casey were placed in communication. Since then stations have been added at Friday Harbor, and on the revenue cutter Grant. Others are to follow at Victoria, Cape Flattery and points on the Alaskan coast.

MONTREAL, CANADA—The Bell Telephone Company has announced that it will carry on extensive work in Manitoba and the West during the coming year. The plan will include the erection of ten to fifteen central exchanges in the towns and villages not yet occupied, and the opening of twenty to twenty-five toll stations at villages not already reached by the company's lines. Several additional lines will be erected to keep up with the increasing business to points in Dakota, Minnesota and Wisconsin.

PEORIA, ILL.—The annual meeting of the Mutual Telephone Company, of Minier, was held recently, when all old officers were reelected as follows: president, John F. Quigg; vice-president, William Buehrig; treasurer, R. J. Mitchell; secretary, B. F. Quigg; directors, John F. Quigg, C. F. Wullenwaber, R. C. Crihfield, R. J. Railsback and William Buehrig. The company has passed its dividends the past year, putting its earnings and quite an additional sum into betterments, so that the physical condition of the system is excellent.

GRAND RAPIDS, OHIO—The Crescent Telephone Company held its annual meeting at Weston, and elected officers as follows: president, John Bonner, of Weston; vice-president, S. Cottingham, of Deshler; secretary, Azor Thurston, of Grand Rapids; treasurer, W. D. Mudge, of Weston. The company is one of the largest independent companies in northwestern Ohio which operates in small towns, having exchanges at Grand Rapids, Weston and Deshler, with lines extending from these exchanges into the country and all near-by towns.

DES MOINES, IOWA—The Iowa Telephone Company is preparing to construct eight toll lines out of Des Moines, commencing early in the spring. The lines are intended to extend from Des Moines in several directions to the state line, and are to be devoted exclusively to the business of larger towns. Sioux City, Omaha, Davenport, Clinton and Dubuque will probably be terminals of five of the lines, while other lines will probably extend north to Minneapolis and St. Paul, and south in the direction of Kansas City and St. Louis.

ALLENTOWN, PA.—The annual meeting of the stockholders of the Consolidated Telephone Companies was held recently, when the following directors were elected: G. O. Albright, Allentown; George R. Bedford, Wilkesbarre; W. L. Connell, Scranton; Thomas Daugherty, Allentown; F. M. Green, J. P. Helfenstein, Shamokin; C. W. Kline, Alvin Markle, Hazleton; R. E. Wright, Allentown; Isaac Hiester, A. J. Brumbach, W. Kerper Stevens, Reading; W. J. Hartzell, Allentown; A. P. Trautwein, Carbondale, and W. A. Lathrop, of Wilkesbarre.

GLENWOOD SPRINGS, COL.—The Colorado Telephone Company has notified the different exchanges on the western slope of the purchase of the Western Slope Telephone Company, which owns lines extending from Rifle through Meeker, Hayden, Craig, Steamboat Springs and Hahns Peak to Wolcott, a distance of 250 miles. It is understood to be the intention of the purchasing company to put in a new copper circuit over the entire line, and to make it equal to its lines elsewhere in the state. It is said that the company intends to connect from Steamboat Springs with the line which is built into Middle Park from Georgetown by Fred Rockwell and associates about five years ago.

WAPAKONETA, OHIO—At the annual meeting of the stockholders of the Peninsular Telephone Company, of Florida, in which a number of Ohio citizens are interested, the following board of directors was elected: W. G. Brorein, Buckland, Ohio; Guy Huffman, St. Mary's, Ohio; George K. Detweiler, Toledo, Ohio; J. H. Goeke and W. H. Hauss, Wapakoneta, Ohio; W. U. Lathrop, Bradentown, Fla., and J. J. Lunsford, Tampa, Fla. The officers of the company are W. G. Brorein, president; W. H. Hauss, vice-president and secretary; Guy Huffman, treasurer, and J. J. Lunsford attorney. It was decided to enlarge the plants at Tampa and a number of other cities, and to construct more toll lines, including an extension to Jacksonville, Fla.

NEWARK, OHIO—The Newark Telephone Company has elected the following directors and officers: president, Harry Swisher; vice-president, J. C. Brennan; secretary, C. H. Spencer; treasurer, Edward Kibler; E. T. Rugg, W. S. Weiant, J. J. D. McNamar. It is reported that the company now has 75,000 feet of cable strung in Newark, and that the exchange had grown in the past year from 1,203 telephones to 1,811. In the past year $21,038 has been spent in additions to the property, which is valued at $180,000, including the Granville exchange, which is valued at $10,000. Besides paying dividends on common and preferred stock the company last year spent nearly $10,000 out of the earnings in the extension of the plant. By a unanimous vote the stockholders voted to increase the capital stock from $100,000 to $150,000, by issuing $50,000 six per cent preferred stock.

ELMIRA, N. Y.—At the annual meeting of the New York State Telephone Company the following officers were elected: president, W. D. Barnard, of Philadelphia; vice-president, Edward Davis, of Philadelphia; treasurer, E. M. Yarnall, of Philadelphia; secretary, Boyd McDowell, of Elmira; general superintendent, G. B. Wright, of Binghamton. The report of Vice-President Davis showed an increase in telephone connections from 3,617 telephones on January 1, 1904, to 4,231 telephones on January 1, 1905, and an increase in revenue of over $1,000 each month during the year. Besides this increase in the number of telephones at local exchanges the company has completed its long-distance line from Elmira to Owego and Binghamton, and a line from Towanda to Canton, Pa. A new exchange has been established at Endicott, N. Y., where a switchboard is now being installed.

Digitized by Google

PERSONAL MENTION.

MR. FRANK KING, Bristol, Pa., has been appointed superintendent of the Hammonton, N. J., Electric Light Company.

THE HON. LUTHER R. MOORE, of Saco, Me., has been elected president of the York Light and Heat Company, succeeding the late Mr. George P. Westcott.

MR. T. L. ROSE, for several years local manager at Cameron, Tex., for the Southwestern Telephone Company, will go to Yoakum as manager of the company's exchange in that city

MR. FRANK TRUMBULL, of the Trumbull Electric Manufacturing Company, Plainville, Ct., is traveling in South and Central America. Mr. Trumbull has secured a large number of Cuban orders, and reports that business is very brisk in the new territory.

MR. MUNSON D. ATWATER has been appointed district superintendent at Indianapolis, Ind., for the Central Union Telephone Company. His position as local manager will be filled by Mr. W. R. Hirst, formerly superintendent of the Cleveland Telephone Company.

MR. E. J. BURNS, Rock Island, Ill., has been appointed manager of the Rock Island and Moline exchanges of the Union Electric Telephone and Telegraph Company. Mr. H. H. Pratt, who has been manager of the Tri-City exchanges for the past year, will be manager of the Davenport, Iowa, exchange.

MR. FRANK H. HARRIS has been elected superintendent of the street railway and electric light and power system in Anderson, S. C. He was formerly connected with the Birmingham Machine and Foundry Company, and later with the electric light and power department of the Birmingham Railway, Light and Power Company.

OBITUARY NOTICES.

MR. WILLIAM B. COMSTOCK died at his home in Alpena, Mich., February 7, aged sixty-two. He was a prominent lumberman and banker of that town, and was one of the original promoters of the Rochester & Eastern Rapid Railway.

MR. NATHANIEL R. FERGUSON, secretary and treasurer of the Missouri & Kansas Telephone Company, died on January 30, at his residence in Kansas City. Mr. Ferguson was born in New Holland, Ohio, in 1853, and went to Kansas City in 1865 with his father. Since the organization of the Missouri & Kansas Telephone Company in 1882, Mr. Ferguson had been an officer, holding his last position for about five years.

MR. FREDERIC H. CURTISS, contracting superintendent of the Kansas City Home Telephone Company, died at his residence in Kansas City, Mo., on the afternoon of January 29. Mr. Curtiss was a graduate of the University of Minnesota. He was contracting manager of the Twin City Telephone Company, of Minneapolis, until the Home company was started in Kansas City. He was a member of the University, Railroad and Commercial clubs, of Kansas City, Mo.

ELECTRICAL SECURITIES.

Although the market was at various times decidedly irregular during the past week, the values at the close were practically higher than for any week during the present year. The trading is estimated, however, to have been largely professional, and influenced by a desire to attract public attention. In this direction, however, there has been considerable failure of late, as, outside of a demand for high-class investments, the public is neither buying with great activity nor unloading, even though real declines take place. Despite this attitude of aloofness on the part of the public, it is held, in many quarters, that this is not a matter of suspicion, but is rather a disposition to wait until a new boom takes place. The passage of the railroad rate regulation law by the House of Representatives affected the stock market but little, it being the consensus of opinion that, with the early recess of Congress, the measure can not be pushed through the Senate this session. There continued to be indications of expanding industrial prosperity in almost every line. The production of iron for January established a record, in that it amounted to 1,176,500 tons, against the previous best monthly record of 1,713,000 in May, 1903. Railroad earnings have also been showing improvement, and while the gains over last year are not large, they have been general for roads in all sections of the country.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 11.

New York:	*Closing.*
Brooklyn Rapid Transit	62⅝
Consolidated Gas	208¼
General Electric	187
Interborough Rapid Transit	218
Kings County Electric	200
Manhattan Elevated	174¾
Metropolitan Street Railway	122¼
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	190

The results of the operations of the Brooklyn Rapid Transit Company for the year ending December 31, 1904, are as follows: gross, $15,459,660; expenses, $9,261,915, leaving net of $6,197,745; other income, $237,141, making a total of $6,434,886; charges and taxes, $4,961,614; surplus, $1,473,271, as compared with $1,138,217 for 1903, an increase of $335,055. In January, 1905, gross earnings of the system increased $110,000. If earnings are maintained at this rate for the rest of the current fiscal year the system will show gross earnings for the fiscal year ending June 30 next of over $16,000,000.

The report of the Interborough Rapid Transit Company for the three months ending December 31, 1904, shows that the surplus for the last quarter of 1904 was $439,569. A report on transportation for six months states that the number of passengers carried from July 1, 1904, to December 31, 1904, was 155,557,136, an increase of 22,254,345. There were 90,105,066 passengers carried during the three months ending December 31, an increase of 16,245,582 over the same three months the previous year. In the quarterly report the gross earnings were $4,472,855, an increase of $815,145; the net earnings, $2,584,768, an increase of $323,453; the total income, $2,680,781, an increase of $333,068, and the net income, $853,569, being an increase of $103,234. The operating expenses of the road increased $491,692, the total operating expenses being $2,584,768. The net earnings for the six months ending December 31 were $4,448,628, being an increase of over half a million dollars.

Boston:	*Closing.*
American Telephone and Telegraph	142¾
Edison Electric Illuminating	250½
Massachusetts Electric	55¼
New England Telephone	136
Western Telephone and Telegraph preferred	103

Philadelphia:	*Closing.*
Electric Company of America	10⅝
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	10½
Philadelphia Rapid Transit	28⅞
United Gas Improvement	113¾

The board of directors of the Philadelphia Rapid Transit Company has disposed of an issue of $10,000,000 4 per cent bonds at par. They are fifty-year first mortgage bonds upon the property of the Market Street Electric Railroad Company, and are guaranteed by the Philadelphia Rapid Transit Company. There will be turned over to the company for immediate use for the building of elevated and underground lines $5,000,000, and the balance as required from year to year for the extension of the system.

Chicago:	*Closing.*
Chicago Telephone	143
Chicago Edison Light	157
Metropolitan Elevated preferred	61½
National Carbon common	43
National Carbon preferred	113
Union Traction common	13
Union Traction preferred	50

The receivers of the Union Traction Company have secured $400,000 by floating certificates in New York.

Digitized by Google

ELECTRIC LIGHTING.

EDGAR, NEB.—The electric light plant has been completed and placed in operation.

SEATTLE, WASH.—The municipal electric lighting plant has been placed in operation.

LITHONIA, GA.—The Panola Light and Power Company has completed the work of wiring Lithonia for electric lights.

LANSING, MICH.—Citizens of DeWitt have made arrangements with the Lansing & Suburban Traction Company to furnish electric lights for the village.

GOODWATER, ALA.—Arthur Salmon has secured a franchise to install an electric light plant in Goodwater, and hopes to have the town lighted by May 1.

SYRACUSE, N. Y.—Officers of the Syracuse Lighting Company plan an expenditure of over $100,000 for the improvement of their lighting system and the betterment of the service.

WATKINS, N. Y.—The electric light plant of the Watkins Consolidated Gas and Electric Light Company was burned on February 3. Watkins will be in darkness until a new plant is erected.

LOGANSPORT, IND.—At a meeting of the Flora town council a franchise was granted to David Milles for an electric light plant. The contract calls for fifteen arc lights at $80 each per year.

ROYALTON, MINN.—Royalton is soon to commence the installation of an electric light plant, it having just floated $10,000 of bonds for this purpose. The bonds brought $10,371, with ten bidders in the field.

ELLENSBURG, WASH.—Ellensburg is now lighted with electricity from the water-power plant, situated on the river three miles above the town. The new plant has a capacity of 1,000 horse-power.

PITTSBURG, PA.—The People's Light and Power Company, recently organized at McKeesport, has been granted a franchise by the select council of Pittsburg to erect poles and string wires on every street.

CLEVELAND, OHIO—The council has confirmed a contract with the Cleveland Electric Illuminating Company to light the streets at a cost of $73.65 per arc light per year. The total will be over $150,000.

REARDAN, WASH.—J. M. McDowell has begun the work of installing the electric plant for which the Reardan council recently granted him a franchise. He expects to have the town lighted by March 1.

STERLING, ILL.—The Lee County Lighting Company, of which H. C. Higgins is the manager, has acquired the titles and ownership to the dam and hydraulic plant of the Dixon Power and Lighting Company. The consideration is given as $200,000.

BUFFALO, N. Y.—Application for permission to erect poles, lay conduits and wires in the different streets of Buffalo has been asked of the board of aldermen by the Iroquois Electric Light Company, which was recently incorporated by a number of prominent men of Buffalo.

NEW BRUNSWICK, N. J.—The Carteret Electric Light, Heat and Power Company, at a meeting of the stockholders held at Rahway, decided to sell its stock to the Public Service Corporation. The par value of the stock is $100, and the Public Service Corporation paid $150 a share for it, giving a bond issue as payment.

SPOKANE, WASH.—It is rumored that the Spokane Light and Power Company, composed of George Turner, F. P. Hogan, J. C. Williams and others, and which has a franchise in Spokane to lay wires for electric lights, electric heat and electric power purposes, is preparing to take advantage of its franchise and install a system.

STILLWATER, MINN.—The Stillwater Gas and Electric Light Company has amended its articles of incorporation so that money can be raised wherewith to pay off the old bonded indebtedness, construct a new gas works in Stillwater, and take over the property of the Apple River Power Company, which generates electricity for Stillwater. The articles provide that the company can have an indebtedness of $500,000.

TROY, N. Y.—At an early meeting of the Cohoes common council it is understood that the Hudson River Water Power Company will make application for a franchise, with the privilege of constructing a power line to Cohoes, so that it may furnish electric power to Cohoes manufactories. It is understood that the advent of the company in Cohoes is favorably looked upon by many business men, and it is likely that the company will be granted a franchise when it applies for it.

EDUCATIONAL.

BULLETIN OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The bulletin of the Massachusetts Institute of Technology, Boston, Mass., just issued, contains the president's report for the past year, discussing the condition of the institute, and the reports of various heads of departments, together with a number of statistics relative to the work being carried on.

JOHNS HOPKINS UNIVERSITY—The Johns Hopkins University, Baltimore, Md., will hold its annual exercises, commemorative of the opening of the university, on the twenty-second of February. The principal address will be delivered by Dr. William Osler, professor of the principles and practice of medicine. The exercises will begin punctually at eleven o'clock in McCoy Hall.

CATALOGUE OF THE STEVENS INSTITUTE OF TECHNOLOGY—The Stevens Institute of Technology, Hoboken, N. J., has issued its annual catalogue for the year 1905-1906. This contains a large number of half-tone photographs of the buildings, and interior views of the various shops, laboratories and classrooms are also shown. Requirements for admission and descriptions of the courses are given, together with sample entrance examination papers, a list of the students, subjects of theses for the class of 1904, and a complete list of the alumni.

WORCESTER POLYTECHNIC INSTITUTE—The thirty-fifth annual catalogue of the Worcester Polytechnic Institute has been issued. It is a volume of 214 pages, giving full information in regard to entrance requirements, courses of study, equipment, etc., lists of alumni with their present occupation, and similar information. The present catalogue shows that the force of instruction consists of a faculty of sixteen professors and assistant professors, and twenty-one instructors and assistants, besides assistants in the Washburn shops. The student enrolment is the largest yet recorded, being 324. Last June the institute graduated forty bachelors of science in the various courses. It conferred also the degree of master of science upon two candidates, the professional degree of mechanical engineer upon two, that of electrical engineer upon one and the degree of doctor of science for the first time upon one. These degrees are all conferred for work done, since the institute confers no honorary degrees.

UNIVERSITY OF WISCONSIN—The Carnegie Institution, of Washington, D. C., has recently made a grant of $2,500 to Professor C. F. Burgess, of the department of applied electrochemistry of the College of Engineering, University of Wisconsin, to aid him in carrying out investigations upon the properties of pure iron and its alloys. During the past three years, Professor Burgess has developed a method of producing iron electrolytically of a very high degree of purity, in a manner similar to that employed in the refining of copper. Previous to this work pure iron had been obtained only in very small quantities, and at excessive cost, but Professor Burgess is now able to produce comparatively large quantities at a small cost, using for this purpose a cheap grade of steel. Careful analysis of this product fails to show the presence of any foreign element, with the exception of hydrogen, which can readily be driven off by heat. There is already a considerable demand for this iron for scientific purposes, and about half a ton has already been made. The possibility of producing pure iron on a comparatively large scale opens up a very promising line of investigation with reference to the qualities of the pure iron itself, and of any desired alloy with other elements. The importance of this line of research has been recognized by the above-named grant of $2,500 for the current year.

Digitized by Google

ELECTRIC RAILWAYS.

PORT JERVIS, N. Y.—The Intervale Traction Company, which is preparing to build an electric railway between Goshen and Newburgh, has elected H. B. Odell, president; Louis Stotesbury, vice-president; W. Johnston McKay, secretary and treasurer.

PITTSBURG, PA.—The Munhall & Homeville branch of the Pittsburg Railways Company is to be extended for a distance of two miles into Bull Run, Mifflin township. It is announced that the extension will be commenced as soon as the weather permits. There are several hundred families living in the vicinity which the proposed line will traverse.

HUNTINGTON, IND.—The city council of Warren has granted a franchise through the town to the Breed-Shideler interests, which propose to build an electric line from Marion to Warren and there connect with the Portland, Montpelier, Warren & Huntington traction line. The latter road, it is said, has been financed and will be built this summer. The Breed-Shideler interests own the Marion & Wabash traction line, which has been in operation since last summer.

ALLENTOWN, PA.—The annual meeting of the Allentown & Reading Traction Company was held recently at Allentown. These officers were elected: president, H. E. Ahrens, Reading; vice-president, Solomon K. Hoffman, Hamburg; secretary, Asa R. Beers, Mauch Chunk; treasurer and assistant to the president, George B. Schaffer, Reading. Directors, W. D. Mohn, Mohnsville; John M. Kutz, Mahanoy City; P. L. Diener and Frank R. Wagner, Hamburg; Jas. S. Ahrens and G. H. Gerber, Reading.

MEMPHIS, TENN.—The Clarksville Electric Street Railway Company has filed an application for an amendment to its charter, increasing the capital stock from $20,000 to $25,000. It is also sought to change the name to the Clarksville Railway and Light Company. The amendment will likewise authorize the extension of the lines of the company to the Kentucky-Tennessee state line, to a number of other points in adjacent territory and along some of the streets of Memphis now not occupied.

ZANESVILLE, OHIO—Rufus C. Burton, S. A. Weller and H. A. Sharpe, of Zanesville; Frank McCormick, of New Concord; and Samuel Nicholas, of Coshocton, are organizing a company, the object of which is the construction of an electric railway from Zanesville to Coshocton and New Philadelphia *via* New Concord, Adamsville and Coshocton, to connect with the line from New Philadelphia north to Cleveland. It is stated that agents have already procured almost all the required rights of way for the proposed line.

NEW ORLEANS, LA.—Stock and bondholders of the New Orleans Railway Company, of Trenton, N. J., which recently went into the hands of receivers have appointed a committee of five to perfect plans of reorganization looking to the purchase of the company's properties. The members of the committee are R. M. Walmsley, New Orleans; John W. Barr, Louisville; I. L. Lodewk Pierson, Amsterdam; J. A. Blair and Otto P. Bannard, of New York. It is understood that they were appointed through the New York Securities and Trust Company, which undertook to underwrite the company's securities.

NEW HAVEN, CT.—An official statement, issued from the offices of the New York, New Haven & Hartford Railroad, says that at a meeting of the board of directors of the Berkshire Street Railway Company, held in New Haven, the old board of directors resigned and the following were elected: C. S. Mellen, C. F. Brooker, D. Newton Barney, William Skinner, Arthur D. Osborne, H. M. Kochersperger, E. H. McHenry, Calvert Townley and James S. Hemingway. These men are directors of the Consolidated Railway Company, the corporate name of the concern through which the new York, New Haven & Hartford Railroad has already taken over various electric lines in Connecticut. Officers were chosen as follows: president, C. S. Mellen; vice-president, E. H. McHenry; treasurer, A. S. May; clerk, J. G. Parker. Calvert Townley was appointed assistant to the president.

WASHINGTON, D. C.—The annual report of the Anacostia & Potomac Railroad Company has been made public. It shows a capital stock of $2,000,000, divided into 40,000 shares, of which $1,998,100 has been paid in. The total amount of the funded debt is $2,517,000, and there is no floating debt. The length of the road is shown to be more than sixteen miles, the total cost having been $4,241,911.89. The total number of passengers carried during the year was 9,874,521. The total receipts during the year were $304,252.31, divided as follows: passengers, $297,000.69; chartered cars, $720; mail, $377.64; advertising, $1,285.20; rents, $50; interest, $4,818. The expenses of operating and repairs are $176,092.53, divided as follows: maintenance, $8,049.63; equipment, $18,240.80; miscellaneous, $15,543.82; employés, $78,969.95; power and transportation, $42,752.38; damages, $7,623.53; rents and use of other roads, $4,912.42. The total operating expenses and fixed charges are given as $310,775.14. The deficit for the year is shown to be $6,523.83.

NEW COMPANIES.

CHICAGO, ILL.—The Kester Electric Manufacturing Company has been reorganized under the name of the Chicago Solder Company.

JERSEY CITY, N. J.—The Federal Railway Signal Company has been incorporated by Richard C. Fessende, of Orange; James Fraser Reid, of Newark, and John F. Gough, Jersey City.

NEW YORK, N. Y.—The Connecticut Dynamo and Motor Company has been incorporated with a capital of $17,000. The incorporators are D. McDonald, H. J. Brewer and J. P. Munn.

MONTCLAIR, N. J.—The Keystone Rail Joint and Supply Company has been incorporated with a capital of $100,000 by James Haway Griffith, Jr., Frederick G. Townsend and Clarence E. Thornall, all of New York city.

NEW YORK, N. Y.—The Kerr Electric Company has been incorporated with a capital of $1,000, to manufacture electrical goods. The incorporators are Duncan A. MacIntyre, Oliver B. Goldsmith, Arnold L. Davis, all of New York city.

LEGAL NOTES.

ELECTRIC FUSE LITIGATION—In the suit of the American Electric Fuse Company against the Rolfe Electric Company and Charles A. Rolfe, in the circuit court for the county of Lenawee, Mich., involving the ownership of the Rolfe pioneer self-soldering protector patents, a decision was handed down on February 4, in favor of the American Electric Fuse Company.

DECISION CONCERNING PATENTS FOR APPARATUS FOR MAINTAINING A CONSTANT CURRENT IN A SERIES ALTERNATING CIRCUIT—On February 6, 1905, Judge Archbald, sitting in the circuit court of the United States for the Eastern District of Pennsylvania, handed down a decision in the case of the Manhattan General Construction Company *versus* the Helios-Upton Company. The patents involved were Nos. 684,340 and 688,165, issued October 8, 1901, on the inventions of Malcomn H. Baker. These patents relate, respectively, to apparatus for maintaining a constant current in a series alternating circuit operated from high-potential mains, and the method of securing constancy of current by such means. Judge Archbald held the method patent invalid, as, in effect, the claiming of a principle. Claim one of the apparatus patent—No. 684,340—was also pronounced invalid, but claim four, as follows, was sustained: "In an alternating circuit a series of translating devices having a regulating reactance coil having a moving part adapted, when moved to different positions by the magnetic pull of the coil, to cause varying choking effects, the said moving part being acted upon by a force opposing the magnetic pull, which force is so adjusted throughout its effective range of operation as to counterbalance the magnetic pull when the moving part is in such positions with respect to the coil as are adapted to produce constant current." The defendants plead lack of infringements because of mechanical differences of construction. The Baker patent illustrates a device having a pivoted arm bent at a certain angle, a moving coil being at one end, and a compensating weight being at the other end of the arm. The Helios-Upton regulator has its moving coil mounted upon the end of a swinging pendulum arm, swinging upon an inclined U-shaped core, the pull of the coil on the core being coordinated with the increasing gravitational force as the coil was moved from the vertical toward the horizontal. The opinion states that the claims must be read in the light of the entire specification of the patent. A decree was ordered, and the case referred to a master for an accounting.

Digitized by Google

INDUSTRIAL ITEMS.

THE MEEK & BEACH COMPANY, Coshocton, Ohio, announce that after February 15 they will be known as the Meek Company. There will be no change in the management. This company manufacture signs and novelties for advertising purposes and are calling particular attention to their lithographed metal signs.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., held its annual stockholders' meeting on February 2. The retiring board of directors was reelected. The board includes E. M. Barton, Frederick B. Fish, Henry S. Howe, Alexander Cochrane, W. R. Patterson, Arthur D. Wheeler, H. B. Thayer, A. C. Bartlett, Charles Williams, Jr., Charles W. Amory and Thomas Sherwin.

THE ELECTRIC STORAGE BATTERY COMPANY, Allegheny avenue and Nineteenth street, Philadelphia, Pa., is distributing two handsome catalogues descriptive and illustrative of the chloride accumulator and the Exide battery for electric vehicles. This catalogue gives prices, weights and characteristics of the various cells, and should be secured by all prospective purchasers of this form of apparatus.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., increased its capital stock to $100,000 on February 7, 1905. It is the intention of the company to build a new four-story brick factory during the coming year. The present quarters have become too small for the largely increasing business. The company intends to make a specialty of the panel and switchboard business. Catalogue No. 5 is now ready for delivery, and will be sent upon request.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., announces that H. F. Sanville & Company, Philadelphia, Pa., are handling the Shawmut soldered rail bond in their territory. William S. Brown, of New York; Thomas G. Grier & Company, Chicago; L. F. Mahler Company, St. Louis; Spranley & Reed, of New Orleans, and John R. Cole Company, of San Francisco, are handling a complete line of electrical specialties manufactured by the Chase-Shawmut Company, for their respective territories.

THE REYNOLDS-DULL FLASHER COMPANY, 177 Adams street, Chicago, Ill., is distributing a valuable catalogue descriptive of Reynolds-Dull flashers. This catalogue gives many valuable points on selecting a flasher. The various connections for two-wire and three-wire systems are shown, and the essential points to be considered in manipulating flashing signs are carefully indicated. The various forms of apparatus manufactured by the company, and their applications, are illustrated and described.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., has established a southwestern sales office in the city of St. Louis, Mo. Mr. E. J. Pietzcker, who has been attached to the western sales department of the company, with headquarters in Chicago, for the past two years, has been appointed manager of the new sales office, and will be located at 521 Security Building, St. Louis. Mr. Pietzcker has had many years' experience in the wire and cable business, and his long residence in the South will afford him facilities for renewing old acquaintances in that territory. Enquiries from Missouri, Kansas, Oklahoma, Indian Territory, Arkansas, Texas, Louisiana, Mississippi, New Mexico, the western half of Tennessee and Kentucky, and the southern half of Illinois, will be promptly served from this office.

THE IMPERIAL BRASS MANUFACTURING COMPANY, 245-247 South Jefferson street, Chicago, Ill., has been organized by Mr. Charles McNell, for the manufacture of general brass and aluminum work in all branches. Mr. McNell was connected for the past thirty-three years with the Turner Brass Works, of Chicago, serving as vice-president and general superintendent for the past sixteen years. Mr. W. S. Noyes, who has also been actively connected with the Turner Brass Works for nearly fourteen years, as secretary and treasurer, has associated himself with Mr. McNell as secretary of the new company. The company is installing a complete line of the best modern machinery and tools, and will shortly be in a position to execute orders for brass, bronze and aluminum castings, plating, polishing and machining of all kinds, including screw machine and punch press work, and spinning and stamping in brass, aluminum and steel. The company will also be equipped for making special dies and tools to order, and wood and metal patterns.

THE CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York city, calls attention to a decision of the supreme court of Rhode Island in the case of an employé's suit for damages, because of injury sustained through entanglement with a machine. It was shown that the friction clutch through which the machine was driven failed to work, but it was also proved that the machinery was stopped within six or eight seconds after the closing of a near-by push switch operating a Monarch engine-stop and speed-limit system. On this proof the employer was absolved from blame, and a verdict rendered in his favor. From time to time attention has been called to the number and seriousness of flywheel accidents, and the necessity of some automatic means of preventing steam engines from racing. The Consolidated Engine-Stop Company will be pleased to furnish complete information on this subject upon request.

W. R. OSTRANDER & COMPANY, 22 Dey street, New York city, are distributing the fourteenth edition of their large catalogue. In addition to the catalogue there is being distributed a twelve-page trade discount sheet applying to this catalogue. The catalogue illustrates and describes every variety of article and apparatus which has any bearing upon electrical construction. The articles listed include speaking tubes and whistles, electric bells and batteries, electric burglar-alarms, electric gas lighting material, watchmen's clocks, electromedical apparatus, line material and construction tools, electric lighting supplies, fan and power motors, arc and incandescent lamps, miniature lamps, novelties, electric heating specialties, telephones and telegraph systems, telegraph instruments and lightning arresters. The company also issue special catalogues describing fully their telephone instruments and electric fans. Any of these catalogues may be had upon request.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36 West Jackson Boulevard, Chicago, Ill., made an interesting exhibit at the recent convention of the Wisconsin Independent Telephone Association, Madison, Wis. This exhibit included the various types of magneto self-restoring drop switchboards, both the American express and the Bell express, and also all the different kinds of magneto and central energy telephones manufactured by the company. The Leich four-party selective signaling system was operated and shown to the visiting exchange managers and engineers. The new Burns adjustable telephone also attracted considerable attention. The company was well represented by General Manager J. G. Ihmsen, Sales Manager Max W. Zabel, Western Representative S. J. Bear, and the company's Indiana representative, H. A. Nuttall. The American Electric Telephone Company is issuing a number of bulletins, comprising a series of twenty, running from No. 7 to No. 26, any of which may be secured upon application.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., announces the following awards of the international committee of the Louisiana Purchase Exposition in recognition of the engineering ability of the designers of apparatus exhibited by the company: grand prizes have been awarded to Elihu Thomson, Swampscott, Mass., for various applications of electricity; to C. P. Steinmetz, Schenectady, N. Y., for electric lighting, and to F. J. Sprague, New York city, for applications of electricity to transportation. Gold medals have been awarded to C. G. Curtis, New York city, for a multistage steam turbine; to W. L. R. Emmett, Schenectady, N. Y., for vertical-type steam turbine and generator, and to W. B. Potter, Schenectady, N. Y., for applications of electricity to transportation. Silver medals were awarded to W. S. Moody, Schenectady, N. Y., for transformers; to E. M. Hewlett, Schenectady, N. Y., for distribution of energy, switchboards, etc.; to H. F. T. Erban, Schenectady, N. Y., for apparatus for generating electricity; to H. G. Reist, Schenectady, N. Y., for apparatus for generating electricity; to L. T. Robinson, Schenectady, N. Y., for scientific apparatus, measuring apparatus, and laboratory and standard instruments, and to F. P. Cox, Lynn, Mass., for measuring instruments, indicating, recording and integrating.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 8. NEW YORK, SATURDAY, FEBRUARY 25, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

CONTENTS.

EDITORIAL:
Electricity as a Means to an End 313
Station Simplification 313
Power from Niagara Falls 314
Transmission Outlook 315
Switchboard Simplification 315
Some Tests on the Use of the Synchronous Motor in Compensating for Lagging Currents in a Circuit, by E. A. Regestein 316
Meeting of the American Trade Press Association 318
The Power Plant of the Chattanooga Electric Company, Chattanooga, Tenn. 319
Apparatus for Preventing Rail Spreading 323
Electric Railways—the Art and the Men, by Frank J. Sprague 324
Absorption Dynamometer 326
Convention of the International Association of Municipal Electricians 326
Determination of the Commercial Efficiency of Continuous-Current Machines 326
The Office of the "Brooklyn Eagle" 326
Fuel Economy in Steam Power Plants, by William H. Booth and J. B. C. Kershaw 327
The New Valtellina Locomotives 332
Pacific Coast Water Powers for Electrical Operation of Railroads 333
Rapid Transit Subways 333
Electric Railway Operation in a Great City, by H. H. Vreeland 334
British Royal Commission on Coal Supplies 335
Convention of the Kansas Independent Telephone Association 335
The Iowa Telephone Association 335
ELECTRICAL PATENTS 336
Electrical Trucks in Cologne, Germany 337
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 338
Letters to the Editor 340
Electrical Equipment of the Suburban Lines of the Great Western Railway, England 340
Electrical Manufactures in England 340
INDUSTRIAL SECTION:
An Improved Direct-Connected, Variable-Speed Motor Drive for Planers 341
Westinghouse Bipolar Motors for Direct-Current Circuits 343
Electric Locomotive Destroyed by Fire 343
A New Armature Disc and Segment-Notching Press 344
The T. & A. Selective Central Call System 344
Small Engine-Driven, Revolving-Field Alternators 345
Air-Compressors at the St. Louis World's Fair 346
Steam Turbine Plant in the Klondike 346
Two Telephone Specialties 346
Extensions to the Carnegie Institute Building at Pittsburg 346
The World's Output of Lead 346
CURRENT ELECTRICAL NEWS 347

ELECTRICITY AS A MEANS TO AN END.

Electricity occupies a peculiar position in our every-day life: From the frequent use of the word one would think that it is one of those things most essential for our happiness. This is true in a way, but how many stop to think that actually they never use electricity at all; they only use the effects which it produces. Our electric lamps give us light only because a little thread of carbon or a short column of gas is kept incandescent by heat. Our electric cars are for moving us about, not for transporting electricity. We get from the telephone and telegraph noises, and not electric currents. Electricity, then, is merely an agent by which these other actions are produced, but, happily for us, it is the most convenient and the most universally applicable agent which we have ever discovered. Exception to the general statement made above may properly be taken with respect to the use of electricity in therapeutics, an important application, but one which, for the moment, we have not in mind.

One interesting result of the peculiar position occupied by electricity is the relation of the electrical manufacturers and supply companies to the public. Who of us ever buys an incandescent lamp or a telephone? These are all bought from the makers by large companies who supply us not merely with lamps, but with light or with telephonic communication. As regards the telegraph, the same is true, and so it is with respect to the railway motor. These are all bought by large companies which have more or less of the character of public service corporations.

An exception may be made with respect to the constant-speed motor, whether for alternating or direct current. But then again, these are generally used in factories, and not by the general public. Indeed, it is somewhat remarkable that, although electricity itself does so much for us, individually we have practically nothing to do with it. There is one main reason for this. It is because electrical energy is better for transmitting power from one point to another than any other form of energy. This is true of the telephone, for the work performed by a small vibrating sheet of iron causes a similar sheet to vibrate in unison somewhere else. It is true of the electric lamp, for the heat which produces the light is generated by electricity, itself generated at a distant station. The convenience of the electric motor depends upon the same effect. The coal burned a mile or more away enables us to operate our machinery when and how we please, without our knowing where or how the coal is burned or the water power is employed. Electricity is, then, as was said above, merely a means to an end, but a most convenient means to almost any end.

STATION SIMPLIFICATION.

One of the marked tendencies of modern central-station design is toward general simplification of the entire plant. This tendency is due not only to a desire to reduce the cost of the station, but because it is believed that the simpler the plant the more reliable it is, and, at the same time, the less the upkeep. It is true that this simplification sometimes means abandoning certain practices which were introduced with a view toward adding reliability to the plant, but larger experience in the design and operation of electrical machinery has brought greater confidence in the machines themselves, and to-day less need is felt for providing for every thinkable contingency. Moreover, the increased size of the central station and of the generators themselves has made it possible to adopt different methods of treating trouble. In an electric generating station of ten or twelve years ago, trouble on the line caused either a disaster at the station or a disconnection of the line. To-day a short-circuit on the line brings but little risk to the generating station, since

Digitized by Google

the power which may flow through the fault represents a smaller part of the total output of the station than was true in the earlier plants. Frequently, trouble of this kind may be allowed to burn itself out. or is taken care of by an automatic switch. This switch, however, is designed so as not to be opened as soon as the fault occurs, but only after it has persisted for a time.

It is interesting to follow the changes in the layout of a central electric station. The old ideal used to be an arrangement which enabled any generator to be operated from any engine. This was accomplished by the use of line shafts, to which any or all of the engines might be belted at will. In those days everything was coupled together except alternators, for the boilers were fed into a common header, and the engines were belted to the same line shaft, to which all the generators were also belted, and in direct-current stations it was the custom to operate the generators in parallel. For alternating-current stations, however, although it had been shown theoretically that it was possible to operate the generators in parallel, the practical man hesitated for some years, and though his switchboard frequently provided for this method of running, he never availed himself of it.

The first departure from the old ideal occurred at the engine, when the line shaft was eliminated. Then it became impractical to operate more than two or three generators from the same engine without adopting an arrangement of engines which was anything but satisfactory, though it was thought desirable that one generator should not be dependent upon a single engine. When the direct-connected generators came into use, this made still more difficult the operation of one generator by any one of several engines, but a very ingenious system was devised by Mr. B. J. Arnold, which accomplished the end nicely, and bridged over the change from multiple driving to individual driving. The ideal arrangement at this stage was everything in straight lines; the boilers in one, the engines and generators in a second and the switchboards in a third.

Up to this point we have the boilers connected in parallel as well as the generators with engines operating independently. The last step has been the separation of the boilers, or, rather, the grouping of boilers in independent sets. This has been brought about for several reasons, one of them being the comparatively small floor space required by the steam turbine, which makes desirable a new arrangement of boilers, and suggested their separation into independent groups.

This arrangement leaves only the generators in parallel at the bus-bars, and it is somewhat interesting to note that, as the alternating-current system has become standard for large stations, practice to-day consists in doing exactly what was not done ten years ago—that is to say, we operate our boilers and engines independently, but parallel our alternators, while in those days we paralleled everything but the alternators.

This separation of the power-station apparatus into independent groups has some advantages. That which will appeal most to the operating engineer is simplification. It is true it has some drawbacks, since it involves banking a set of boilers whenever a generating set is shut down, but as stations are operated to-day this is not of such great importance.

POWER FROM NIAGARA FALLS.

Some alarm has been expressed recently lest the large power plants now being erected at Niagara Falls may produce a noticeable effect upon that magnificent waterfall. Fear seems to be felt that the work will not stop when the plants now in course of erection are completed, but that the present companies will enlarge their works or that other companies will be formed which will eventually draw off most of the water which now goes over the falls, leaving nothing but a rocky bed down which will trickle an insignificant little stream. To prevent any such happening, it is urged that the state or the federal government shall take some action which will guarantee the preservation of the falls.

This alarm seems to be largely unnecessary, as a little consideration of the present conditions will show. When all of the plants now in course of erection at the falls have been completed, and the last turbine installed, the total output will be something less than 600,000 horse-power. The total power of the falls has been variously estimated at from five to seven million horse-power, so that the present undertakings will, at the most, draw off only about one-tenth of the water flowing down the Niagara river. Looked at in this way, the output of the plants is small, although, when compared with the total hydroelectric developments of the world, it is very considerable. Now, this figure of 600,000 horse-power—it is a little more than this if one adds in the plants along the Welland canal—is what is suggested for the future, and not what will be the immediate output of the plants when they are first put into service. Mr. C. B. Smith, who was until recently prominently engaged in the construction work at Niagara Falls, says that, for a generation at least, not more than 400,000 horse-power will be consumed in the Niagara region. This figure probably represents the maximum output of the Niagara plants for some time to come. The machinery for developing the additional 200,000 horse-power which the charters of the present companies allow them to produce will not be installed until the companies are assured that they can dispose of it. To do this, the power must be transmitted some distance, but this is expensive and can only be done when it would be more expensive to use coal.

It has been shown that, while the development of our waterfalls is important, this work will have little, if any, effect upon the consumption of coal, and hence will not tend in any way to reduce the price of this fuel. On the other hand, every increase in the price of coal enhances the value of the waterfalls. Our coal supplies will last for a long time to come, so that danger of exhaustion can not be urged as an excuse for the installation of additional plants at Niagara Falls. It must, however, be borne in mind that every pound of coal burned represents the deduction of just that much from the resources of the country, while the use of a waterfall is simply converting to useful purposes energy which is otherwise going to waste. When we can see the end of our coal supplies we will be ready to look at the situation in a different light, and then it will be recognized that, although the Niagara falls have a great value as a spectacle, they will then be far more valuable as a source of power. By

Digitized by Google

that time we shall probably have devised more economical methods of using our fuel, and we will, at the same time, have so organized our forestry works as to ensure a continued flow of water through the Niagara river, provided, of course, the lakes do not find a new outlet at Chicago, as has been threatened. Let us hope so, at least.

TRANSMISSION OUTLOOK.

The noteworthy achievements of the last ten years in long-distance transmission of electrical energy have led many to believe that almost anything is possible in this field; and being possible, it will be profitable. The conclusion is far from being justified. The transmission engineer would have some difficulty in setting limits to the possible, but he would have no difficulty in drawing a line to mark a region beyond which transmission certainly would not be profitable under present conditions. Within this line would be, first, a region of debatable ground which would require careful study to determine what parts of it should be developed. Still nearer to the source of power would lie the section offering profitable development, if any such section exist, a question which also must be determined by careful study.

Should it be found to pay to transmit to a certain distance, it does not necessarily follow that it would pay as well, or even pay at all, to transmit to all points within that distance of the source of power. A factory immediately at the power plant may find it can produce its own power at less expense than it can buy it from the larger station. The cost of transporting or transmitting energy either in the form of fuel, water or electricity does not necessarily vary directly as the distance it is carried.

It is true of a transmission project, as of any other undertaking, that the decision must rest on its money-making probabilities, and not on its merits as a beautiful piece of engineering. In a lecture delivered recently by Dr. F. A. C. Perrine before the Brooklyn Polytechnic Institute some of these phases of transmission problems and the conditions influencing them were discussed. These conditions may be natural, or they may be wholly artificial, but in any case they must be reckoned with. One interesting case coming in the latter classification is that of a mine owner who is entirely surrounded by a competitor and who can dispose of his product only to this rival. He may, as suggested, find a profitable outlet by erecting a generating station and selling, not his coal, but the electrical energy which he produces by means of his coal, at distant points.

Another instance when electrical transmission may be found to pay is when fuel in a certain locality is exceptionally dear because of lack of railroad facilities. Doubtless many sections will be found where electrical transmission may be undertaken because of some such local conditions and it is in this direction that Dr. Perrine expects the greatest development of electrical transmission to take place. The work will probably be done quietly and will attract little attention because it will lack those features which appeal most to the public, stupendous size, as at Niagara Falls, or enormous distance, as in California.

SWITCHBOARD SIMPLIFICATION.

The process of station simplification has, unfortunately, not extended to the switchboard, or, rather, to what is to-day virtually a switch-house. Here the apparatus has not only increased in size and in complexity, but the number of appliances deemed necessary has been multiplied. As voltages have increased, the difficulties of installing safely these high-potential devices has also increased. The increased voltage has itself increased the number of appliances needed, for now every station instrument must have its transformer, and these must be properly housed, since they are connected to the high-voltage system. The increase in voltage, as well as in the output of the stations, has made necessary a great change in the design of switches. Where formerly a double-pole, double-throw knife switch answered all needs, there must to-day be groups of high-potential, mechanically operated oil switches, which are not only more or less complicated in themselves, but which make necessary a secondary operating switchboard, with its sets of switches and indicators. Further, the operator at the switchboard has extended his control until he can now change the speed of the driving engines; and in order that he may conduct his work confidently, automatic signaling systems are installed. This increase in complexity of the switching—or possibly one might better say the distributing—appliances is undesirable, but it is hard to see where it could be simplified. A large station should have at least two sets of buses, and this being the case, the necessary switches for connecting any generator to either set must be installed. It has become the custom to place indicating and recording instruments wherever they can be of any service, and the few protecting devices which are installed are necessary as safeguards in times of unusual difficulties.

Comparing the switching devices of a large high-tension, alternating-current station with generators operating in parallel, with such a system as has been introduced by Thury, where several moderately high-potential, direct-current generators are operated in series to give a much higher voltage, which is used for distribution, the difference is striking, as practically all the switching appliances of the parallel plant are done away with. All that is needed is one simple switch, which cuts in or cuts out each generator. The Thury system is very pretty in a way, and other advantages besides simplification are claimed for it. It is even hinted that it will be practicable to operate such a system at 100,000 volts; but, somehow or other, it does not seem suitable for general purposes. It may be well enough for generating power at one point and distributing it at another some distance away, but for general distribution it has not the flexibility of the constant-potential system. It suggests, however, the desirability of simplifying the switchboard of the modern high-tension station, if it can be done. In almost every other part of the station this is the direction in which we are working, and, indeed, this same principle is being followed—as far as may be—in other electrical applications. As was said above, it is not easy to see just where simplification can be made, but it is worth while calling attention to its desirability.

Digitized by Google

SOME TESTS ON THE USE OF THE SYNCHRONOUS MOTOR IN COMPENSATING FOR LAGGING CURRENTS IN A CIRCUIT.

BY E. A. REGESTEIN.

The use of the synchronous motor to regulate the power-factor of a transmission line or distributing circuit has of late received considerable discussion. Some tests made by the writer serve to bring out this property of the synchronous motor very clearly.

To begin with, a few words as to the considerations involved may not be out of place. As is well known, if the excitation of a synchronous motor running at constant load from constant potential mains be varied, the current taken by its armature, and therefore its power-factor, vary correspondingly. For a stable condition of operation the counter-electromotive force induced in the armature of

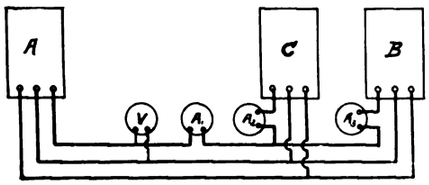


FIG. 1.—METHOD OF CONNECTING MACHINES.

the motor must equal the impressed electromotive force minus the impedance drop through the armature due to the current flowing. If, now, the field current of the motor be varied, since the speed can not change, and the counter-electromotive force must remain the same, a wattless magnetizing current will be taken from the line by the armature, which reacts on the field, so as to keep the flux at the required value independent of the field current. Hence, as the field current is diminished a wattless magnetizing current, lagging with respect to the impressed electromotive force, will be taken from the line, in addition to the current in phase with the impressed electromotive force which supplies the power required. This current strengthens the field flux, raising it above the value due to the field current alone. The smaller the field current the greater will be the wattless magnetizing current flowing in the armature to keep the flux at the required value. Similarly, if the field current is increased beyond the value which gives the required flux, a wattless magnetizing current leading with respect to the impressed electromotive force will flow in the armature, counteracting the excessive ampere-turns on the field. Thus, as we increase the excitation from a low value the power-factor of the motor increases until at normal excitation we have unity power-factor. As the field current is still further increased the power-factor again diminishes due to the leading current taken by the armature.

Under ordinary conditions the field current is adjusted so that the armature current is a minimum, *i. e.*, the motor is running at unity power-factor. Where, however, the motor is connected to a transmission line or distributing circuit of which the power-factor is less than unity due to lagging current, by overexciting the motor, causing it to take leading current, we may bring up the power-factor of the line. If the motor is of sufficient capacity the leading current of the motor may fully compensate for the lagging current on the line giving unity power-factor on the generators. In other words, the line is now drawing its wattless current from the synchronous motor instead of from the generator.

In this way the resultant current in the line is reduced. This mere fact will also reduce the line drop. If the line has appreciable inductance, moreover, the drop is still further reduced by bringing the current and electromotive force into phase. By overexciting the motor sufficiently we can actually raise the voltage of the line.

Since overexcited synchronous motors connected in this way take leading currents, they are frequently called rotary condensers. Rotary condensers have been installed in a number of instances on a system feeding induction motors. Due to the compensation of the lagging currents

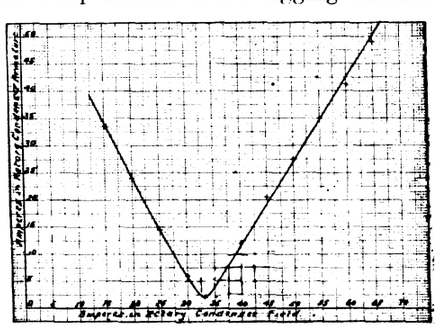


FIG. 2.—RELATION BETWEEN AMPERES IN FIELD AND ARMATURE OF ROTARY CONDENSER.

taken by the induction motors, by the leading current taken by the rotary condenser, the generators being relieved of this wattless component have been enabled to carry a much greater connected load.

The following test brings out these points very clearly. Three machines connected as in Fig. 1 were used. A, the generator was a 500-kilowatt, three-phase, 2,200-volt machine; B was a 700-horsepower, 2,200-volt, induction motor; C was a 150-kilowatt, 2,200-volt, synchronous motor. The induction motor was run free, taking from the line a large current which lagged nearly ninety degrees behind the electromotive force. Readings were taken of the volts between mains, the amperes taken by the synchronous motor, the amperes taken by the induction motor,

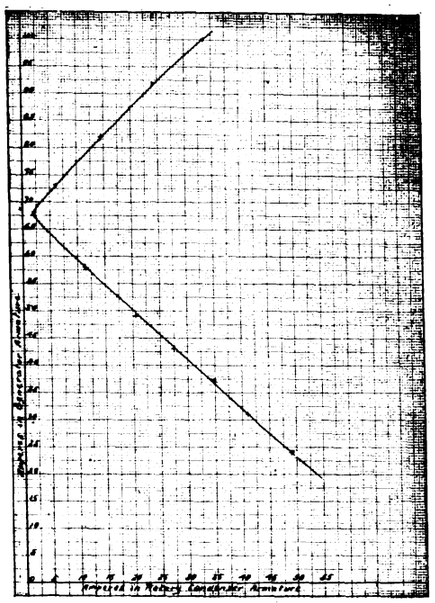


FIG. 3.—RELATION BETWEEN AMPERES IN LINE AND IN ARMATURE OF ROTARY CONDENSER.

and the amperes delivered by the alternator. At the beginning of the test the field current of the rotary condenser was such as to cause it to run at unity power-factor, taking a small current sufficient to overcome its losses while running free. Two series of observations were taken, the first for increasing values of the field current in the rotary condenser and the second with decreasing field currents. The voltage between the mains was maintained constant throughout the test at 2,200 volts by varying the field excitation of the generator.

The readings are shown in tabular form:

Line.	Alternator.		Rotary Condenser.		Induction Motor.
Volts.	Armature Amperes.	Field Amperes.	Armature Amperes.	Field Amperes.	Amperes.
2200	68	50.0	2.0	33	68
2200	58	47.5	11 8	40	68
2200	49	46.0	20.5	45	68
2200	43	44.0	27.5	50	68
2200	37	42.5	35.0	55	68
2200	31	42 0	41.0	60	68
2200	24	40.0	49.0	65	68
2200	68	50 0	2.0	33.0	68
2200	73	51.0	6.0	30.0	68
2200	82	55.0	14 5	25.0	68
2200	92	56.5	24.0	20.0	68
2200	100	58.8	33.5	15.5	68

The induction motor, being connected

Digitized by Google

to constant potential mains at no load, takes a constant current. The field current of the generator, it will be seen, was decreased in order to keep the voltage constant in the first series, and increased in the second series. The amperes delivered by the generator decrease in the first series and increase in the second. The amperes taken by the rotary condenser armature increase in both series.

The increase of the current in the rotary condenser armature both for an increase and for a decrease of its field current is in accordance with the considerations above, the current being leading for larger field currents and lagging for the lower field currents. Fig. 2 shows the relation between amperes field and amperes armature of the rotary condenser, being merely its phase characteristic.

Fig. 3 shows the relation between amperes in the line and amperes in the armature of the rotary condenser. The curve changes direction abruptly at the armature current in the rotary condenser corresponding to normal excitation, *i. e.*, at unity power-factor on the rotary condenser. As this current increases due to overexcitation, the current being leading, the line current falls off. On the other hand, as the rotary condenser current increases due to underexcitation, it being lagging, the line current also increases. The line current is the vector sum of the current taken by the induction motor and the current taken by the rotary condenser. As the field excitation of the latter increases, the leading current drawn

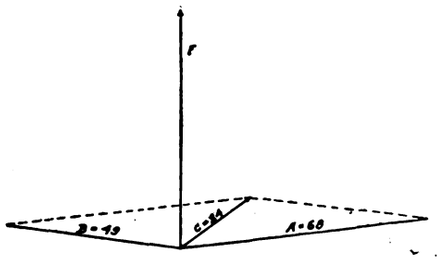


FIG. 4.—RELATION BETWEEN CURRENTS.

by it from the line counterbalances the lagging current in the induction motor, causing the line current to decrease. Fig. 4 shows the vector diagram of these currents for the readings corresponding to a field current of sixty-five amperes in the rotary condenser; A representing the lagging current taken by the motor, B the leading current taken by the rotary condenser, C the resultant line current delivered by the generator, and E representing the phase of the electromotive force; E not being drawn to scale on account of its extreme length compared to the current vectors. The tests were carried as far as the current capacity of the rotary condenser would permit. By increasing the field of this machine still further, the resulting greater armature current would, as indicated in Fig. 2, still further reduce the line current. This would continue until the leading current in the rotary condenser exactly balances the wattless current in the line, and the current and

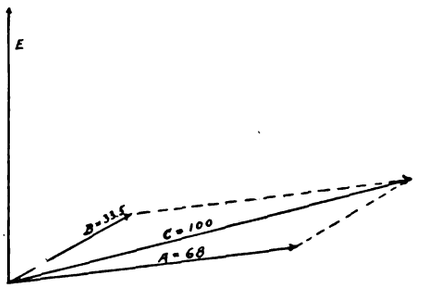


FIG. 5.—RELATION BETWEEN CURRENTS.

electromotive force in the line are in phase. If a still further increase in the rotary condenser current be made, the current delivered by the generator will again increase, it leading the electromotive force.

Fig. 5 shows the relation of the currents for the upper part of the curve; Fig. 2, when the rotary condenser takes lagging current due to underexcitation.

As in Fig. 4, A represents motor current, B the current taken by the rotary condenser, C the resultant line current and E the phase of the electromotive force. The diagram is drawn to show the relation existing for the set of readings taken with 15.5 amperes in the field of the rotary condenser. As the line current is much greater under these circumstances, the use of an underexcited synchronous motor should be avoided.

It is to be noted that although the machine used as a rotary condenser was run unloaded, there is no objection to taking a useful load from the machine provided that the machine is of sufficient current capacity. This will merely cause the machine to take an additional current from the line in phase with the electromotive force supplied. Since this current is in quadrature with the magnetizing current, the actual current flowing will be less than the numerical sum of these two components. We could utilize a given machine to the greatest extent by loading it up equally with a useful and with a wattless component of current. Under these conditions each component may reach 0.71 of the normal current capacity without having the resultant current exceed that capacity. Where, however, the total capacity is required for wattless leading current to balance lagging current on the line, a useful load could not be taken without overloading the machine. The permissible useful load would depend, in a given case, entirely on what fraction of the total capacity was being taken up with wattless current. In several instances machines have been designed with a view simply to relieve the generators of the wattless component of the inductive load, leaving, therefore, no capacity for useful load.

It should be borne in mind that in ordinary working the possible reduction in generator current would not be as great as in this particular test, since in this case the load current was almost entirely inductive. The wattless component alone can be reduced. The possible reduction in current in a given plant would, therefore, depend entirely on the power-factor at which the plant in question is operating.

In this test no attempt was made to determine the possible variation of the line voltage by regulating the field of the rotary condenser. The voltage was kept constant by regulating the generator field. The tendency of the rotary condenser to raise the voltage is very evident, however, since the greater the field current in the rotary condenser the further must the generator-field current be reduced to keep the line voltage constant. The degree of this voltage regulation would depend, of course, on the inductance of the circuit. Fig. 6 shows the relation between field

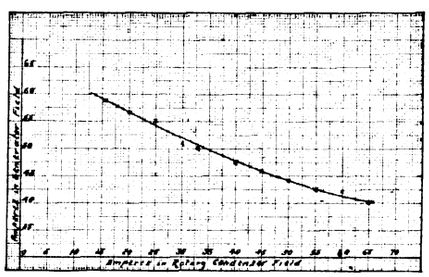


FIG. 6.—RELATION BETWEEN FIELD CURRENTS OF GENERATORS AND ROTARY CONDENSERS.

currents of generators and rotary condenser to maintain constant line voltage.

As an example of what may be accomplished in an actual installation may be cited the case of a certain cotton factory in the South, which was equipped with about 4,000 horse-power of induction motors and 3,000 horse-power of generator capacity. Due to the fact that the average load on the motors was low the power-factor was likewise low, requiring excessive current and voltage at the generators. Instead of installing additional generator capacity to handle the required current, a 500-kilovolt-ampere rotary condenser was

Digitized by Google

installed to supply the lagging currents, thereby relieving the generators. By this means the current delivered by the generators was reduced about twenty per cent, while the voltage required at the generators was reduced about fifteen per cent. The rotary condenser was much cheaper than another generator installed in the power-house together with its engines. Also since the rotary condenser can be installed at the centre of distribution, the line from the power-house is likewise relieved of the same amount of current, and its regulation correspondingly improved.

Meeting of the American Trade Press Association.

At the regular meeting of the American Trade Press Association held at the Hardware Club, New York, Friday evening of last week, Mr. Arthur Warren, manager of publicity for the Allis-Chalmers Company, Milwaukee, Wis., delivered an address on technical and trade journals from the standpoint of the advertiser. There was an excellent attendance, and the speaker's interesting and instructive address was listened to with close attention and much applauded. The address was discussed at some length by members of the association.

Mr. Warren presented in a particularly felicitous manner the questions of character of publication, the field it directly reached, its circulation and its editorial and news scope as valuable elements entering into the manufacturer's decision of a journal's advertising value, and permitted a vein of subtle sarcasm in dealing with the circulation question with some of the methods that had obtained in the past in the efforts made to secure advertising, such as the "meaningless write-up" and the influencing of orders through the personality of the publisher. The question of circulation was discussed at some length and the belief expressed that honest, reliable figures were to be desired as against unverified claims, and the figures given in Rowell's (American Newspaper Directory) were used as a basis of comparison. Mr. Warren concluded as follows:

But there is one nuisance that we all know about, and that is the "write-up." It is a nuisance to you; it is a nuisance to us.

But there is a vast difference between the "write-up," dreary, fruitless, and undisguised, and the timely article that has news value, or interest for the commercial or industrial world, for the factory, the mill, the executive, the artisan, the engineer, the miner, the financier, or the operative. These articles are legitimate, if they are well written and informing. A good deal depends on that. The custom has grown up for the manufacturers to supply articles to the trade and technical press. If these articles are not always well written it is because of the difficulty we all experience, manufacturers as well as editors and publishers, in finding the men who can write well. On the other hand, if editors complain because they do not receive articles of sufficient merit, the owners of the papers must in some part blame themselves. The trade and technical press has added a new problem to the many problems of the manufacturer. I would hesitate to tell you how many requests a great engineering concern receives for articles to be written by its engineers who are experts in their respective specialties. You might think the mere figures an exaggeration. But the fact is that if all these requests were complied with the engineers would have little time left for engineering. And, after all, designing, and constructing, and installing, to say nothing of selling, are what their employers pay them for. If the requests of the press are to be complied with the manufacturers must employ a staff of writing engineers. This, however, would seem to be the proper function of the press itself.

Some papers are very conservative in these matters, carrying conservatism to the point of superstition. They are quite within their rights, and they know best whether they gain in the long run; whether they give their readers precisely what their readers want. The other day the editor of a prominent trade journal returned a short biographical sketch and portrait of a well-known engineer who had just abandoned an old faith for a new one, going up higher among the mighty of a competing concern, and he said—the editor—"we do not publish biographies, and never print portraits. In thirty years" (or it may have been twenty) "we have had but one biographical account in our columns, and that was an obituary"!

Yet in thirty years, or even in twenty, there have been engineers worth mentioning. And some fond foolish persons, like ourselves, have a sort of sympathy with papers that deal with living men rather than with dead ones. (Applause.) And it may be noticed that for business reasons, and for professional reasons, business men and professional men turn more and more to the papers that combine dignity with enterprise.

There is a field of enterprise which the trade and technical press has yet to develop. You cover the advertising field very thoroughly, most assiduously, with a persistence which even the Japanese army and the heroic defenders of Port Arthur might envy. But you have not yet developed the field of information. A hundred, two hundred, advertising solicitors visit the manufacturer; editors very rarely appear. Send out your writers to the manufacturers, not merely your advertising solicitors; borrow a leaf from your colleagues of the magazines and the daily press of the better sort. It will pay you. And it will pay best the papers who send the best men and who send them most frequently.

There should be, and there can be, closer touch between the papers and the manufacturers. And that closer touch can be obtained without the loss of any independence on the part of the press. The papers that are not independent, the papers that are partisan and that curry favor, are the papers we don't want. The manufacturing concerns are sources of news. You want technical news, and perhaps other kinds of news. But very often, especially in regard to large undertakings, you do not get the information until it has lost its news value. There are reasons for that. Perhaps they will never be entirely overcome, because the manufacturer has not only to guard his own interests, but he has to guard the interest of his customer. When large investments are at stake the persons who are paying the money have the privilege of keeping their own counsel. You, as business men, can understand that clearly enough. And again, when the manufacturer is producing a new invention he prefers silence until he has protected himself by patents, completed his tests, and perhaps made a successful installation or two.

But it is not impossible that a place may be found whereon the manufacturer and the press can meet to their common benefit, where you can obtain information while it still has the quality of news, and news backed with authority. And to find this meeting place there is no better way than to send out your best writers on exploring expeditions. Cultivate personal relations between the men who have the information to impart, and the men who know how to put it together in an interesting and useful manner. Your writers will learn something new wherever they go, if they are the right men, and if they go about it in the right way. I, for one, shall have no sign at my door forbidding them entrance. There are writers on your staffs whom the ablest men in the engineering world will be glad to meet, to whom courtesies and facilities will be extended, and who will themselves be benefited, and through them their papers, by personal contact with the actual conditions that prevail. If you have not writers enough to spare from your offices you can get them.

I can see the twinkle in your eyes; I can anticipate exactly your immediate response: "Enlarge our advertising contracts so that we can afford to do this thing!" But if a man can not dine on bread alone (and the evidence to-night is that he does not if he is a publisher), neither can the press live on advertising alone. You are doing good work now. Do more of it. There are new activities in which you can engage. If you are liberal be more liberal still. And if I am not mistaken you can do much to bring about a condition of affairs in which you will not be perpetually chasing the advertiser, but the advertiser will be running after you.

Digitized by Google

The Power Plant of the Chattanooga Electric Company, Chattanooga, Tenn.

THE Chattanooga Electric Company, of Chattanooga, Tenn., completed an important addition to its plant in July of last year, which, on account of the installation of Curtis steam turbines and the introduction of some novel features, will be of interest to describe.

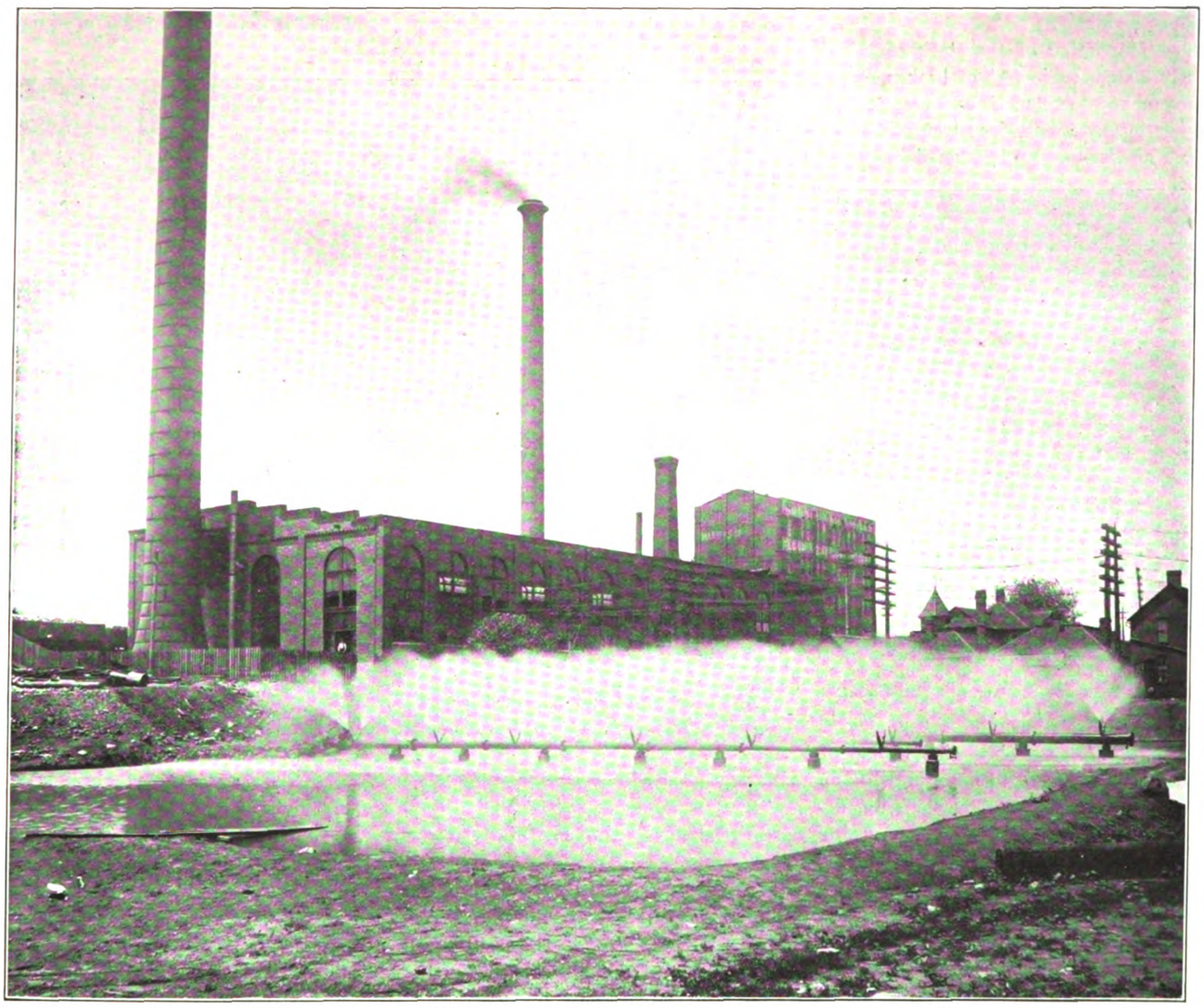
The addition to the plant consisted of a seventy-five-foot extension to the old building, on the same general lines, only that the new part has a steel truss roof covered with book tile and asphalt, and the floors are of iron girders filled in with corrugated iron arches and concrete, overlaid with red and white hexagon tile. The present building with the extension is of red brick, 180 feet long and 82 feet 2⅝ inches wide.

The engine room is 45 feet 10 inches wide and 165 feet long.

The boiler room is 36 feet 4⅝ inches wide and 180 feet long.

The floor of the boiler room is three feet below the floor of the engine room.

The height of the engine room to the bottom of the roof trusses is 27 feet 6 inches.



THE POWER PLANT OF THE CHATTANOOGA ELECTRIC COMPANY, CHATTANOOGA, TENN., SHOWING COOLING POND AND SPRAY.

The engine room is provided with a ten-ton traveling crane having a span of 44 feet 7 inches.

Light is admitted through twelve arched windows on the north side of the building, each of which is ten feet wide and reaches to the roof.

The steam-raising equipment, which remains of the old plant, consists of four 250-horse-power water-tube boilers of the Babcock & Wilcox type, and one 800-horse-power Goubert feed-water heater and Worthington duplex feed-water pumps.

The four boilers are connected to a self-supporting steel stack 150 feet high and 6 feet inside diameter, which is lined with firebrick part of the way, the balance being of common brick.

In the old engine room there has been retained one Harrisburg standard, tandem-compound, 400-horse-power, non-condensing engine, direct-connected to a 200-kilowatt, three-phase, 2,300-volt, General Electric alternator, and a 225-kilowatt, 500-volt, direct-current, General Electric generator.

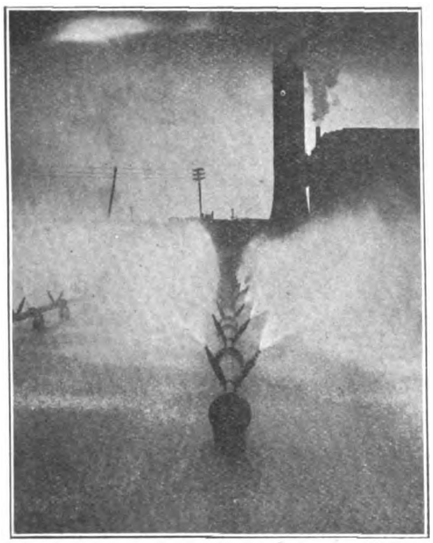
In the new addition have been installed two batteries of Babcock & Wilcox water-

Digitized by Google

tube boilers, each battery containing two 410-horse-power boilers, having 4,046 square feet of heating surface and 67.6 square feet of grate area each. These boilers have the new extension or Dutch oven furnaces which extend four feet from the boiler fronts.

The boilers connect to a new self-supporting steel stack 200 feet high and 10 feet in diameter inside of the firebrick lining, which extends from bottom to top. The main flue at its largest part is 7 feet wide and 10 feet 6 inches high. The main damper is operated by a Locke damper regulator.

The foundation of the stack contains nearly 25,000 cubic feet of broken stone concrete, and the stack is anchored to the foundation by twenty-four two-inch bolts which are fastened to lugs on the side of



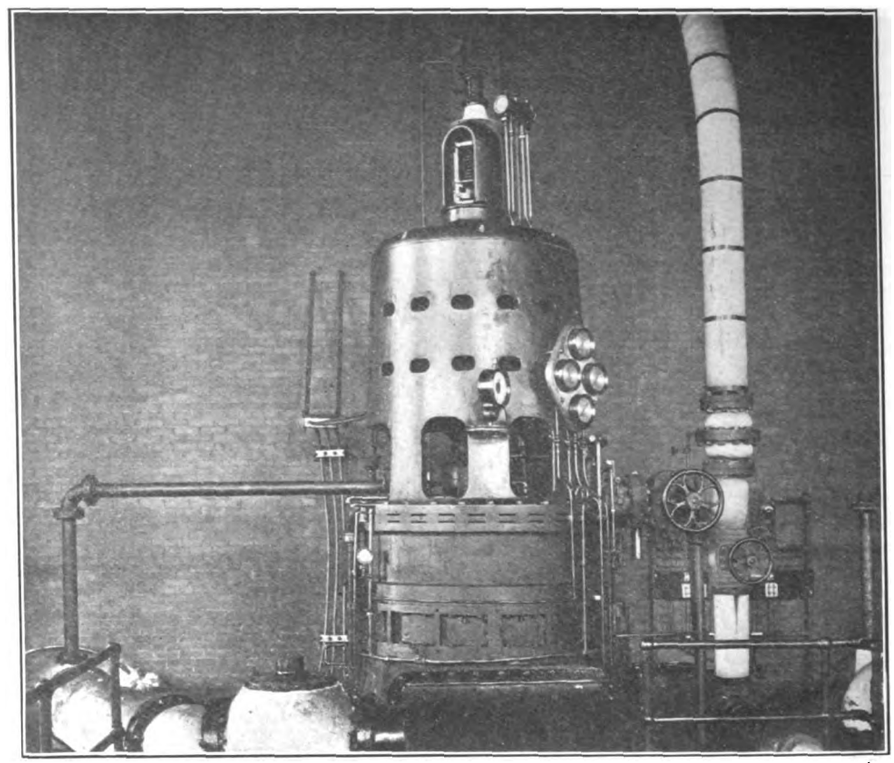
THE PIPE LINE AND NOZZLES IN THE COOLING POND.

the stack. A good close view of top of the stack assembled before putting up is shown on page 322. The stack was designed by Sargent & Lundy, consulting engineers, Chicago, Ill., and was built by Walsh & Weidner, of Chattanooga, Tenn.

Coal is brought in over a trestle and dumped into bins at the rear of the boiler room, from whence it is wheeled in over three dormant floor scales and registered by counters similar to fare registers. In this manner an accurate account of fuel and output is kept for each twelve-hour run.

In the extension to the engine room there have been installed three General Electric-Curtis steam turbines and alternators of 500-kilowatt capacity each, and a foundation for a fourth turbine has been provided. These alternators are three-phase, sixty-cycle, 2,300-volt and run at 1,800 revolutions per minute.

Oil is forced into the step bearings of the Curtis turbines at a pressure of 250 pounds per square inch by means of geared plunger pumps driven by direct-current motors, and as a provision against failure of this source of oil supply a Worthington duplex steam plunger pump is arranged to start up automatically in case of failure of one of the electric pumps. Even if the steam pump should fail to start promptly the flow of oil and pressure would be maintained for thirty minutes by means of an accumulator which works on the principle of a hydrostatic press. In practice all of this oiling arrangement is extremely practical and satisfactory.



CURTIS TURBO-GENERATOR OUTFIT.

A new type of mercury vacuum gauge indicates the vacuum in each turbine and condenser. These gauges are short glass tubes closed at the top in the same manner as a barometer, with the bottoms dipping into a mercury well hermetically sealed from the atmosphere but connected to the condenser. An absolute vacuum in the condenser would cause the mercury in the column and that in the well to come to the same level, the difference in level being a measure of the vacuum in inches upon the scale. These gauges have exhibited many advantages over the old style of open gauges.

Each turbine exhausts into a Worthington surface condenser having 2,000 square feet of cooling surface, and the water from the hot wells is pumped back to the feed-water tanks by Worthington two-stage centrifugal pumps, driven by General Electric three-horse-power, three-phase motors running at 1,800 revolutions per minute.

The condensing outfit also consists of two Worthington 8 by 14 by 10-inch horizontal rotative vacuum pumps; one Worthington seventy-five-horse-power centrifugal pump, driven by a seventy-five-horse-power General Electric, three-phase, 2,300-volt motor; one two-stage, seventy-five-horse-power Worthington centrifugal pump, driven by a New York Safety Steam Engine Company's vertical steam engine, the exhaust of which is used for heating the feed water.

The plant being located some distance from the river it was not possible to utilize the river for condensing purposes, and it was necessary to resort to other methods for obtaining condensing water. The plan adopted of spraying the water into the air by spray nozzles has proved very satisfactory.

This part of the equipment consists of forty-two spray nozzles furnished by the Schutte & Korting Company, Philadelphia, Pa. These nozzles are provided with a conical-shaped core having spiral grooves which give the water a rotary motion and form a spray fountain about

Digitized by Google

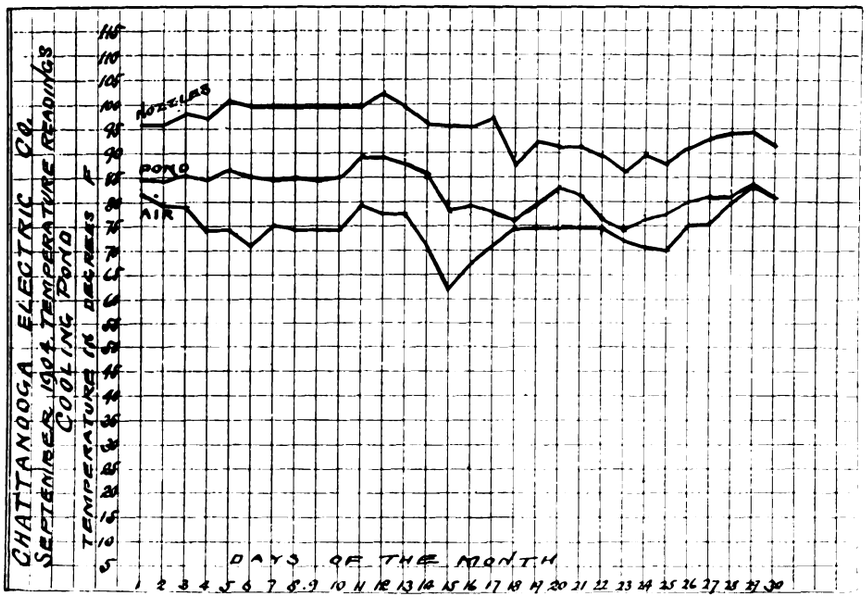
twenty feet high and thirty feet in diameter. The water is conducted to the nozzles through a system of piping supported upon brick piers in the pond and is returned to the condenser through a twenty-four-inch pipe by means of centrifugal pumps.

The spray fountains, of course, work better during cold weather than they do during warm weather. This will be seen from the daily temperature readings for the months of September, 1904, and January, 1905, the average number of degrees cooling in September having been 12.10, while in January it was 18.25, but the cooling has been sufficient to maintain a vacuum varying from twenty-seven and one-half to twenty-eight inches. The accompanying plotted temperature shows the striking sudden variations of temperature in Chattanooga in January and how closely the temperature variations of the pond water follow those of the atmosphere.

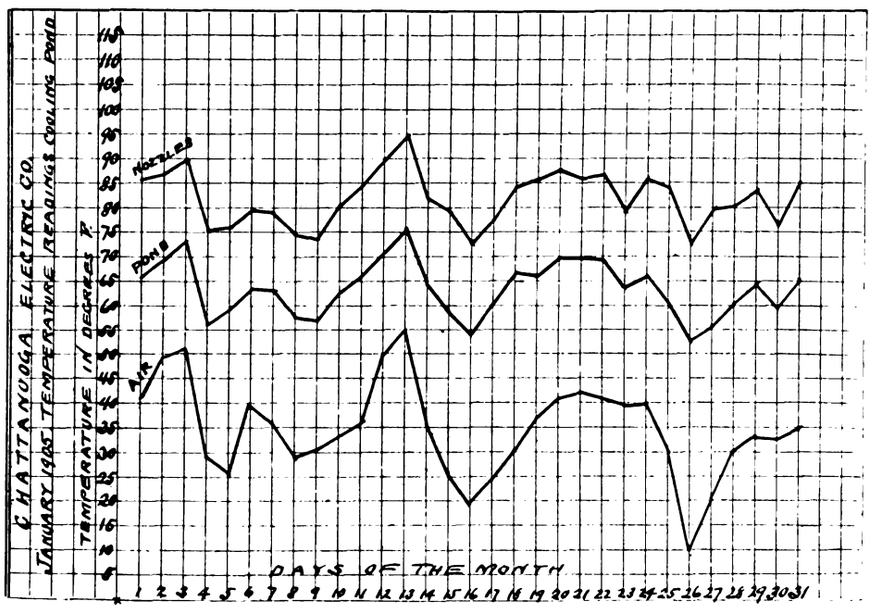
The pressure at the nozzles is fifteen pounds per square inch. The loss of water due to evaporation and seepage into the earth is made up from a driven well 500 feet deep, from which water is obtained by means of an air-compressor built by the Ingersoll-Sergeant Drill Company.

The new boilers are supplied with feed water through either of two pumps, one of which is a 9 by 6 by 10-inch vertical Worthington duplex Admiralty pump, mounted directly on the side of a 3,000-horse-power closed coil heater built by the National Heater Company.

The other feed pump is a five-stage



Relation of Nozzle Temperature to Air and Cooling Pond, September, 1904.



Relation of Nozzle Temperature to Air and Cooling Pond, January, 1905.

TEMPERATURE READINGS OF COOLING POND IN SEPTEMBER, 1904.

Date.	Temperature Air Dry Bulb.	Temperature Air Wet Bulb.	Temperature at Nozzles.	Temperature Water in Pond.	Degrees Cooled.
1	82	70	96.75	84.87	11.88
2	79	71	95.87	84.50	11.37
3	78	70	97.87	85.37	12.50
4	74	69	97.12	84.25	12.87
5	74	67	102.25	86.50	15.75
6	72	67	99.00	85.00	14.00
7	75	67	99.00	84.75	14.25
8	74	68	99.12	85.00	14.12
9	74	66	99.12	84.37	14.75
10	74	66	99.87	85.00	14.87
11	78	69	99.37	88.87	10.50
12	77	69	102.97	88.87	14.10
13	77	69	99.25	87.75	11.50
14	71	63	96.87	85.62	11.25
15	62	57	90.37	77.87	12.50
16	67	60	90.37	78.62	11.75
17	71	65	92.12	77.37	14.75
18	74	66	87.87	76.37	11.50
19	74	68	92.25	78.25	14 00
20	74	70	96.12	82.50	13.72
21	74	69	91.87	81.37	10.50
22	74	67	89.50	76.12	13.38
23	72	63	86.50	74.62	11.88
24	71	64	89.62	75.75	13.87
25	70	67	87.87	77.12	10.75
26	75	70	91.37	80.00	11.37
27	76	70	93.25	83.25	10.00
28	80	73	94.37	81.37	10.87
29	83	74	94.87	83.50	11.37
30	81	73	92.00	80.62	11.38

TEMPERATURE READINGS OF COOLING POND IN JANUARY, 1905.

Date.	Temperature Air Dry Bulb.	Temperature Air Wet Bulb.	Temperature at Nozzles.	Temperature Water in Pond.	Degrees Cooled.
1	41.12	39.75	85.50	66.62	18.88
2	48.87	47.12	87.00	68.50	18.50
3	50.87	49.87	89.87	73.37	16.50
4	28.00	26.37	75.75	56.50	19.25
5	25.87	24.25	75.25	58.75	16.50
6	39.25	38.25	78.37	63.50	14.87
7	36.12	40.87	77.25	63.00	14.25
8	28.87	27.87	74.87	57.50	17.37
9	30.37	29.12	73.87	56.37	17.50
10	33.25	32.62	81.00	62.50	18.50
11	35.87	34.12	84.00	66.00	18.00
12	49.00	48.50	89.50	70.62	18.83
13	54.62	53.00	94.12	76.00	18.12
14	36.00	34.50	82.12	64.12	18.00
15	26.12	24.62	77.87	58.37	19.50
16	19.00	17.37	73.75	54.37	19.38
17	24.25	22.62	77.87	60.72	17.15
18	30.12	29.75	84.62	66.75	17.87
19	37.00	34.00	85.25	66.25	19.00
20	41.37	40.37	87.50	69.37	18.00
21	42.37	40.62	86.62	69.50	17.12
22	41.75	39.87	86.87	68.75	18.12
23	39.75	37.87	78.12	63.37	14.75
24	40.00	38.12	85.50	66.00	19.50
25	30.50	28.50	84.37	61.62	22.75
26	10.00	7.62	73.50	53.25	20.25
27	20.75	19.12	78.62	56.12	22.50
28	30.00	28.12	80.25	60.75	19.50
29	32.87	30.87	83.37	64.37	19.00
30	32.75	32.50	76.62	59.50	17.12
31	35.00	33.50	85.00	65.87	19.13

Digitized by Google

Worthington volute pump, direct-connected to a General Electric thirty-horse-power, three-phase, induction motor.

The company furnishes power for operating all of the cars of the Chattanooga Electric Railway Company, and for this purpose has installed four General Electric eight-pole, 300-kilowatt, rotary converters running at 900 revolutions per minute and converting 2,300 volts, sixty-cycle current to direct current at 600 volts for the railway feeders. The rotary converters can be started from either the alternating-current or direct-current end.

For exciting the fields of the alternators there have been installed one vertical marine set, consisting of a compound engine, direct-connected to a General Electric thirty-five-kilowatt generator; one thirty-five-kilowatt exciter driven by a fifty-horse-power, 2,300-volt, three-phase induction motor, and one thirteen-kilowatt exciter driven by a three-phase induction motor.

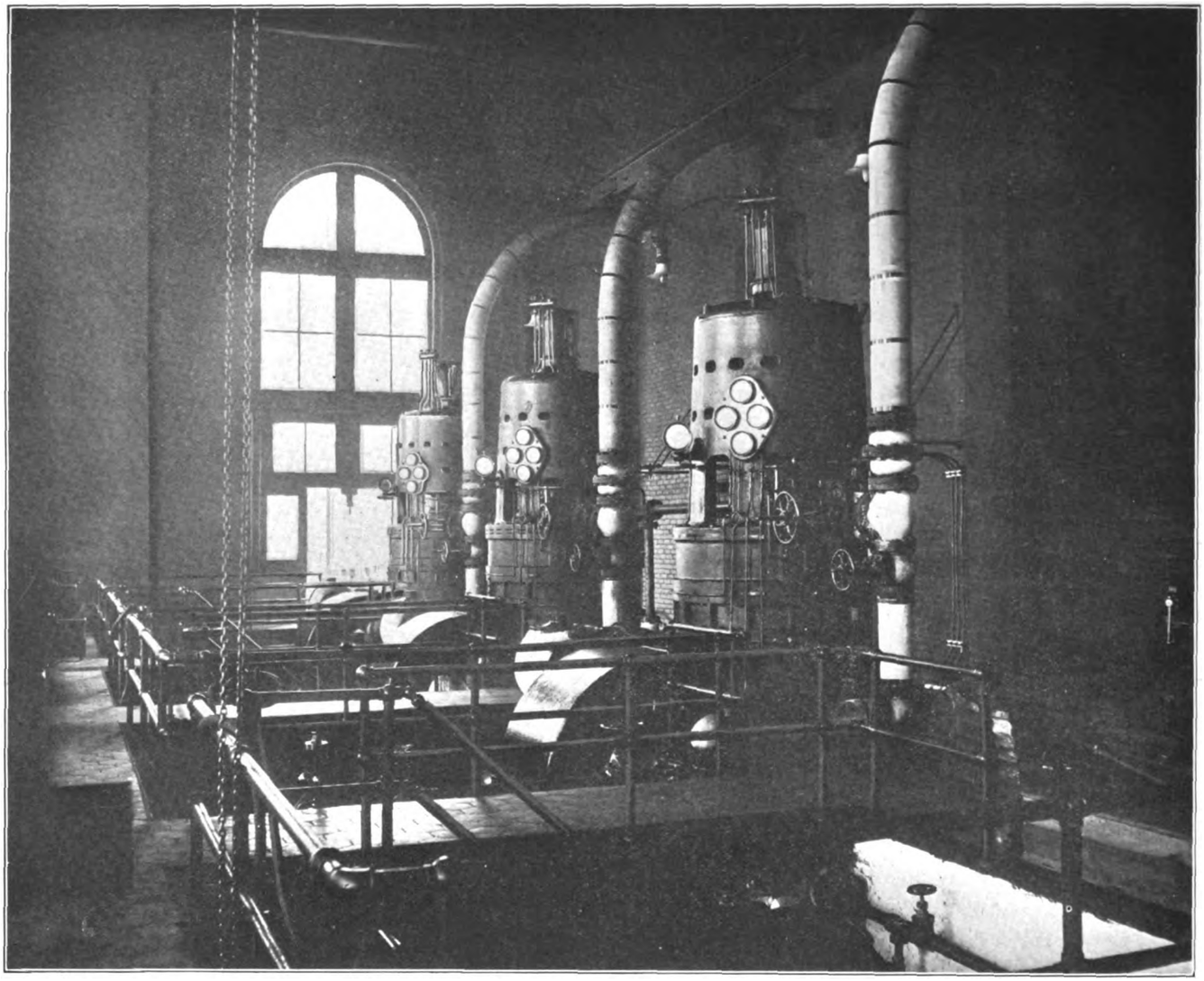
Four 330-kilowatt General Electric air-cooled transformers are placed directly over a tunnel in the basement, through which air is forced by means of two blowers operated by three-horse-power induction motors. These transformers convert the current from 2,300 volts, three-phase, to 430 volts, six-phase, for the rotary converters.

The switchboard is of black slate and is equipped throughout with the latest type of General Electric switchboard instruments and controlling apparatus.

Single-phase current at 2,300 volts is distributed to the line for lighting purposes through four oil switches. Three-phase current at 2,300 volts is distributed for operating induction motors.

Each of the rotary converters is provided with a Thomson recording watt-meter on the direct-current end for measuring the power sold to the electric railway. Each of the generators has its own polyphase meter, and all the lighting and power feeders are similarly equipped. In addition to these meters each auxiliary motor has its own meter, so that it is possible to check up the amount of power loss in converting from alternating to direct current and the amount of power used for operating the auxiliaries.

The company furnishes all of the street lighting of the city and has recently changed over from the open series arc system to the alternating-current series enclosed constant-current arc system, and supplies current to 230 lights through three 100-light 6.6-ampere constant-cur-



INTERIOR VIEW OF CHATTANOOGA ELECTRIC COMPANY'S TURBO-GENERATOR PLANT.

CAP FOR NEW SMOKESTACK.

Digitized by Google

rent General Electric transformers. These lamps took the place of open arcs of 9.6 amperes, and the change is giving great satisfaction to the public.

The Chattanooga Electric Railway Company operates twenty-five cars of seventy-five and ninety-horse-power equipments and weighing from 35,000 to 38,000 pounds each.

The total length of the different lines is about twenty-five miles, most of which is double track and includes several heavy grades. The cars maintain a fifteen-minute schedule and all run into a central transfer station. With this number of cars, equipment and schedule three rotary converters of 300 kilowatts each easily take care of the load, which varies from 500 to 1,500 amperes at 600 volts and an average consumption of 10,000 kilowatt-hours per day of eighteen hours.

The entire plant was built and the machinery manufactured and installed by the General Electric Company.

Since July 4, the date of taking on the entire load of the street railway company and the commercial and public lighting, the turbines have been in continuous and successful operation, without a single breakdown or interruption to the service.

The cost of coal has been cut down to about one-third of what it was when operating with high-speed simple engines, and the cost of feed water has been practically eliminated on account of the possibility of using the same water over again after passing through the turbines. The accompanying photographs are good views of the cooling pond and the interior and exterior of the power-house.

Prevention of Rail Lengthening and Track Spreading.

[*From United States Consul Muench, Plauen, Germany.*]

The spreading and lengthening of rails and track on double-track railways has recently formed an interesting topic of discussion in the engineering circles of Germany. The tendency of steel rails and tracks to lengthen in the direction followed by passing trains has long been a disturbing factor here in the conduct of double-track roads, it being asserted, on authority, that, aside from the element of danger, the cost of remedying this particular evil consumes as much as thirty to forty per cent of the entire annual expense of track repairs on such roads. The main causes of such lengthening are variously supposed to be the thumping of the rolling stock against the rear ends of the rails, the friction of wheels under the stress of powerful brakes and weights, and the pressure of wheel flanges against the outer rail of curves. Single-track roads are not similarly affected, because the passage of trains in both directions acts as a natural corrective of the evil.

Through this forward motion of the rails the safety space between rail ends disappears and any increase in temperature is liable to result in the spreading or bulging of the track, as also the twisting and tipping of sleepers and ties, an effect especially noticeable and injurious

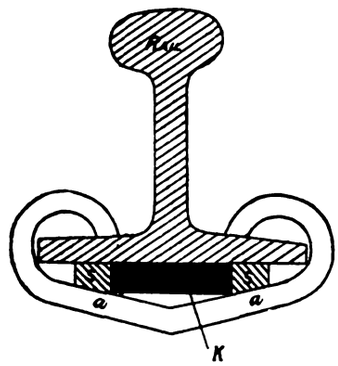


FIG. 1.—CROSS-SECTION OF RAIL AND APPARATUS TO PREVENT CREEPING.

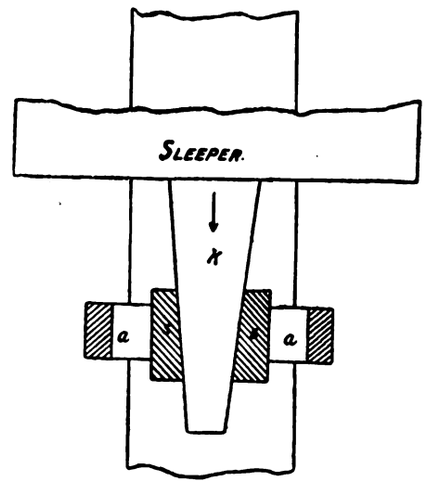


FIG. 2.—HORIZONTAL SECTION OF APPARATUS TO PREVENT RAIL CREEPING.

near switches and frogs. At sharp grades and curves it may happen that one rail is moved forward, while the other assumes the opposite motion, thus bringing about a dangerous twisting of the roadbed.

Recently an invention has been perfected by an engineer named Dorpmüller, which is claimed to have completely solved the difficulty.

The apparatus consists of an iron clasp or clamp (indicated on the accompanying sketches by the letter *a*), the curled ends of which hug the base flanges of the steel rail from the top and which firmly hold against the bottom of the rail a key or wedge of iron (*k*), the wide end of which is calculated to rest firmly against the side of the next adjoining sleeper. This wedge again drives two pieces of iron (*s s*) against the slanting bottom of the clamp, thus automatically and successfully holding in place the entire apparatus by means of the very force that is sought to be counteracted. Through the application of a sufficient number of these clamps at points where the track appears particularly endangered, the entire roadbed is rendered steadfast, and the movement forward of rails has been successfully overcome.

The lines between Aix la Chapelle and Düsseldorf and between Cologne and Herbesthal have been equipped with this apparatus. Severe tests have been made at points where the trouble has heretofore been greatest, and it was found that by applying eight clamps to each fifty-foot rail, laid upon a gradient of 1.37, and where fifty-four trains per day passed thereon, practically no movement of track or rails took place during a period of eighteen months, while, without this appliance, it had been necessary to restore normal conditions about every three or four weeks.

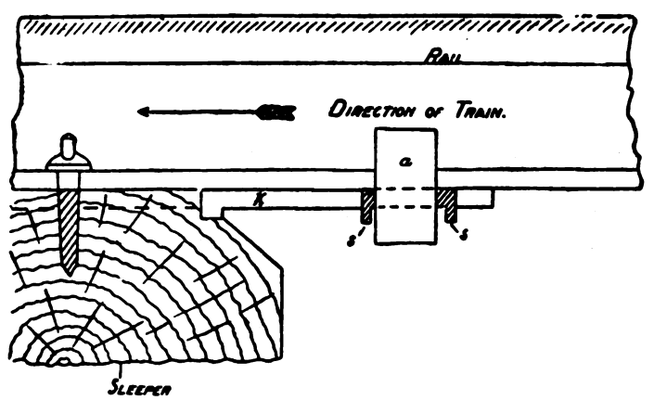


FIG. 3.—SIDE VIEW OF RAIL AND APPARATUS TO PREVENT CREEPING.

Should further details be desired, they could doubtless be had from the inventor or from the Zeitschrift des Vereins deutscher Ingenieure, Berlin.

Digitized by Google

ELECTRIC RAILWAYS—THE ART AND THE MEN.[1]

BY FRANK J. SPRAGUE.

To Thomas Davenport, blacksmith, of Brandon, Vt., belongs the honor of making the first recorded experiment, for in 1834 he showed at Springfield, and again in Boston, a toy model, mounted on wheels, and propelled a few feet on a circular railway from a primary battery. This was but one of his accomplishments, for history relates that in a few years he constructed and put into operation no less than a hundred motors of a type now of course obsolete.

Four years later Robert Davidson, of Aberdeen, constructed a locomotive which was tried on the Edinburgh-Glasgow Railway. In 1847 Moses G. Farmer, one of the most prolific of early experimenters, exhibited a small model at Dover, N. H., and three years later in Boston Thomas Hall showed an automatically reversing motor. A year later Professor Page, of the Smithsonian Institute, with congressional help, equipped and ran a car on a road near Washington. All these, and various other experiments of those early years, depended on the use of primary battery, and hence, irrespective of the shortcomings of the machines themselves, commercial success was impossible. It was not until the invention by Pacinotti in 1861 of the continuous-current dynamo, improved and developed by Siemens, Whitestone, Varley, Rowland and others, and the discovery of the reversible functions of the dynamo electric machine, said to have been made originally by Pacinotti in 1867, but certainly proved, some say at first by accident, by Gramme and Fontaine in 1873, that the key to the transmission of energy was found.

Between this date and the beginning of experimental work on modern lines I find a mention of but one name, that of George Green, a poor mechanic in Kalamazoo, Mich., who built a model operated from a battery through the track and an overhead wire.

About four years later three inventors, whose names are known the world over, became almost simultaneously and independently interested in electric railways. These were Dr. Werner Siemens, Stephen D. Field, and Thomas A. Edison. To the former belongs the credit of actually operating the first road supplied from a dynamo which carried passengers, as shown at the Berlin exposition in 1879. A toy-like affair it was, a miniature locomotive pulling three small carts seating about twenty passengers. As illustrating how trivial facts connected with early experiments stand out, one of the younger Siemens recently told me that these small cars being provided with division arms, quite some anxiety was displayed when it was discovered that to accommodate the German Emperor, a man of large physique, one of them had to be removed. I note that this practice has been extended to our subway to provide room for our everyday emperors.

The demonstration by Siemens was followed by other exhibition equipments, and in 1881 by the installation of a short line with one car at Lichterfelde near Berlin, the first commercial road. This was followed by others by the same house, and an ambitious project for an elevated railway in Vienna.

In 1879 Field filed a caveat, showing an electric railway taking current from a wire enclosed in a slot, and in 1881 made experiments in Stockbridge, Mass. In 1880 Edison, utilizing one of his old Z lighting dynamos, constructed and operated a small road in a yard of his laboratory at Menlo Park, using the two rails as conductors.

About this time various other inventors began to take up the study of the subject, and Jenkins, Ayrton and Perry began the development of telpherage or automobile railways. Chance is oftentimes responsible for inventions, and perhaps for my own entry into the railway field, for although I had become interested as early as 1879 in the possibilities of a somewhat eccentric motor, it was not until 1882, when my duty as a member of a jury at the Crystal Palace, Sydenham, London, took me on the underground railroad, that I seriously considered this special problem. This interest took the form of a project for operating that road by adopting the general system of constant potential supply developed by Edison for electric lighting, and using the tracks as one conductor, an overhead one supported by the roof as the other, contact with the latter to be made by a roller carried on a spring-supported saddle, a forerunner of the modern trolley.

In the year 1883 Field and Edison combined forces, and exhibited at the Chicago railway exhibition a locomotive called the Judge, which ran around the gallery, the motor used being a Weston electric light dynamo.

Siemens also installed the first line in Great Britain, that at Portrush, Ireland, and another short line was installed at Brighton by Magnus.

Charles J. Van Depoele, a woodcarver by trade, but an electrician at heart and an indefatigable worker, began experiments at his factory in Chicago, using a five-light dynamo on a car platform, and taking current from a wire laid in a slotted plank, following this by a short line at the Industrial exhibition.

It was in 1883, too, Leo Daft began his labors at Greenville, N. J., following them that fall with the operation of the Ampere at Saratoga, and soon after with small roads elsewhere. Bentley and Knight began their experiments in the yards of the Brush Electric Company, and in the following year they installed a short conduit line in Cleveland, which was spasmodically operated during that winter. In the latter year Van Depoele operated a road at the Toronto exhibition, and about that period Anthony Renkenzaun, a particularly able engineer, actively conducted storage battery work abroad.

The year 1885 was prolific. Daft began operations in Baltimore on the Hampden branch of the Union Passenger Railway with two locomotives, this being, I think, the first regularly operated railroad in the country. His ambitious work on the Manhattan Elevated with the Benjamin Franklin was a remarkable effort, but like all then made on that road, as well as those made a number of years afterward, met with but little encouragement.

I had now resumed railway studies, and began the construction of motors for experiments on this road, these being used first on a private track in an old sugar refinery, and then on the Elevated in May of the following year, but on somewhat different lines, for the motors were centered on the axles of regular trucks geared to them and freely supported at one end, this practice being subsequently generally adopted, but after some months I, too, quit, and then tried the construction of a locomotive car.

Meanwhile Van Depoele had begun operations at South Bend and Minneapolis, Henry had installed a small line in Kansas City, and Short had embarked on experiments with a series system at Denver.

This and the next two years saw active work by all of us who had ventured in this new field, some with central station and others with storage battery supply, the principal roads actually installed being by Van Depoele and Daft.

In 1887 the equipment of the Richmond Union Passenger Railway fell by

[1] Abstract of an address at the annual dinner of the American Institute of Electrical Engineers, New York, February 8, 1905.

Digitized by Google

good fortune to my company, and that year may be fairly said to mark the beginning of active development.

Looking back these nearly twenty years, I am reminded of the cry of the prophet, "Oh, ye of little faith," and yet I, for one, and I think I may speak for most of the others, would not have had it otherwise, for let me tell you, my younger brethren, whether it be on the battlefield or in civil pursuits, there is no victory so sweet as that wrung from almost certain defeat; and if you need encouragement in present or future struggles, let me bid you ask of the living and the dead the record of 1879 to 1888. They will tell you of cynicism, ridicule and unbelief, of unremitting labor and disappointment, of poverty, sickness, wreck and ruin, but they will also tell you of their inspirations, of exalted moments, of hopes realized, of victories won.

The adoption of electricity on the West End Road by Mr. Henry Whitney, to whom must be awarded the credit for initiating the modern consolidations of street railways, was followed by a period of extraordinary activity in commercial and technical development, in which for a time the Sprague and Thomson-Houston companies were principal competitors.

This development has no parallel, and to the query now came it so, I answer: it was due to the genius of opportunity, the crying needs of transportation, and the quick wits which saw the coming light.

The ten years following Richmond were marked by continued and vital improvements in apparatus and equipments, among which must be specially mentioned the introduction of the carbon brush by Van Depoele, the Thomson magnetic blowout by Potter, form-wound armatures by Eichmeyer, and the combination of resistance and series parallel control, the latter originally proposed by Hopkinson in 1880. Cast iron gave way to steel, two-pole motors to four, open-type motors to enclosed and protected, and the single-gear again resumed sway.

For a long time the single trolley held, and for much of the future will continue to hold, first place, because of simplicity, effectiveness and minimum first cost.

The Allegheny and Boston conduits had been abandoned, but in 1893 a short line was tried in Washington on the Love system, and in the following year work was begun in New York on the Lenox avenue line and carried to that successful conclusion which warranted its adoption there, under the auspices of William Whitney and Henry Vreeland, and soon after in Washington under Connett, although a line had been in operation at Budapest for some time.

Train operation as distinguished from that of single cars began on the South London road in 1890, and this was followed by various proposals for the New York elevated, the installation of the intramural road at the World's Fair, Chicago, the equipment of the Lake street elevated, and by other installations. Heavy locomotives were built in 1892 and 1893, both for experimental work and for regular operation in the Baltimore & Ohio tunnel.

Meanwhile the limitations of direct-current motor work were greatly extended by the development in polyphase transmission, and the transformation into continuous current at lower pressure by static and rotary transformers, through the work of Tesla, Stanley, Scott and others. The first actual proposal to use this combination was made in 1896 by our past president, Mr. Arnold, and it has now become the standard practice.

One immediate result was that rapid introduction of comparatively long distance high-speed interurban lines, which although generally operating single cars have had such an influence upon steam railways and been so instrumental in welding together urban and rural communities.

But with all the advances made, train operation was still limited, and largely because of adherence to old established locomotive practice. Having been for a long time engaged in developing the indirect control of elevators, the thought suddenly flashed upon me that trains could be better operated by simultaneously operating a number of controllers, each with its own motors, thus allowing any desired aggregation of independent units in a train having all the characteristics of the individual. This, known as the "multiple unit" system, received its baptism on a train of cars at Schenectady in 1897, and was first adopted at the South Side Elevated of Chicago, although I had for a long time pleaded for an opportunity to make a demonstration on the Manhattan Elevated, as I had pleaded for many years for electric operation in all rapid transit work. It was, of course, a logical development, and has now received the stamp of universal recognition. Some measure of its practical importance may be gathered from the statement that by reason of the increase in capacity alone, it has the potentiality of adding at least fifteen millions of dollars to the capitalized value of the subway.

Up to the present time almost all important work has been conducted with continuous-current motors at moderate potentials, but on any large system this requires the transmission of energy primarily from a long distance by alternating current, and reduction to a lower pressure and transformation at substations.

To economically extend the radius of electric operation from these substations, it is, of course, essential to work at comparatively high pressure, and in order to attain this end without running into serious or assumed difficulties with continuous-current motors, as well as to get rid of the moving element in substations, the activities of leading engineers, among whom must be mentioned Tesla, Finzi, Lamme, Eichberg and Steinmetz, have for some time been bent on the development of the alternating-current motor. The earlier attempts in this direction were for a machine without a commutator, that is, one that could be operated by polyphase currents, and it is on these lines that the admirable work of the Ganz Company and the high-speed tests on the Zossen military line in Germany have been carried. But the recent developments, in this country at least, have been almost wholly along lines of single-phase operation in order to maintain the simplicity of the present trolley line practice. A large measure of success has already been attained in this direction, so much so that the single-phase motor can now be accepted as an essential contribution to railway operation, its adoption being a matter of individual determination. In this connection I should add that Mr. Arnold was one of the earliest and has been one of the most consistent advocates of single-phase operation.

Such is the brief and imperfect review of an industrial development whose spidery web has enmeshed our modern life, and is rapidly changing the current of our affairs. And where now are the men who have borne the brunt of the fray? Werner Siemens long ago has passed to his reward, after a life of useful activities. Charles Van Depoele, too, has gone, leaving behind an ineffaceable record. Then Reckenzaun, Henry and Short joined the vast majority. But Field and Edison, now, thank God, happily recovering from a serious illness, and Daft are with us. And so are most of my own corps, the boys to whom my heart ever goes out in gratitude and affection, who stood loyally shoulder to shoulder and fought a good fight in the old days. One of my trusted associates, Dana Greene, found sudden death in the icy waters of

Digitized by Google

the Mohawk in the midst of a splendid career, but Oscar Crosby, wearing the laurels of an intrepid explorer, has come out of the desolate East after achieving fame and nearly immortality in the frozen peaks and solitudes of the Himalayas.

A younger generation is coming to the front, and new and splendid fields await them. The hum of the motor is no longer a song only of emancipation, but a hymn of praise, paen, challenging on its chosen ground the locomotive whose throbs have been rightly called the heartbeats of civilization.

Is it a siren's song? Not if listened to soberly and with the guide of experience. And perhaps I may on this occasion say a few words in answer to that ever-present query, "Will trunk lines be operated electrically?"

We stand in the midst of the solution of grave and complicated problems, incident to the demands of our local situation. Terminal improvements on the New York Central, Pennsylvania and Long Island railroads, costing nearly eighty millions of dollars, and making possible chiefly because of electric traction, supplementing the equipment of the surface, elevated and underground railways, may well dazzle the mind, and lead to hasty conclusions, forgetting that in so far as these problems are out of the ordinary they are many of them special in character.

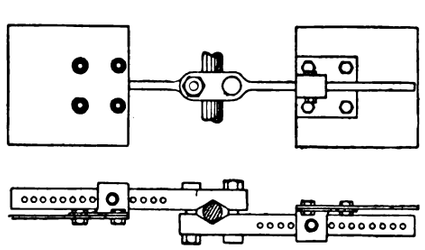
We have thirty thousand miles of line to the credit of the electric railway in this country alone, but the character of the traffic and the service performed by these lines is absolutely distinct from that pertaining to trunk-line operation. Two hundred thousand miles of road and over half a million miles of track are in its grasp, a prize worth fighting for, but not easily won. Understand, I do not for one moment take the position that a railroad, no matter how large, can not be operated electrically. It can be. Energy of that amount can be transmitted for any distance commercially required. Motors of large power and aggregated into combinations of capacity greater than that of any steam locomotive can be built and perfectly controlled.

And with great power there is, of course, the possibility of high speeds, but a well ballasted track, free from curves, grades and grade crossings, a reserved right of way, perfect brakes and signals, infrequent stops, and favoring outward conditions are equally essential to steam or electric traction of the first order. It is sustained, not extraordinary maximum, speed which is required in practical service, and sustained speed is a matter of finance.

What, then, will determine the future? Solely this financial factor, as it must the future of any other great industrial problem. When savings in operation and the increased return from traffic on any road will more then pay a fair dividend on money invested for electrical equipment, then and then only will trunk lines, great or small, be operated electrically. As I have often stated, the problem resolves itself into a question of relative density and the character of load-factor, and these essentials are, of course, vitally connected with the allowed working potential on a trolley line. There is a tendency to assume that the limitation of operations by continuous-current motors has been reached, and that the only possible large development is with the alternating-current motor. I say God speed the alternating-current motor, and every mile it adds to the radius of action is a mile to the good, but speed also its sister, which has as yet by no means reached the limit of its usefulness.

Absorption Dynamometer.

In the *Electrical Engineer* (London) for February 3, a simple absorption dynamometer, designed by Mr. W. G. Walker, is described. As will be seen from the accompanying illustration, the dynamometer is merely a centrifugal fan, consisting of two arms which may be bolted



WALKER ABSORPTION DYNAMOMETER.

to the shaft of the motor, and which carry two vanes. These vanes may be adjusted radially, or vanes of different size may be substituted quickly. When once the dynamometer has been calibrated in a certain position, the power absorbed for every speed is known.

Convention of the International Association of Municipal Electricians.

At the meeting of the executive committee of the International Association of Municipal Electricians, held at Erie, Pa., February 13, the date for the convention was set for August 29, 30 and 31, 1905.

Determination of the Commercial Efficiency of Continuous-Current Machines.

The *L'Industrie Electrique* (Paris), in its issue of January 25, prints a translation of an article by M. S. Baldine, from the *Electritchestvo,* in which the well-known Hopkinson or circulating test for determining the efficiency of continuous-current machines is examined. The test, as usually made, involves several sources of error. The currents in the two armatures are equal, but this may be allowed for by computation. However, the iron losses are not the same, since the voltage of the generator must be somewhat higher than that of the motor. A method of correcting this is suggested. It consists of connecting in the circuit between the motor and generator an auxiliary supply, such as a storage battery, and in series with this is a regulating resistance. Then, for any particular load, the loss of potential due to leads and armature resistances is computed, and the auxiliary adjusted until this loss of potential is just compensated by the auxiliary source of electromotive force. This being done, it is known that the iron losses in the two machines are the same, and the difference in the copper losses may be allowed for, as indicated above. The method of computing the necessary auxiliary potential for any particular load is given, as well as the equations for the efficiencies of the two machines.

The Office of the "Brooklyn Eagle."

The *Brooklyn Eagle* has recently enlarged its fine building and has added every modern convenience, not neglecting the many facilities provided through the medium of electricity. Its tower is illuminated nightly by some 1,500 incandescent lamps which are used on special occasions for signaling. The *Eagle* presses are controlled by the Kohler electric system, and each press is operated by individual electric motors, as is every piece of machinery in the entire building. The use of that wonderful time-saving invention, the telephone, is reduced to a science in the large and convenient reporters' room. Each reporter's desk is wired so that the portable telephone can be brought to it and conversation carried on without his leaving his work.

A party of New York newspaper men and electric light and electric railway officials were shown through this interesting building on Saturday last under the guidance of Mr. Herbert F. Gunnison, the publisher of the *Eagle*. The party previously enjoyed a luncheon held at the Hamilton Club, presided over by Dr. St. Clair McKelway, the editor in chief of the *Eagle*.

Digitized by Google

FUEL ECONOMY IN STEAM POWER PLANTS.[1]

BY WILLIAM H. BOOTH AND JOHN B. C. KERSHAW, F. I. C.

INTRODUCTION.

In presenting this paper the authors are aware that economy in most or all electrical power plants, as usually understood, is at present unattainable. The lighting station, the load of which at every moment of its working hours can, with care, be arranged to suit the economical load of the running plant, is nevertheless seriously handicapped by the very short length of time during which the total plant is at work. The possession of a really durable and efficient storage battery would raise the load-factor of the plant probably eightfold. The traction power-house, the load-factor of which, for tramway work, varies approximately with the cube root of the number of cars run, can not be worked economically, because, though all the power in the station must be run all the working hours, excepting, of course, necessary spares or stand-by plant, yet the load on the running plant varies from a maximum to a minimum every few minutes, and the mean load of the plant, except in the case of systems of several hundred cars, is but a small proportion of the total maximum load, and the steam engines at least must be wasteful. Here again economy in its fullest sense is a question of accumulators.

The authors assume that the fullest economy of first cost, and more especially of running cost, is recognized by all station engineers as only obtainable, in the present state of knowledge, by means of a battery. But they are also aware that the battery is so far from perfect that its adoption in any case must still be a matter of grave and careful deliberation, and that the greatest economy ideally possible is too controversial to enter into in this paper, save incidentally. But there are numerous economies possible in every power plant, and an endeavor will be made to point these out in the hope of stimulating the search after possible and practicable economy, to suggest thoughts on which all station engineers may work—thoughts many of them suggested to the authors by engineers who have directed their own energies in certain directions more than in others. Economy, commercially considered, is not identical with economy of first cost, nor yet with economy in fuel or wages. Nor can commercial economy be defined even as that compromise which makes the best return on the outlay, for there are other considerations which are sometimes paramount.

It is, for example, justifiable to economize plant in a traction station down to such a point that, at occasional special loads, the cars shall run a small percentage slow. But the parallel happening in a lighting station is altogether undesirable and defeats its own ends, because the public who use current are not yet trained to switch off some lamps when current fails. In all which follows, therefore, it must be understood that every means to economy that is put forward must be considered afresh for each particular case, for its adoption may be good or otherwise, according to the company in which it finds itself, and, though the authors are particularly concerned in fuel economy pure and simple, they are not unmindful of the discounts to be made on account of commercial considerations.

Steam-power economy is to be secured by attention to fuel and its combustion, feed water and its treatment and heating, furnace design and arrangement, steam treatment and its use in suitable engines.

The subject divides itself into the several heads as follows: (1) feed water; (2) fuel; (3) boilers and furnaces; (4) steam; (5) waste gases; (6) draught. In such a paper statistics would only lead to controversies that might obscure the intention of the paper, which is rather to emphasize principles than to indicate beaten paths.

FEED WATER.

Most electrical engineers are now ready to admit the importance of attention to the physical and chemical characteristics of their feed-water supply, and they recognize the impossibility of obtaining the highest efficiency from their boilers if the water is passed into them without preliminary heating, carrying all the original suspended dirt and dissolved impurities. Only very few natural waters are fit for use in steam boilers without some preliminary treatment; chemical examination can alone reveal whether this treatment is required and what must be its character. It is not the authors' purpose to go at length into the theory and practice of water softening for steam-raising purposes, and they will only deal very briefly with a few of the more important points arising in a consideration of the subject. The practical side of the subject was dealt with very adequately by Messrs. Stromeyer and Baron in a paper read before the Institution of Mechanical Engineers last session.

Analysis—The examination of a water intended for steam-raising purposes should cover its acidity or alkalinity, presence of oily or fatty matter, total solids, temporary and permanent hardness. A trained chemist is required for this work. The examination of the water supply should be repeated at monthly intervals, since changes occur in the composition of all natural waters, according to the period of the year and the rainfall. Water taken from rivers or streams near the coast is subject to contamination by sea-water at the periods of flood tide in the spring and autumn, and this danger must be recognized and guarded against.

When softening apparatus is installed, whether of the automatic or intermittent type, daily tests should be made of the water leaving the apparatus, since there is grave risk in many cases of excessive amounts of chemicals being used for softening. This excess produces priming and other evils in the boilers. The authors have seen at a north country works an ingenious automatic arrangement of twenty-four vessels for retaining this number of separate samples of the water during the day's work, each one filling in succession and requiring one hour for this purpose. The chemist at these works spends half an hour each morning in this sampling place (which is kept locked), and tests in this time selected samples of the previous twenty-four hours for alkalinity and hardness. Some check of this kind is imperative, since even the most reliable types of automatic softening apparatus are apt at times to get out of order, and variations in the composition of the water supply, as already noted, occur during the spring and autumn months of the year.

Softening Apparatus—All waters containing more than fifteen English degrees of total hardness (*i. e.*, an equivalent of fifteen grains of calcium carbonate per gallon) should be subjected to treatment with chemicals before use in the boilers; and in large steam-generating plants it would probably pay to put in a softening apparatus when the water employed tests above ten degrees of hardness.

The addition of "boiler compositions" to the feed water as it enters the boilers is unscientific and bad. A boiler is designed for making steam, and not for carrying out half a dozen other operations, which sellers of "secret" compositions and unwise engineers sometimes attempt in it. External treatment of the water in an apparatus, which permits removal of the deposit before the water enters the boiler, is therefore an essential condition of scientific steam-boiler management. The

[1] Paper read before the Institution of Electrical Engineers, January 12.

Digitized by Google

authors do not propose to discuss the relative advantages of automatic and intermittent softening apparatus. Each type has its advantages and disadvantages, but scientific control is required with one, as with the other, to obtain the best results; and, in the absence of this, boiler troubles are certain sooner or later to ensue.

Scale and Grease Troubles—A thin coating of scale upon the boiler plates is advantageous, since it protects the iron from pitting and corrosion. When this coating has increased to one-twentieth of an inch in thickness no further advantage is gained, and the rate of the heat transfer through the plates is diminished enormously as the scale increases in thickness. The heat-conducting power of scale is stated by various authorities to be between one-thirtieth and one-hundredth that of boiler plate, and should the scale contain oil, its conductivity for heat is still further reduced. The presence of oily matters in scale can be easily detected by heating a small portion of the scale upon a platinum spatula in a Bunsen flame; the scale, if it contains oil, chars and gives off a disagreeable odor under such conditions. Oil in the water supply, and oily scales are a cause of pitting and corrosion, since animal and vegetable oils yield decomposition products of an acid character, at temperatures which may easily occur within the boiler. The examination of the water supply must, therefore, include tests for oily and fatty matters, when water from the exhaust is employed. When mineral oils are used for lubrication this danger, of course, is not so great, since these oils do not yield fatty acids on decomposition; but even in this case it is the better plan to keep the oily matters out of the boilers by efficient filteration. The addition of caustic soda to the feed water as it enters the boilers, in order to saponify the fatty matter, is not to be recommended, since soapy water leads to priming and other troubles only a little less serious than those caused by oils. Although the complete separation of oil and grease from feed water is not a simple matter, it can be effected with well-designed apparatus intelligently worked. As a guard against pitting and corrosion, the authors recommend the use of zinc slabs and rods, bolted in suitable positions to the stays and angle plates of the boiler. The action of this metal is too well known to require comment; and even if its electrochemical action does not come into play, these metal projections into the body of boiling water will help to promote regular steaming in the boiler.

Preheating and Thermal Storage—The advantage of feeding the boilers with water approaching as nearly as possible to the boiling temperature is now fully recognized. Not only does this promote more regular steam generation and, therefore, the efficiency of the boiler plant, but it also accelerates the softening process, since the chemical reactions upon which this is based take place much more rapidly in hot solutions than in cold or warm ones, and the precipitates obtained are more easily settled out in the former case.

The only question regarding the value of preheating upon which engineers are now disposed to differ, relates to the use of live steam for this purpose. It is admitted that all the waste heat of a boiler plant, whether of the exit chimney gases or of the exhaust and condensing water, should be utilized, if possible, in the feed-water supply, and that the heat obtained in this way is clear gain. But, the advantages of using live steam, in addition, for heating the feed water up to 212 degrees Fahrenheit, or above that limit, as in the thermal storage system, is not by any means fully recognized, and there is still a disposition to regard this method of using live steam as uneconomical and wasteful. The authors do not agree with this view. The heat of the live steam is retained in the feed-water heater, and the advantages to be gained by having all the water heated to a temperature of 212 degrees Fahrenheit or higher, far exceed the slight loss of heat which occurs by condensation and radiation from the connecting pipes between the preheater and the boilers. Of course this loss must be minimized by placing the feed-water heaters close to the boilers.

The real cause of the increased efficiency which independent authorities (as, for instance, Mr. Miller and Colonel Crompton) assert has been obtained from boilers fed with water at or above 212 degrees Fahrenheit, is not yet settled. If water containing solid matter in suspension be heated in a glass vessel, it can be observed that convection currents are set up which continue until the boiling temperature is attained. These currents must necessarily absorb some portion of the heat energy of the fuel, and convert it into mechanical work. A possible explanation of part of the gain observed when feeding boilers with water at or above 212 degrees Fahrenheit is, therefore, that the loss of heat due to the performance of merely mechanical work is avoided, and the whole of the heat energy of the fuel is devoted in the boiler to the conversion of the water into steam. In the feed-water heater as usually designed, convection heating does not take place to any great extent, the water being heated by falling through the steam in the form of mist or spray.

This explanation finds some support in a paper read by Mr. Hamilton before the Belfast Mechanical and Engineering Association in 1902, and quoted in a leading article in the *Engineer* of August 19, 1904. In this paper Mr. Hamilton pointed out that the hotter the water inside the boiler the greater is the amount of heat which passes through the boiler plate per unit of superficial area, the measure of relative efficiency being the gain in temperature when not steaming and the water evaporated when steaming. The increased heating power when steaming represented a gain of about 100 per cent in the normal heat-transmitting power of the boiler plates.

The subject is well worth more study than it has yet received, for the facts relating to the gain in boiler efficiencies when fed with water at or above 212 degrees Fahrenheit seem indisputable, and when a satisfactory explanation of the cause has been given engineers will no doubt be ready to adopt preheating and thermal storage plant to a much greater extent than is now the case. The steam boiler of the future is likely, in fact, to be specially designed for this double duty of preheating its feed water and providing steam; and it is interesting to note that one or two boilers of this type have already been designed and patented.

FUEL SUPPLY.

The importance of the fact that fuel represents fifty per cent of the total works cost in the generation of electricity, and that from ten to twenty per cent of this outlay can be saved, is often ignored by engineers when contemplating the low price at which they have placed their fuel contracts. It is held that because fuel is cheap, therefore it may be wasted with impunity; and much of the inefficiency to be found in the boiler houses of electricity works is to be traced to this fallacy.

But a ten per cent saving on the total works costs is worth effecting even when these costs are exceptionally low; and systematic sampling and testing of the fuel would in many cases be found to save money. The supplies of fuel, whether cheap or dear, ought, therefore, to be subjected to regular sampling and testing. A check upon the colliery firm or coal merchant supplying the fuel is afforded by the laboratory examination, and this is useful not only in maintaining regularity in the quality of fuel supplied, but also in affording a basis for the new contracts

Digitized by Google

which are from time to time made. The recent letter of Mr. C. E. C. Shawfield, of Wolverhampton, which appeared in the *Electrician* of October 7, 1904, is proof that at last the truth of these statements is being recognized; and the only criticism the authors have to make on this letter is, that Mr. Shawfield does not appear to recognize the need of employing specially trained men for sampling and testing work.

Sampling—The sampling of fuel requires care if the sample is to be representative of the bulk supplies, and much of the distrust in engineers' minds relative to the value of laboratory examination of fuels, has been due to lack of expert control of the sampling operation. A copy of sampling rules is, therefore, included in the appendix of this paper, and it is recommended strictly to adhere to these when sampling fuel for analysis. It may be considered a striking fact, but it is none the less true, that a sample of only one pound in weight, when properly taken, can be truly representative of 50 or 100 tons of coal; and from such a one-pound sample a trained chemist can, by further grinding and reductions, obtain a sample of two grammes or less which shall be equally representative of the original bulk of fuel.

Whole shiploads of copper and iron pyrites containing several hundreds of tons are regularly sold on the results of the analyst's tests made with only one-half gramme of ore, without any disputes occurring between buyer and seller, and it is certainly not impossible to obtain equally accurate sampling and testing in the case of fuel. But, as already said, scientific knowledge and control are required in the sampling operation, and lacking this no fuel test is worth the paper upon which it is written. The idea should therefore be given up that a few shovels of coal taken from any part of the fuel heap and placed in a box constitute a "sample," and some personal time and attention should be devoted to the rudimentary principles of sampling and to the training of men specially for this work.

A regular and constant check upon the fuel supplies can then be obtained by having daily samples of the fuel taken. These samples can either be tested separately, or an average can be obtained at weekly intervals, by mixing all the daily samples and reducing these to smaller bulk in the manner described in the sampling rules. When a coal-conveying plant is installed, an automatic sampling arrangement should be added to it.

Testing—The testing of fuel for technical purposes should cover moisture, ash, coke, volatile matter and calorific value; the last being calculated from the proximate analysis and also ascertained by burning from one-half gramme to two grammes of the fuel in one of the various forms of fuel calorimeters. Men without training in chemical analysis should not undertake this kind of work. Fuel calorimetry is difficult, and even trained chemists require practice and experience in it before trustworthy results can be obtained.

Placing Fuel Contracts—It is often found that the fuel which yields the best laboratory test results is not that which produces the most steam per pound of fuel when burned under the boilers; and a tendency is manifest to make use of this fact as an argument for dispensing altogether with fuel analyses and calorimetric tests, when placing fuel contracts. This view is a superficial one, and is wanting in a true appreciation of the factors which govern the combustion of fuel under the boilers.

Every type of boiler-surface is naturally best fitted for burning a specific kind of fuel, and by empirical trials this fuel may, of course, be found. When fresh contracts are to be made two courses are open; either to obtain a fuel as nearly as possible equal in physical and thermal properties to that last contracted for—or, to obtain a different fuel and adapt furnaces and draught to the new fuel. Now the chemical and calorimetric examination is of the greatest value in either case. It simplifies the search for a fuel similar in all characteristics to that last used, since if the percentage of ash, volatile matter, coke and fixed carbon be determined, the desired fuel can be selected without recourse to the troublesome and expensive steam-raising trials under the boilers. If, on the other hand, another type of fuel be selected owing to its much lower price, the laboratory examination will be a guide to the changes required in furnace construction, methods of firing and draught, in order to get smokeless combustion and high efficiencies, when this fuel is burned under the boilers.

Too little attention has certainly been given in the past to this question of adapting the furnace construction and methods of firing to the fuel, and whatever boiler makers chose to recommend has been much too readily accepted. Most of the electricity works where high-priced fuel is now being used, because it is asserted that steam can not be kept up or that smoke is produced when burning cheaper fuel, are simply playing into the hands of the South Wales colliery companies.

The authors assert that with suitable furnace construction and scientific control, bituminous fuels can be burned without causing smoke troubles and with high efficiency under every type of boiler, and that great savings in fuel costs could be effected in this direction. But the furnace construction must be adapted to the fuel, and it is absurd to suppose that furnaces designed for burning anthracite or semi-anthracite fuel will satisfactorily burn fuels containing thirty per cent or more of volatile matter. The percentage of volatile matter which a fuel gives off when heated is in fact a measure of the size of the chamber required for its complete combustion, and it is here that the laboratory examination of fuel yields results of the greatest value. That such an examination is still regarded as unnecessary and of no help in the placing of fuel contracts, is clear proof of how much has still to be learned in the scientific control of steam plant.

AIR SUPPLY.

The advantages to be gained by a preheated air supply are very great, and it is surprising that hitherto so little attention has been given to this subject. In 1881 Hoardley, in the United States, published details of some unfavorable experimental trials relating to the use of preheated air, and possibly these unsuccessful results may have deterred others from experimenting along similar lines. But the gain in economy and efficiency by raising the combustion temperature inside the furnaces by the use of heated air is great, especially if heat otherwise wasted is applied to heat the incoming air.

This ideal system would be to reduce the exit flue gases to atmospheric temperature by means of economizers, air heaters, and preliminary feed-water heaters—chimney draught being dispensed with and the draught produced by fans. The preliminary feed-water heaters would be placed last in such a system, and the whole of the remaining heat would be removed from the exit gases by spraying the water through them, or by use of a tower filled with tiles or flints.

Little or no unconsumed carbon would be produced under the conditions obtaining with a very high temperature in the combustion chamber of the furnaces, and the sulphur dioxide and CO_2 absorbed by the feed water would be neutralized in the water-softening operation. It must be

Digitized by Google

remembered here that the sulphur would finally appear in the boiler as sodium sulphate, but the authors suggest that it (the sulphur) might be recovered in some way, and made a source of revenue to the feed-water purification plant. The air-heater would be of the type used in the regenerative gas furnace—lengthened contact with a considerable surface of heated brickwork being necessary to heat air, which is a poor conductor of heat and demands time for its temperature to be raised.

As regards the thermal advantages of heating the air used in the combustion process it may be pointed out that from twenty pounds to twenty-five pounds of air are usually required per pound of fuel burned, and if this air could be raised to 300 degrees Fahrenheit before entering the furnace the final temperature after combustion would be increased practically by a like amount. A gain of 300 degrees Fahrenheit in the furnace temperature is not to be despised.

According to Stromeyer's experiments[1] the usually accepted formula for the relation between the rate of heat transmission (a) and temperature (t) is incorrect, and in place of the former varying as the square of the temperature difference, or $a \sim (t_2 - t_1)^2$, the ratio is expressed by the formula, $a \sim (t_2 - t_1)$. Even though the ratio be not as the square of the temperature difference the formula shows that a much greater efficiency will be obtained from a high than from a low initial furnace temperature.

The most important causes of low initial furnace temperature are excessive air supply to the furnaces and too sudden contact of the half-burned gases with the water-cooled tubes or plates. Larger combustion chambers and refractory furnace linings are the proper remedy for the latter evil, and gas-testing is the check and remedy for the former.

Furnace temperatures might, in many plants, be raised 500 degrees Fahrenheit or 1,000 degrees Fahrenheit by attention to these two points alone, but even then the limit of what is attainable in this direction would not be reached. By the use of a heated air supply in conjunction with closed-in ash-pit and induced or forced draught, much higher temperatures can be attained in the boiler furnace; and should Rowan's suggestion[2] for working such furnaces under two or three atmospheres pressure be adopted, further increases of 715 degrees Fahrenheit and 493 degrees Fahrenheit could be attained. The possibility of obtaining far higher evaporative efficiencies from boiler plants than any yet attained, by intensifying the combustion along these lines, is therefore strikingly manifest, and it is surprising that hitherto so few attempts have yet been made to put these suggestions to a practical trial in new plants or extensions.

The authors have, however, recently inspected one plant where mechanical draught, closed ash-pits and a heated air supply have been installed. This station has recently been designed and erected under the charge of Mr. S. E. Fedden, for the Sheffield (England) corporation at Neepsend, and is at present equipped with two 1,500 kilowatt turbo-generators of the Parsons type. It has not yet commenced full work; but excellent results are said to have been obtained with the same system of induced draught and heated air supply at the older generating station of the Sheffield corporation, and it is believed that these results will be surpassed in the new station. A full description of this plant has already been published.[1]

The limit of improved efficiency possible in this direction is that imposed by the ability of the steel used for boiler construction to withstand very high temperatures under steam pressures of 150 pounds or 200 pounds; but no doubt the resisting qualities of steel plates in this respect could be greatly improved, and the more general use of refractory linings to the boiler furnaces would also assist in meeting this difficulty.

BOILERS AND FURNACES.

The choice of a boiler will depend on the circumstances of each particular case.

There are three general types of boilers:—(a) The large shell type such as the Lancashire and Marine. (b) The large water-tube. (c) The small water-tube.

For long-continued steady work such as electric tramway work the type (a) is good. For lighting work and large installations type (b) is good. Type (c) is suitable for the peaks of loads of short duration, and can be heavily forced without danger.

In every case there are certain stand-by losses to be reduced by attention to air-tight brickwork and heat insulation. The rate of loss can be found by closing the dampers and observing the rate of pressure or temperature reduction of a standing boiler. The losses thus observed may be greater than those from a boiler at work, for they include air-leakage loss, which may be less with a working boiler than with one at rest. That a boiler contains much heat in a large mass of water is no reason why its stand-by loss should be great. Small stand-by loss is rather a question of external heat radiation and of convection by air currents. Hence the importance of tight dampers. The type of boiler to be employed is less a matter of heat storage than of rapidity of steaming from colder conditions. Once the temperature of full pressure has been attained, the boiler containing much water will answer as rapidly as the flash boiler to an increased urgency of fire. The conditions of an electric light station may be held to point to the use of light water-tube boilers of the express type fired by liquid fuel. This policy will be the more suitable as the load peak becomes of greater height and shorter duration. The expense of fuel will be counterbalanced by the staff reduction which a purely mechanical plant renders possible.

The economy to be secured by employing cheap and uneconomical engines for getting over brief peaks of the order of those in a lighting station must not be allowed too great weight in view of the fact that a wasteful engine makes a greater demand on the boilers and too big a saving in engine cost will demand too great an expense in extra boiler power or too large an increase of fuel combustion if the boilers are unduly forced to supply the extra steam. But it may well form a point to be considered whether a boiler that can be heavily forced for short periods is not most suitable for high peak loads. On this point engineers should distinguish between an installation for home and for abroad. Abroad, in many places, one need often only count upon forcing boilers for the few minutes either side of the maximum peak. The same forcing can not be done for hours at a time, as might be required any winter in a big English city during a fog which may last a week. It behooves the designer, therefore, to proportion boiler plant cautiously for lighting work, and somewhat more boldly for mere power work. But he should certainly consider

[1] Memorandum to the Manchester Steam-Users' Association, 1902.

[2] *Cassier's Magazine*, December, 1903.

[1] The *Electrician*, vol. lili, p. 465.

Digitized by Google

the possibilities of superior fuel used for short periods only.

Where coal is the fuel the provision of a second supply will present difficulties that may be more serious than the provision of more boilers; but with a system of liquid fuel, the conveyance of the fuel to the furnaces is a simple matter, and it may well pay to employ expensive liquid fuel during heavy loads of short duration, if capital outlay is thereby reduced together with rent and attendance.

This seems for Great Britain at least the proper use of liquid fuel, and this view is forced on us by a consideration of the relatively small output of liquid as compared with solid fuel. Any more general employment of liquid fuels would deplete the market and raise prices.

The Lancashire Boiler—This type of boiler has the advantage of larger water contents and will respond to a sudden demand for more steam with less loss of pressure than is possible with boilers containing less water. In every type of boiler the water is at the temperature of the steam and only awaits the addition of its latent heat to become steam. Obviously, therefore, the urging of the fire to greater activity will promote an increased production of steam proportionate to the increase of heat units generated by the fire, no matter what the weight of water in the boilers.

The Lancashire or shell type of boiler has the advantage of small heat-radiating surfaces, especially where several boilers are set in a battery. With most water-tube boilers there are at least two side walls to every two boilers. There are only two side walls to any number of the Lancashire boilers, and heat radiation is confined to the front end and top. The chief disadvantage of the Lancashire type of boiler is the furnace. It is narrow in width, has a low crown of water-cooled plate inimical to good combustion, and it can not be lined with firebrick without considerably reducing its dimensions, nor so far do we know of any very successful lining having been done in this country except in dust-firing.

The shell boiler has a large water surface, and gives off steam quietly and fairly dry. It costs very little to maintain, and, being certain and reliable, can be employed with a less proportion of spares than other boilers. In large installations the advantage of a larger water contents is reduced because the steam output of a dozen or twenty water-tube boilers may average out to a steady curve. But for small stations the shell boiler offers better prospects of steady pressure.

The Water-Tube Boiler—Though this boiler does not possess the steady steaming qualities of the larger shell boiler, this fault decreases as the number of boilers increases. It is more apt to prime, and it has greater liability of stand-by losses and larger radiation losses and maintenance. Being externally fired, it possesses great furnace potentialities, which are easily secured. The water-tube boiler can take full advantage of the external furnace provided that the process of combustion is allowed to be carried out in conformity with the known facts of physics and chemistry.

The Small-Tube Boiler—This boiler is merely another step forward in the process of splitting up the heating surface and reducing water contents. Carried to still greater lengths, it produces the flash boiler.

As the water contents are small steam can be got up quickly from cold water, but even here, as shown in Fig. 1, considerable heat is absorbed by the brick lining of the casing, so that the full out-

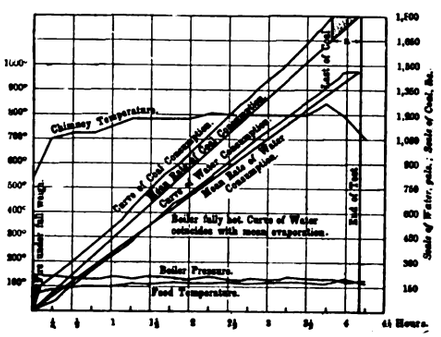

Chimney Temperature.
Curve of Coal Consumption.
Curve of Water Consumption.
Mean Rate of Water Consumption.
Boiler fully hot. Curve of Water coincides with mean evaporation.
Boiler Pressure.
Feed Temperature.
End of Coaling.
End of Clinkering.
Scale of Water, gals.; Scale of Coal, lbs.
Hours.

FIG. 1.—BOILER TEST. CURVES SHOWING HEAT STORAGE IN BRICK CASING OF SOLIGNAC BOILER.

put of steam does not begin until the boiler has been some time steaming. Hence the bend at the beginning and end of the coal and water lines in the diagram, showing heat absorbed and given off by the brickwork. These small boilers appear to offer themselves for supplying emergency steam. Fired by liquid fuel, some of these boilers, such as the Solignac, could instantly be put in full work if filled up with fully heated feed water from a thermal store tank. The full fire might be started almost as soon as the water had been turned into the empty boiler.

FURNACES.

The economy possible from many appliances lies entirely in the possibility of using a cheaper fuel. Unscientifically designed furnaces are unfortunately of lowest first cost. There are certain essentials to the perfect combustion of bituminous coal which, if wanting, render necessary more expensive Welsh coal. The three essentials for the proper use of bituminous coal are a furnace so arranged that the gases given off the green fuel and air to burn those gases shall travel over the length of the fire together, under a draught velocity of not less than thirty feet per second. The mixed gases must have a free unencumbered space beyond the furnace in which to complete combustion, and this combustion will be complete if the third essential of temperature be present.

In shell boilers of the Lancashire type without cross tubes, with roomy brick flues and a 200-foot chimney, a careful hand stoker will burn bituminous fuel without smoke. But this boiler has a water-cooled furnace, and is at just about the critical point as regards smoke production. With a less skilled man or a less active draught smoke will be produced. The presence of water cross-pipes beyond the bridge will render smoke still more easy to produce. Observations of some thousands of boilers, with and without cross-pipes, have demonstrated to the authors the great influence of this detail on smoke production.

The ordinary furnace of the usual types of water-tube boiler is hopeless. No perfect combustion can possibly take place where the gases rise vertically from the grate and pass directly between the cold tubes above. The essential sweeping effect is absent; there is no air mixture, and there is no sufficient temperature. Yet almost invariably this common and inefficient setting is accepted for the few pounds of saving effected in first cost, with the result that the whole cost of the boiler in a year or two is paid away in the shape of more costly coal.

The water-tube boiler, in common with most or all externally fired boilers, can be supplied with a furnace of perfect form, of refractory material, and with suitable air admission. Such a furnace will be smokeless and economical. The water-tube boiler has thus undoubted potential advantages over the shell boiler which has a furnace, perfect it may be in form, but covered with a water-cooled arch difficult to line with refractory temperature conserving material. That air mixture and time are recognized to be factors may be judged from the fact that, in the Belleville boiler, jets of compressed air have been blown into the furnace to produce rapid horizontal movement and mixture of the gases, and to compel combustion by lengthening the path of the gases between the fire surface and the water tubes. The effect of the air jets is to diminish smoke, but they are

Digitized by Google

a poor and uncertain substitute for proper form of furnace. The familiar classroom experiment of extinguishing a candle by cooling the flame by means of the heat-radiating power of a cone of wire helps one to realize the conditions under which bituminous coal is ordinarily burned.

As between Welsh coal and bituminous, the thermal units of the latter per unit of cost are usually superior to those of the former, and it is easy to understand why large power stations prefer to pay an occasional £100 in smoke fines rather than to abandon one coal for another of twice the cost, though it is less easy to understand why correctly formed furnaces are not employed. In existing stations, with floor lines fixed, basements occupied, and pipes difficult to alter, the change to good furnace conditions may involve considerable difficulty, but in laying out new plant it should be possible to afford the necessary head-room to give good furnace arrangements. The appearance of 99 out of any 100 boiler houses tends to the impression that the designer has acted on *laissez-faire* principles, or has been denied the small additional cost that would be added to the lowest tender which, irrespective of future trouble and expense, rules his employers' judgment.

In running a station, coal is one of the principal items of cost, and the ability to employ cheap coal justifies a reasonable expenditure on furnaces to enable such cheap coal to be used. Only, however, by suitable furnaces can the minimum of cost be secured, and the great economy usual as between Welsh and bituminous coal, is only to be had where furnace forms, draught, and lining are correct. Possible only with care in internally fired boilers, this correctness is easy to obtain with externally fired boilers, but is rarely attempted. Smoke is looked upon as inevitable, and the engineer may make all the smoke he wants if he can show that he has used ordinary plant.

Heating Surface Efficiency—Particularly in water-tube boilers, provision must be made to ensure that all heating surface is effective. Gases from the furnace will flow by the path of least resistance to the chimney, and while this path must not be unduly baffled, the area of the path must be sufficiently small to compel the travelling gas to search out every part of the heating surface.

It is perhaps easier to apply suitable tile baffles where the path of the gases is parallel with the tubes than when it is across them. Since the gases shrink in volume as they traverse the heating surface, the cross-sectional area of this space should be progressively reduced if necessary, to prevent short-circuiting. Where final temperature is high after passing a reasonable area of heating surface, the explanation may be sought partially in this direction.

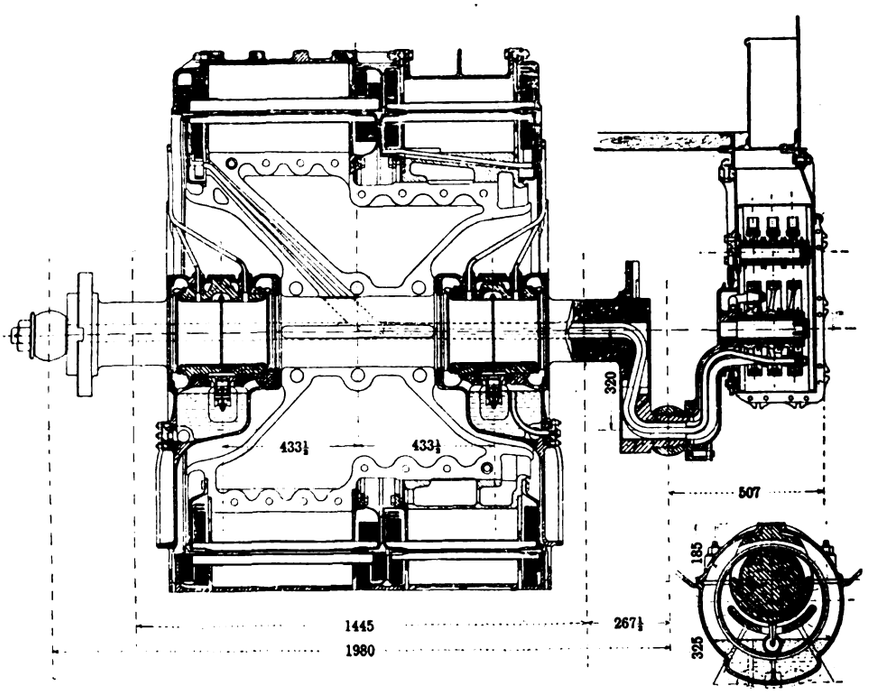
(To be continued.)

The New Valtellina Locomotives.

Three new locomotives have been secured by the Valtellina Railway Company from Ganz & Company, of Budapest. These machines run at two speeds, the change from the higher to the lower being brought about by concatenation. The high speed will be between thirty-seven and forty-four miles per hour, the lower speed being half of this. The frequency is fifteen cycles per second, and the voltage is 3,000.

The motors are three-phase machines, which will give a constant draw-bar pull of three and one-half tons at the higher speed, and six and one-half tons at the lower. The acceleration called for requires that a train weighing 400 tons shall be started on a grade of 1 in 1,000 from rest and brought up to a speed of eighteen and one-half miles per hour in fifty-five seconds. A train weighing 250 tons on the same grade must be brought from rest to a speed of thirty-seven miles per hour in 110 seconds. It is required that the same acceleration be obtained if the voltage fall ten per cent. It is specified that the temperature rise of the motor shall not be more than sixty degrees centigrade at any part after ten hours running at full load.

The motors drive through connecting rods, and are not mounted on the locomotive axles. There are three pairs of driving wheels and two pairs of pony wheels, one at each end of the locomotive. There are two motors on each locomotive, placed between the driving axles. As will be seen from the accompanying illustration, these motors are practically two machines, directly connected, there being on each a double winding, one for high voltage, and the other for low. By means of these windings the concatenation is effected. But three slip rings are needed for this, and, as will be noticed, the conductors are carried through the driving crank. Each motor has two cranks, set at right angles. The high speed of the motor is 225 revolutions per minute. Each rotor is mounted on four bearings. The two inner bearings keep the rotor in its proper position with regard to the stator; the other two fix it with regard to the locomotive frame, and serve as well to support the motor as a whole. The stator is prevented from turning by four bolts, but these support little, if any, of its weight.



MOTOR ON NEW LOCOMOTIVES OF VALTELLINA RAILWAY, ITALY.

The total weight of the locomotive is sixty-two tons. The useful weight is forty-two tons. The length overall is about thirty-eight feet, and the wheel base, seven feet eight and three-eighths inches. The diameter of the driving wheels is four feet eleven inches.

Mr. Robert B. Porter in a recent lecture before the Society of Arts in London, on the electrification of railroads, stated that when present projects are completed London will have more electric railway mileage than any city in the world and also more capital invested in electric railways than anv other city. About $150,000,000 is at present being expended on the railways in the city.

Digitized by Google

Pacific Coast Water Powers for Electrical Operation of Railroads.

"The Use of Pacific Coast Water Powers in the Electrical Operation of Railroads" was the title of a comprehensive and interesting paper read before the Pacific Coast Railway Club on January 21, in San Francisco. The paper was presented by Mr. Robert McF. Doble, consulting engineer of the Abner Doble Company, of San Francisco, and was well illustrated with stereopticon views.

The advantages of electric traction over steam for the operation of railroads were considered under three heads: those appealing to the passenger and resulting in an increase of traffic; those pertaining to the centralization of power; and the economies in first cost, maintenance and operating expenses. As the advantages to the passengers, were mentioned the cleanliness and the better ventilation and lighting of electric cars, and the possibility of obtaining higher average and maximum speeds.

Under the advantages of a central power station, the author spoke of the present-day limitations of the steam station and of the possibilities of obtaining power from hydroelectric plants. Particular reference was made to the conditions on the Pacific coast, where available water powers are distributed at frequent intervals all the way from Southern California up into British Columbia. Only a very small portion of these water powers has been developed, even with the stations now operating and the transmission systems now carrying power throughout the central portion of the state, and the conditions would seem to make profitable the operation of at least some of the railroads by electricity. In such a system of distribution as is possible in California, considerable power might be generated by trains descending mountain divisions and thus fed back and utilized in the distribution network.

Under the third heading, reference was made to the saving in the cost and maintenance of track, the possible increase in capacity of existing railroads, the saving of time and labor in the operation of an electric locomotive, its characteristic simplicity and the rapidity with which repairs can be made. The relative reliability of the steam and electric plant was held to be in favor of the latter, especially in consideration of the local conditions in California, where a number of water-power plants feeding into the same distribution system would make exceedingly remote the possibility of breakdown of anything more than an individual locomotive, and the chances for that were only half those for the steam locomotive.

For comparison, Mr. Doble next considered briefly some of the typical modern steam locomotives and took up the discussion of several different types of electric locomotives using direct current. Alternating-current systems, both polyphase and single-phase, were discussed and well-known roads described.

Turning to the achievements of electric traction in California, particular reference was made to the Los Angeles & Redondo Railway, the Pacific Electric Railway, of Los Angeles, and the North Shore and Key Route systems of San Francisco. The North Shore Railroad is of special interest by reason of its being the first and only third-rail line in California, and because of its being operated from a substation which is the terminus of one of the longest transmission lines in the country. The Alto station referred to is 180 miles from the hydroelectric plant at Colgate and 250 miles from the new De Sabla power-house.

As to projected electric lines on the Pacific coast, reference was made to improvements which the Southern Pacific Company has under consideration for its suburban lines in Oakland, Berkeley and Alameda, to the rumored electrification of that company's San Jose and Port Costa lines and also to the possibility of operating its mountainous divisions by electricity. Mr. Doble concluded with some very interesting remarks on the leading hydroelectric power stations and transmission systems of California.

Rapid Transit Subways.

Mr. Lewis B. Stillwell, electrical director of the Interborough Rapid Transit Company, New York city, in speaking at the annual dinner of the American Institute of Electrical Engineers, drew some interesting conclusions as to the value of the present subway in New York city, and the features which should characterize future undertakings of a like nature.

As a public work the construction of the New York subway has been an object lesson of great significance and value. From start to finish it has been carried out under the direction of the Rapid Transit Commission, without fear or favor, and with an eye single to the public good. No money has been wasted and not the slightest scandal of any kind has attended its progress. The work is a splendid monument to the commission and to its engineers. The community has received maximum benefit at minimum cost. At the same time the enterprising men who ventured their capital in the enterprise, at a time when its success was generally considered doubtful, have reaped a handsome reward to which they are in every sense of the word entitled.

As a railway, the subway demonstrates the value of the four-track system with island platforms. This system makes it practically possible to double the speed which can be attained if two tracks are used. Doubling the speed means doubling the distance at which the average man may locate his residence with respect to his place of work, and, as has been pointed out frequently, doubling the distance means quadrupling the area within which men working in a certain business district can locate their homes and plant and cultivate their own individual vines and fig trees. Every north and south subway hereafter constructed on Manhattan Island should have four tracks—not less—and so far as practicable this rule should be applied in the case of tunnels running east and west, except perhaps those sections which are beneath the rivers. Two-track systems having three or four stations per mile can never secure rapid transit in the sense to which that term is properly limited in such a city as New York.

As regards equipment, the subway has demonstrated in the sight of all men the fact that trains weighing 320 tons can be driven by electric power at a speed of forty-five miles an hour between stations and that electric equipment can develop a tractive effort of 45,000 pounds, which is far more than double the draw-bar pull of the average passenger locomotive.

Electrification of the elevated lines in New York has increased their capacity by one-third and has decreased by one-fifth the time spent on trains by the average passenger. It has demonstrated that the cost of maintenance of electrical equipment of rolling stock is materially less than that of steam equipment. It has proved that electricity can render more reliable service than steam, the aggregate delays due to all causes on the Manhattan lines now being less than one-half per car-mile what they were when steam was used as a motive power. It has eliminated smoke, steam and cinders, formerly the cause of so much annoyance to abutting property owners and to people passing beneath the structure, and it has secured financial results eminently satisfactory to the stockholders of the Manhattan company. The combined system now controlled by the Interborough company is operating electrically more than 250,000 car-miles per day, which I believe is about four times the passenger car-mileage of the New York Central system.

Digitized by Google

ELECTRIC RAILWAY OPERATION IN A GREAT CITY.[1]

BY H. H. VREELAND.

I shall not take the time to describe in detail the extent of your opportunity in the business of transportation. That it is vast your observation will have told you. Substantially it is true, that wherever a line of railway in a town or city would be profitable by any means of propulsion, it would be especially profitable propelled by electricity, and your science has already reached that stage of development which shows that its employment in the movement of trains over long distances is close at hand.

Although it is true that all great industries are organized in this country to-day upon substantially the same lines, and while the peculiarities of each are apparently slight, it is in the comprehension of such differences as do exist that a specialist must excel. The distance between the claim agent and the electrical engineer seems remote until it appears that the engineer's device by its too great intricacy or delicacy of construction in the hands of a low-salaried motorman has involved the company into disastrous accidents. The distance between the electrical engineer and the auditor seems remote until when the engineer's device has been tested and compared, and its economic results have been written down in the auditor's cold figures and submitted to the general manager, the engineer is informed that it costs too much for instalment and saves too little in operation. It must not be supposed, therefore, that the utility of an idea or of the machine that embodies it has been fully passed upon even when the operating manager and the master mechanic are satisfied.

You are all familiar with the claim that the consolidation of great properties is against the interests of the individual, of labor as a class, of inventors as a class, of youth and ambition however employed, unless it is backed with money. It is constantly alleged, with most elaborate sophistries, that the ultimate result of consolidations is a reduction of working forces and that the effect of elaborate organization is to thwart ability and stifle hope. I suppose that, in a modified way, the experience of my corporation is that of every other. If it is, this is the fact—computing on a mileage basis, since the street railroads of New York city were consolidated into the Metropolitan system and since the electrical engineer drove the electrical force against the wheels of our cars, we employ three times the number of men that formerly were employed upon the same mileage. We have one president, it is true, instead of twenty odd, and we have reduced the number of secretaries, managers, treasurers and superintendents and the like, but as to the working force, from which the loudest protest is heard against combination, it is three times as great and its wages per individual have increased fifteen per cent.

Not only so, but in our organization we are absolutely dependent upon ability. What should an electrical engineer, who is a director's son but a man of no particular capacity, weigh with me against an electrical engineer through whose device I can start my cars more easily, stop them more swiftly, govern them more accurately, when my relation to my company depends solely upon the value of securities owned by ten thousand individuals scattered throughout the land? Influence may secure to youth an opportunity, it may set his foot in the right direction, but there never was a time when the length and the swiftness of his stride depended so entirely upon the man himself as they do to-day.

But combination has had this result and you must never omit it from your calculations. There is no one of the departments into which a great industry is now classified that is not going to be affected in its operation by each and every idea as to management that is attempted to be put into execution. The general manager, the secretary, the treasurer, the attorney, the chief engineer, the purchasing officer, expert and separate as each may be as to his particular functions, work so completely through the executive head of the industry that at that central point the effect of the slighest change at any spot in the whole working plane of operation is registered for the information of them all with the accuracy of the sensitive plate in the photographer's camera as it records the moving picture. Just when the change occurred and what its effect has been upon the entire prospect are witnessed for the judgment of all.

Important, therefore, as an electrical engineer or other expert is in the system of a street railway, his value depends upon his realization of the unity of the system and the effect which his idea, incorporated into an apparatus, is bound to have upon each department of a complicated organization. Of course he must bear in mind at all times that his machine must go into the hands of a class of men who, however expert they may become in its manipulation, must be recruited in large numbers from those whose physical strength is their chief capacity, there to be subject to continual use under the most disadvantageous conditions that can possibly arise. It must be stowed away where it is out of sight and reach, under the car body and close to the roadway. It must stand not only use, but the hardest sort of abuse, not only from the incompetency of a great army composed of unskilled labor, in which there will always exist a large percentage of gross dulness, and into which there must always be drawn another large percentage of inexperience, but from adverse weather conditions and from adverse conditions of traffic, and that the machine operating under these circumstances, however it may break down, must never be permitted to stand in the way of the car that is coming on.

These conditions, of course, are fairly obvious, but it is beyond belief how often some one or more of them has been overlooked by the electrical engineeer. He learns his business generally in some great establishment largely devoted to experiment where the gross earnings of an ordinary street railroad are written off the books in a single month of fruitless investigation, where he is provided not only amply, but even superfluously, with the tools of his trade, and it is difficult for him to understand when he comes to street railroad work that in the running of a car there is no time for repairs and that no device, however generally useful, can be employed on a street car which, if it falls out of gear, requires the car to be stabled before it can be repaired. He easily forgets that the motorman, however well instructed, is not a machinist; that he must keep his car going without the facility of a machine shop, and that often the most important repairs must be made at dead of night in a dark and narrow pit, with cheap labor and under whatever circumstances the fates may provide.

It is the characteristic weakness of an expert to exaggerate the importance of his line of work to the industry with which he is connected. No established industry can afford to spend more than a certain fixed proportion of its earnings upon improvements and betterments. It must pay its fixed charges, maintain its dividends and store up something in its surplus, and whatever it spends for betterments, whether by the use of what remains after all this has been done or by an issue of new securities, must be done with an eye carefully fixed upon its earn-

[1] Abstract of a lecture delivered recently before the New York Electrical Society, New York city.

Digitized by Google

ing capacity. The expert, whether an electrical engineer or other specialist, is rarely willing to concede this condition of things, and the more absorbed he is in his own line of investigation the more unwilling he becomes to admit that anything else counts. When, therefore, he ascertains that of the all too-insufficient sum that can be applied to improved methods some must go in one direction and some in another, and that the amount that is left for him to work on is but a fraction of the insufficient whole, his dismay not infrequently takes the form of a fit. He has been trained, moreover, in institutions where experiment is a part of the business, and when he goes into the service of an established industry or undertakes work for the advantage of such an industry, he is slow to adjust himself to the fact that it has no funds for experiment. No small part of the discouragement which awaits the specialist as soon as he leaves that occupation in which his specialty is the sole aim and business to employ his talents and training for the benefit of an industry in which his specialty is merely a feature, arises out of this circumstance, and he must quickly learn the great art of making bricks without straw. He will find his consolation in the fact that that is the only way good bricks are ever made; that the man who can only produce when the conditions of production are perfect rarely produces anything worth while; and that the valuable things of life almost invariably come by easy and natural stages from one good and successful thing to another that is better and more successful, from one valuable improvement to another that is better still, and that the perfect has never been reached but is always further on. His opportunity is limited, therefore, not by what has been accomplished, but only by the inevitably insufficient means with which he must work. He has accomplished his greatest triumph when he has adjusted himself to this fact.

So swift has been the advancement in your science that there always exists the great practical danger of your getting too far ahead, commercially speaking, of the operator. If I were to write to a manufacturer of a locomotive and say that I wanted ten of his machines and wanted them to attain a certain standard and be able to perform a certain work, and when I had them a couple of months in operation and, having ascertained that they were not perfectly adapted to my other stock, upon complaint to the manufacturer were to be told, "that locomotive is two months old; what you want is our new locomotive; you must throw all those two-months-old locomotives away and buy our new and perfect machine," I should feel that I was being pretty badly imposed upon. This, however, is a common experience in dealing with electrical engineers and manufacturers of electrical apparatus.

It is no unusual experience for us to buy and install a very expensive electrical device, to discover that it does not work in perfect synchronism with other parts of the machine or with other machinery necessary to be operated with it and to have it said to us, "nothing ails this new motor; it is a good motor. What you want is a new governor; since we made that motor we have made some other new things to go along with it; you must get that." And then before his other new thing has been in operation a week still another and still a better thing has been devised or is claimed to be devised. There is great danger of your getting too far ahead of us. This may be all very well for the development of the science, but in a practical sense it is not well for you or for us. If you are going to make money at your profession, you must help us make money in our business. You must not forever be postponing the day when income begins to pay for investment. You must not be forever requiring one great investment on top of another until we have paid half a dozen times over for substantially the same service. You must keep the practical phase of every subject closely harmonious with experimental conditions.

If I can do you any service, it will be by leaving with you the idea that the world does not want to be pushed or jarred or thrown out of gear; it wants to be facilitated in the daily routine to which it has grown accustomed. It resents a shock; it is pleased with an accommodation; it pays for what it wants. It leaves the giver of what it does not want, though his benefaction be ever so great, to the unsatisfying reward of private reflection.

British Royal Commission on Coal Supplies.

The final report of the British Royal Commission on Coal Supplies has been made. The report is of a reassuring character, as it indicates that the available coal supply is considerably more than had been anticipated. Adopting 4,000 feet as the limit of practical depth in working, and one foot as the minimum working thickness, the commissioners estimate the available quantity of coal in the proved coal fields of the United Kingdom to be 100,914,668,167 tons. The estimate of the coal commission of 1871 was 90,207,285,398 tons, and since that year 5,694,928,507 tons have been raised. The estimate for the concealed and unproved coal fields is approximately 40,483,000,000.

No forecast is made of the time when the coal fields will be exhausted. It is believed by the commission that the use of artificial briquettes will increase, and in this way coal at present valueless will be made use of. The discovery of a less costly and less smoky binding material for use in briquette-making would be of great value.

The coal consumption for 1903 is estimated at 167,000,000 tons. Of this it is said that from 40,000,000 to 60,000,000 tons might be saved if more economical methods of raising steam were adopted.

Convention of the Kansas Independent Telephone Association.

The fourth annual convention of the Kansas Independent Telephone Association was held at the Hotel Throop, Topeka, Kan., February 8 and 9. The address of welcome was made by Governor Hoch, followed by an address by A. A. Goddard, president of the association. The Thursday session was devoted mainly to the reading and discussion of papers, followed by the election of officers, as follows: president, A. A. Goddard, Topeka; vice-president, J. M. Doyle, Belleville; secretary, E. C. Walls, Marion. Executive committee: J. E. Byers, Ottawa; M. L. Robinson, Galena; C. E. Pearl, Hiawatha; W. H. Nedson, Smith Center.

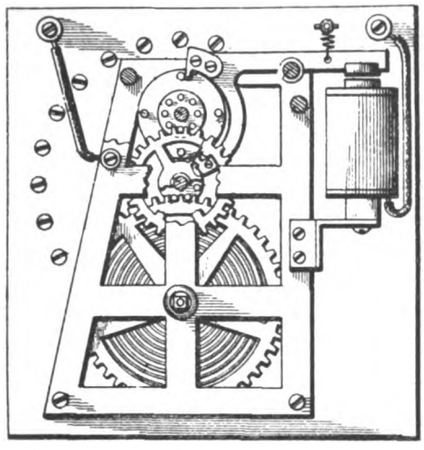
The Iowa Telephone Association.

The ninth annual meeting of the Iowa Telephone Association will be held at the Chamberlain Hotel, Des Moines, Iowa, March 14, 15 and 16. The sessions of the association will be held in one of the private dining-rooms on the parlor floor. Telephone manufacturers and supply men will make exhibits on the fourth floor of the hotel. A full programme is being prepared, and it is expected that the occasion will be a most enjoyable one. The association's banquet will be held on Wednesday evening, March 15. Mr. Charles C. Deering, Boone, Iowa, is secretary of the Iowa Telephone Association.

Digitized by Google

Electrical Patents.

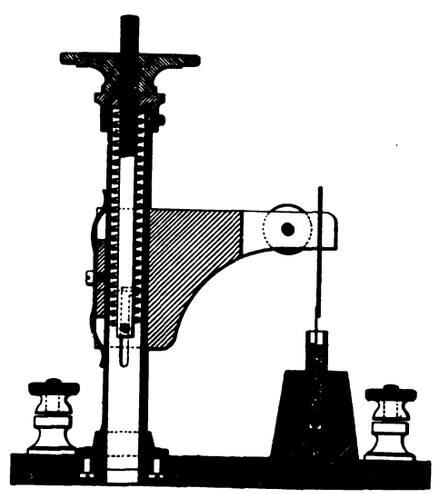
James C. Slater, of St. Louis, Mo., is the inventor of a novel stopping and releasing mechanism, on which he has recently obtained a patent (No. 780,824, dated January 24, 1905). The mechanism comprises a wheel and a lever cooperating therewith to permit the step-by-step advance of the wheel under the impulse of operating mechanism of



Stopping and Releasing Mechanism.

suitable character. The device, while applicable for use in any relation requiring uniform intermittent movement of a rotary element, is designed with special reference to its use as the controlling means of a selector-switch constituting an element of an automatic telephone system—such, for instance, as that described in letters-patent No. 632,759, issued to Mr. Slater on September 12, 1899. In systems of this character the telephones are each provided with an indicating apparatus suitably wired to a selector-switch having a series of contact-points corresponding to the several subscribers' telephones. Each selector-switch is arranged for actuation by an electromechanical switch-operating mechanism, which moves the switch-arm into engagement with any desired contact. The operating mechanism of the selector-switch is controlled by stopping and releasing mechanism operated by electromagnetic means including a circuit-breaker associated with the indicating apparatus of a telephone. The greatest difficulty which has heretofore been experienced in the perfection of an automatic system has been to secure the proper action of the selector-switch controlling mechanism so as to maintain perfect synchronism, the usual forms of such mechanism being more or less liable to race or lock or to reverse under various conditions. The object of the present invention therefore is to produce a device which will be peculiarly adapted for the control of a selector-switch and which, by reason of the novel construction and arrangement of its parts, will be absolutely incapable of racing, locking or reversing, thereby ensuring that perfect synchronism in all its parts so essential to ensure correctness of the call desired. The device comprises a wheel having a smooth periphery and a series of lateral projections. A lever is provided having at one end an accurate arm connected at its upper extremity to the end of the lever and movable into engagement with the periphery of the wheel to constitute a brake therefor. Opposed pallets are located at opposite ends of the accurate arm and alternately presentable in the path of the projections to stop the wheel by the movement of the lever in opposite directions. Means are employed for moving the wheel when released by the lever.

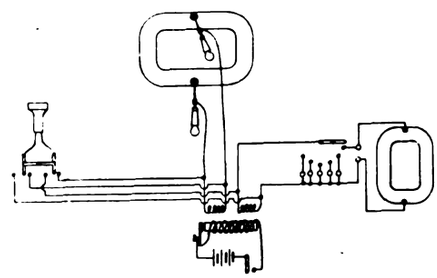
The Wireless Telegraph Exploitation Company, of New York, N. Y., is the owner of a patent recently granted to Frederick K. Vreeland, of Montclair, N. J., on a method of receiving electromagnetic waves or other feeble signal impulses (No. 780,842, dated January 24, 1905). The invention is especially useful for the reception of signals in wireless telegraphy, and depends upon the discovery made by Mr. Vreeland that an electrolytic cell of a special character, when polarized to the



Method of Receiving Electromagnetic Waves or Other Feeble Signal Impulses.

proper critical point by a local battery, is extremely sensitive to transitory or rapidly oscillating currents from another source, which when passed through it tend to depolarize the cell and cause it to offer less opposition to the passage of the local current, which rises and falls in value with the presence and absence of the transitory waves or impulses and affords an effective means for operating a telephone or other signal receiver. The method consists in polarizing an electrolytic cell having a minute anode by means of a local source of electromotive force producing at the cell a voltage above the decomposition voltage of the cell but below the point where a violent evolution of gas is caused, passing the waves or impulses to be detected through said cell and thereby wholly or partially depolarizing the cell, whereby the current in the local circuit will be increased, and observing the variations in flow of the local current.

A novel apparatus for testing the insulation of coils has been recently patented by Edmund W. Kellogg, of Newtonville, Mass. (No. 780,507, dated January



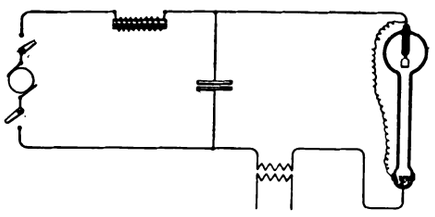
Apparatus for Testing the Insulation of Coils.

24, 1905). The object of the invention is to provide a simple, efficient and inexpensive apparatus of the above character. In accordance with the invention, two independent circuits are employed, each of which includes the secondary winding of an induction coil, and connected with one of these circuits is an insulated coil of known or standard resistance, and with the other an insulated coil whose insulation is to be tested. The primary winding of the induction coil is included in a circuit provided with means for creating an induced current in the secondary winding, which current operates a telephone included in the second circuits, whereby the sound produced in the secondary circuit containing the unknown resistance may be compared with the sound produced in the secondary circuit containing the standard or known resistance and defects in the insulation of the tested coil noted by the difference in sound at the telephone.

Mr. Peter Cooper Hewitt has secured a patent (781,000, dated January 31) on an apparatus for transforming electrical energy, which he has assigned, by mesne assignment, to the Cooper Hewitt Electric Company, of New York. Mr. Hewitt has found that when an enclosed gas or vapor of suitable character and density contained within a holder of suitable character and dimensions and having appropriate electrodes is connected in an electric circuit, there will be opposed to the passage of electric current an initial re-

Digitized by Google

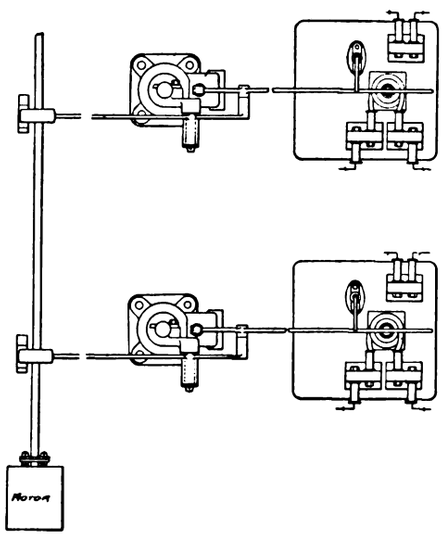
sistance, which may be overcome by an electromotive force of sufficient value, the gas or vapor then serving as a conductor across the gap in the metallic circuit when the proper conditions of current are supplied. This initial resistance appears as a self-created electrical resistance phenomenon at the negative electrode, which, on being overcome, removes itself without any appreciable energy loss. A feature of the invention is that the gas between the electrodes acts as a true vapor conductor after the circuit is once established through the vapor, and when this conductor is made of low resistance practi-



APPARATUS FOR TRANSFORMING ELECTRICAL ENERGY.

cally a short-circuit is formed. Since the vapor resistance factors are known and the conditions they are subject to, the action can always be depended on. By the passage of current, the electrical pressure or voltage is lowered to a point where the resistance to starting reforms, whereupon the checked current rebuilds or reestablishes itself, its electrical pressure rising until the breaking down pressure is again attained, after which the same succession of actions is repeated. The intermittent or vibratory currents produced in the circuit by the circuit-breaker thus described, may be applied to use in the vapor or gas gap itself, or they may be applied to other apparatus, or to both simultaneously. For example, one application of the present invention would be to serve the purposes of furnishing a periodic current for wireless telegraphy and another for producing rapidly varying currents for the purpose of producing light by induction, and still another application would be that of producing light—say in the vapor gap itself—by means of successive electrical impulses of relatively high electromotive force, causing a high illumination of the vapor or gas at such rapid intervals that the physiological impression is that of continuous illumination.

A patent (781,154, dated January 31) has been obtained in this country by Charles A. Parsons, of Newcastle-Upon-Tyne, and James Swinburne, of London, England, Mr. Swinburne being the assignor to Mr. Parsons, on a method of controlling the running of reciprocating engines or turbines driving alternators in parallel. The object of the invention is to provide an arrangement which renders it possible to drive alternators in parallel either by two or more turbines alone or in conjunction with reciprocating engines, so as to reduce the interchange currents to a minimum. To carry this into effect, puffing-valves, of known construction, are used for the control of the turbines, the puffing-valves being operated from a suitably driven shaft in such a way that they open and close simultaneously, while the regulation of the amount of steam passed by each valve is also effected simultaneously, but by means independent of those used for securing the simultaneity of the puffs. If a reciprocating engine is used in conjunction with the turbines, then the shaft which drives the puffing-valves must be driven from a part of the reciprocating engine in such a way that the maximum turning moments of the turbines and the reciprocating engine fall together. If a plurality of reciprocating engines is used, they must be arranged



CONTROL FOR PRIME MOVERS DRIVING ALTERNATORS IN PARALLEL.

among themselves in the manner described above and the shaft which drives the puffing-valves must be driven from a suitable part of some one of them.

An incandescent lamp, having straight filaments and comprising certain improvements for taking up the slack of the filament as it expands or contracts during heating or cooling, is the subject matter of a patent (781,016, dated January 31) recently granted to Almon D. Page, of Newark, N. J. The patent has been assigned to the General Electric Company, Schenectady, N. Y. In the embodiment of the invention, the exhausted envelope of the lamp consists of a straight glass tube. In this tube is located a straight filament of any suitable material, which is electrically connected to leading-in

INCANDESCENT LAMP.

conductors, located, respectively, at opposite ends of the tube. The upper end of the filament is connected directly to one of the leading-in conductors, while the lower end of the filament is electrically connected, through a flexible coiled conductor, to the lower leading-in conductor. The respective leading-in conductors are connected to suitable terminals on the outside of the lamp. The lamp is intended to be used in a vertical position, and Mr. Page has taken advantage of this fact to maintain the filament taut by securing to the lower end thereof a weight which may consist of a glass ball. This ball is located within a small tube, the walls of which constitute a guide for the ball or weight, and prevent the latter from being displaced. The upper end of the tube is closed in, so as to confine the ball, but this turning in is only partial, so that an opening is left for the passage of the lower end of the filament.

Electric Trucks in Cologne, Germany.

A number of electric trucks have been put into service in Cologne, Germany, says *L'Industrie Electrique*, replacing horse-drawn vehicles. These trucks have a capacity of ten cubic metres, as compared with two cubic metres for the horse vehicles. Experience has shown that an electric truck can serve an area of 600,000 square metres per day, while five horse-drawn vehicles are required to do the same work. The daily expense is said to be $5 per electric truck, as compared with $2.50 for each horse-truck. Thus, the electric truck brings about a daily saving of $7.50. One advantage of the electric trucks is that they can be attached to the rear of electric cars.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

A Detector for Hertzian Waves.

A new and simple detector for Hertzian waves is described here by M. Joseph Rodet. It consists merely of a glass tube of suitable size to contain a series of steel bicycle balls. The tube is closed at each end by a brass collar. Through one of these collars projects a brass screw, used for adjusting the pressure on the balls. The alternate balls are oxidized. The device is used in circuit with a telephone and two Leclanche batteries. When employed in this way, M. Rodet has found it quite sensitive and reliable. Its sensibility is not affected by severe shocks, and when once adjusted, it remains adjusted for a considerable time. The inventor thinks that the device is very suitable for use on shipboard, as there is no need to protect it from jars or vibration.—*Translated and abstracted from L'Électricien (Paris), February* 4.

The Bouvier Speed Governor.

A water-wheel governor, designed by M. Henri Bouvier, and used in a French hydroelectric station, is here described. The governor consists of a pump driven at a constant speed, and a valve controlled by a flyball governor. This valve, by allowing more or less of the liquid delivered by the pump to pass into a piping system, controls the pressure within that system. The varying pressure thus produced is used to operate the turbine gates and adjust the flow of water through the turbine. The adjusting device consists of an hydraulic cylinder, within which a piston is moved by the liquid forced through the pipes against a spring. The position of this piston is then fixed by the spring for any fluid pressure in the piping system, and thus the position of the gates is similarly fixed. The action of the governor is as follows: assuming the turbine to be running at any load, and the latter to be increased, the centrifugal governor responds to the change in speed, moves the controlling valve, and changes the pressure within the pipes. This opens or closes the gates, as may be required, the motion continuing until the pressure of the liquid is just balanced by that of the spring. It then stops, and there is no hunting or surging of the governor. It was to avoid this latter trouble that the new governor was devised. It has been in operation for some time, and has given excellent results. The article shows a load and speed chart giving an increase in load from 0 to 1,200 horsepower with a change in speed of about six per cent. Throwing off about half the load caused the speed of the turbine to be increased about two per cent. The curves show no oscillation whatever of the governor. It merely follows the change in load, and becomes steady as soon as the load is steady.—*Translated and abstracted from La Revue Pratique de l'Electricité (Paris), January* 20.

The Efficiency of Electric Hauling Gears.

Accurate figures for the efficiency of spur gearing are not easily obtainable, and there has been a great deal of doubt as to the efficiency which may be secured. In this article Mr. A. G. Hansard describes some interesting tests made to determine the efficiency of an electrically driven haulage gear, in which the reduction of speed is obtained through spur gears. The specifications called for a gear giving a tension on the rope of 5,000 pounds, with a speed of 330 feet per minute, and the speed was to be approximately constant at other loads. It was further requested that a guarantee of efficiency be given in the tender. This latter requirement some of the firms which were asked to bid refused to comply with, others offered to guarantee efficiencies varying from sixty-four to seventy-eight and one-half per cent at three-quarters load. The order was finally placed with the Sandycroft Foundry Company, Limited, Chester, England. The gear is formed of two drums, provided with clutches so that either may be driven independently. They are equipped with hand brakes and a magnetically released strap brake. The reduction in speed is from 600 revolutions at the motor shaft to 24.6 revolutions at the drum, the ratios being sixteen to eighty-three and seventeen to eighty. To determine the efficiencies, the working brakes were replaced by a pair of Prony brakes, and tests made. A number of readings were made at three-quarters load, all being fairly close together. In these it was found that the overall efficiency is eighty-five per cent at three-quarters load, which seems very high. The figures for full load and half-load were 84.6 and 83.1, respectively. The efficiency of the motor had been determined separately by the Hopkinson test, and was found to be 90.5 per cent, which would indicate an efficiency of the gearing itself of over ninety-two per cent. This result was obtained by careful design and accurate working of the gears.—*Abstracted from the Electrician (London), February* 3.

Long-Distance Transmission of Energy.

A study of the problem of line construction for long-distance electrical transmission of energy has been made by Signor Guido Semenza. He holds that this is a mechanical problem pure and simple, the object being to suspend a certain number of wires in a determined way with the least expense for upkeep and first cost, and at the same time obtain a reliable system. The wires should be arranged geometrically at distances determined by electromagnetic laws. Although there are many possible arrangements, the most desirable is held to be one in which the wires are placed at the angles of an equilateral triangle, with one side of the triangle vertical. This arrangement gives the longest allowable span. The support must combine certain mechanical properties with high electrical resistance. As the supports may be placed different distances apart, it is necessary to determine that most advantageous. This is done by treating the problem as has been done in determining the best designs of bridges and other similar structures. In selecting the route to be followed, it should be borne in mind that, although a straight line may be less expensive to erect, since the distance is shorter, and special poles are not needed, the cost of right of way over such a route may make the total cost of such a line greater. Signor Semenza thinks that the effect of the wind pressure has been exaggerated. He points out that the shape of the wire reduces the effective surface, and thinks that an allowance of 100 kilogrammes per square metre of section would be ample. At present 200 or 300 kilogrammes are more often allowed. Long spans with few poles are, in general, advantageous, and these can be used with deep sag. The advantages of iron towers, which are rigid at right angles to the line, but flexible in the direction of the line, are pointed out. In case of a break in the line, such towers will bend and transmit part of the strain to the neighboring towers. A comparison is made between two designs of a line, one using wooden

Digitized by Google

poles placed thirty-five to the kilometre, and the other iron towers placed nine to the kilometre. The expense of the wooden poles is found to be $245 per kilometre; $168 for 210 insulators; $40 for erection; $120 for right of way, and $56 for cross-overs, making a total of $629. For the tower construction, the cost of the towers per kilometre is $360; the cost of erecting them, $90; for insulators, $64.80; for erection, $40; for right of way, $120, a total of $674.80. Thus, the expense of erecting the two lines differs but little, but it is thought that the tower construction will be much less expensive to maintain. A life of twenty-five years is thought to be allowable, while for the wooden pole line it would be only five or, at the most, ten years.—*Translated and abstracted from the Revue de L'Électricité (Lausanne), January* 31.

Insulation of Armature or Other Coils of High-Tension Apparatus.

After some unfortunate experience in having the insulation of high-potential, alternator-armature coils break down, Mr. J. S. Highfield made a careful investigation of this trouble. The particular machine examined was wound for 10,000 volts. The copper is insulated from the core plates by means of solid mica or micanite tubes having a dielectric strength capable of resisting at least four times the working pressure. The ends of the tubes in this particular case are carried out quite clear of the frame, leaving no chance for sparking to take place at the ends. The insulation between the coils is varnished cotton braiding. The coils themselves are formed of ribbons wound through two tubes. Upon examining a coil and splitting open the tube, it was found that serious corrosion had taken place, the braiding being practically destroyed and the copper covered with a green deposit. Upon inspecting the ends where they were wrapped with cloth, it was found that the tube was completely rotted, being quite damp and having a strong acid reaction. The braiding at this point was in fairly good order, but damp and showing an acid reaction. Analysis of the green deposit on the copper proved it to be nitrate of copper. There also appeared to be a certain amount of free nitric acid present. In the empire cloth at the ends of the coils, sulphuric acid was found. As all the materials were of the best, it was suspected that the nitric acid had been formed by a brush discharge which caused ozonization of the air. To make sure of this fact, one of the tubes was cleaned carefully, and a strip of bright copper gauze, covered with pure filter paper, was placed inside the tube. The outside of the tube was covered with tinfoil, and connected to earth. The copper was connected to a supply of 10,000 volts. The paper was not specially dried. Ozone was observed at once in considerable quantities, and in about one week a considerable amount of green deposit of nitrate of copper was formed on the copper gauze, and free nitric acid on the filter paper. This explains the breakdown of the alternator mentioned above. The nitric acid was due to the action of ozone upon atmospheric nitrogen, and the sulphuric acid was due to the action of the nitric acid upon the gypsum contained in the board wrapped around the ends. The conclusion is drawn, that for any machine operating at a pressure of 2,000 volts or over, trouble from this cause may be experienced. While careful drying would delay the trouble, the only means of preventing it would be to exclude completely all moisture. This can only be done by excluding air from the coils. The proper method of doing this would be to fill the entire space, from copper to iron, with insulating material. The mere sealing of the ends of the tubes is not likely to be a remedy, as cracks will develop and moisture will be drawn in as the air alternately expands and contracts. The insulation of the last two or three coils at the end of the armature should be most carefully looked after, as the danger is greatest at these points.—*Abstracted from the Electrician (London), January* 27.

The Future of Railways.

A careful study of the situation confronting the railways of England is here begun by Mr. Philip Dawson. Statistics show that, while the mileage of steam railways and the capital invested in them have increased very greatly during the last thirty years, the percentage of net receipts to total paid-up capital has steadily decreased, and the percentage of working expenses to gross receipts has, on the contrary, steadily increased. There seems to be no reason to doubt that the rapid increase of electric tramways in the large towns and populated districts will affect the steam roads still more, and this will be all the greater when the electric roads undertake other business besides that of hauling passengers. Considering the future of the steam railroads, it should be borne in mind that the services which railway companies render to the public are varied, and a universal system of electric traction can not, as far as present knowledge extends, be looked for in the near future. There is no doubt that, as regards the engineering of the purely mechanical portion of the problem, electric traction could be at once adopted as a substitute for steam haulage; but this is not the problem to be solved, nor is it the one which is having the serious consideration of practical engineers. Unless it can be clearly demonstrated beyond all doubt that the new system will enable larger dividends than at present to be paid on capital invested, there is no justification for recommending its adoption. For purposes of the article, the work of railway companies is subdivided into four classes: first, long-distance main line service, which may be characterized as service with runs of fifty or more miles without stopping, and connecting such places as London and Brighton and London and Liverpool; second, freight traffic involving the use of long and heavy trains having to haul considerable distances at a comparatively slow rate of speed; third, suburban passenger service, connecting the suburbs of the large cities with centres of business; fourth, local or branch lines, connecting the small country towns with the big business centres, or connecting towns on the through main lines to offlying market centres. As regards the long-distance main line service and the freight traffic, it is held that there is no advantage to be gained by superseding steam locomotives. In the case of countries having large water powers which can be utilized at not too great a cost for driving electrical machinery, or where coal is very expensive, the case might be different. Considering the last two categories, the case is different, and there appears to be little doubt that, by using improved methods of locomotion and methods of haulage for suburban and for branch lines, not only could working expenses be considerably reduced, but also the gross receipts could be considerably increased. As regards suburban traffic, it seems that electric traction is the only means of dealing with it; whereas, with branch line service, it appears more probable that motor-cars, driven by some motive power other than steam, may be applied with very beneficial results. The author then considers in detail the general traffic conditions of suburban services. It is held that, as soon as the railways electrify their suburban lines, they will hold a very strong position against the attacks of competing tramways and light railways, since they will have all the advantages of the latter, without the disadvantages of having to operate through crowded thoroughfares. They will be able to operate at higher schedule speeds, as stops are further apart. It is practically impossible to give the requisite high speed by any other than electric traction.—*Abstracted from the Electrical Review (London), February* 3.

Digitized by Google

LETTERS TO THE EDITOR.

London, Brighton & South Coast Railway.

To the Editor of the Electrical Review:

In your issue of February 11, 1905, I notice, under the heading of "The Electrification of an Important English Railway," that the London, Brighton & South Coast Railway has adopted a class of return which I have been advocating for the last ten years; and it can not be considered a breach of professional etiquette if I now give an extract from a private report which I submitted in January, 1903, to one well-known consulting engineer.

"With a surface system of traction using a bare overhead conductor and track rails for its grounded transmission medium, it appears as if the best method would be to not bond the rails. Instead of such bonding, insulated cables could be run between the tracks or in ducts to which all the rails could be connected by means of insulated bond wires. With the generating medium of such a system insulated, such a plan would fairly securely confine the energy used to these insulated cables. Such cables and bonding are at present used on well-designed trolley roads with this exception: that they are bare instead of being insulated."

I may also say that I suggested similar installation to several members of the Liverpool town council in 1896-97.

J. Stanley Richmond.

New York, February 14.

Application of Wireless Telegraphy for Domestic Purposes.

To the Editor of the Electrical Review:

Noting a reference to an adaptation of wireless telegraphy to the operation of music boxes for entertaining purposes, mentioned in the Electrical Review of January 28, 1905, it occurs to me to call your attention to an application of wireless telegraphy to domestic purposes which may be of interest to your readers; as I believe it to be not only novel, but susceptible of extensive employment and with advantage in our homes.

During the year 1904 and the present year as well I have used upon my dining-room table a tiny transmitter consisting of an induction coil with antenna, spark-gap and key, connected by means of a flexible silk cord with four small dry batteries under the table, these being used for sending Hertzian waves through the walls to the kitchen for summoning the maid. In the kitchen mounted upon a board was a second antenna, coherer, relay, electric bell (the tapper of which was used as a decoherer) and about eight small dry batteries. This outfit served to do away with the usual floor push-button which often wears holes in the floor carpet or rug and which button is so hard to locate especially if the table has been lengthened or moved and moreover necessitates making holes in floors and walls for running wires to the bell and batteries in the distant room, it also entails considerable expense, annoyance and dirt. The transmitter used is but little larger than a good sized paper-weight and is rather ornamental than otherwise. I arranged the antennæ in spiral form at the bottom so that by pulling them out and lengthening them I could use the transmitter under the same conditions from any room in the house, by the sick bed, for instance, for summoning the nurse or the maid.

I recently had the pleasure of entertaining at dinner at my home my friends Dr. Lee De Forrest, of wireless telegraphy fame, and Mr. A. B. Frenzel, commissioner of rare minerals for the state of Colorado at the St. Louis Exposition, and they were much interested in the use of "wireless" at my table on that occasion, and Dr. De Forrest said he believed this to be the first application of the system to domestic needs. I might also state that nearly five years ago I used a somewhat similar outfit to ring my front door bell and fire a small cannon in my parlor while entertaining a party of friends at my home. On this occasion I carried the transmitter under my arm to the rear of the building while operating same. The wireless outfit which I employ might with advantage be modified for domestic use. It was built for me by Mr. W. J. Clarke, of the United States Electrical Company, of Mt. Vernon, N. Y., who has done some very early and interesting work in this field.

Yours very truly,

William J. Hammer.

New York, February 7.

Electrical Equipment of the Suburban Lines of the Great Western Railway, England.

The progress which has been made with the electrical equipment of the Bishop's Road-Hammersmith section of the Great Western Railway, of England, is described in the London *Electrician* for February 3. This section is run in connection with the inner circle of the Metropolitan and Metropolitan District Railway companies. The decision of the Great Western Railway Company to adopt electric operation was influenced by the arbitration proceedings as to the method of electric traction to be put into operation upon the inner circle. The total length of the first section to be equipped is 3.69 miles of double track, standard gauge. The track rails weigh 97.5 pounds to the yard. The steepest grade is one in fifty, and the sharpest curve has a radius of 400 feet. An insulated third-rail and fourth-rail system has been adopted, in order that there may be intercommunication between this line and the inner circle. The conductor rails are inverted channel rails of ten square inches section, having a guaranteed average conductivity of 15.5 per cent of that of pure copper.

The power for this line will be generated at Park Royal, three and one-half miles distant from the line. The plant will consist of ten Babcock & Wilcox boilers fitted with stokers and superheaters. There will be eight 750-kilowatt generating sets. The generators are driven by 1,250-horse-power Belliss engines, and are three-phase, fifty-cycle, 6,600-volt machines. Current will be supplied from the generating station through three-core, paper-insulated, lead-sheathed and armored cables, laid in asphalt-lined steel troughing, to two substations, where it will be converted to 600 volts, continuous current, by means of Bruce-Peebles-Lacour motor-generators, in parallel with storage batteries. The trains will be made up of two motor-cars and four trailer-cars, the whole train seating from 304 to 320 passengers. There will be four motors on each car, controlled on the multiple unit system. The average speed, including stops, will be sixteen miles per hour, and the maximum speed, thirty miles per hour.

Electrical Manufactures in England.

The *British Trade Review* (London) for February 1, in an article discussing the trade conditions in Lancashire, says that the work at the electrical factories has improved very materially, and that the British Westinghouse Company, Mather & Platt, and Dick, Kerr & Company and several other concerns have plenty of work. The power companies are also finding more customers and supply power to mills, factories, mines and other undertakings. Both mechanical and electrical engineers are becoming important factors in lighting, hauling and coal-cutting in mines, and coal-cutting machinery is now extensively employed in the collieries.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

An Improved Direct-Connected Variable-Speed Motor Drive for Planers.

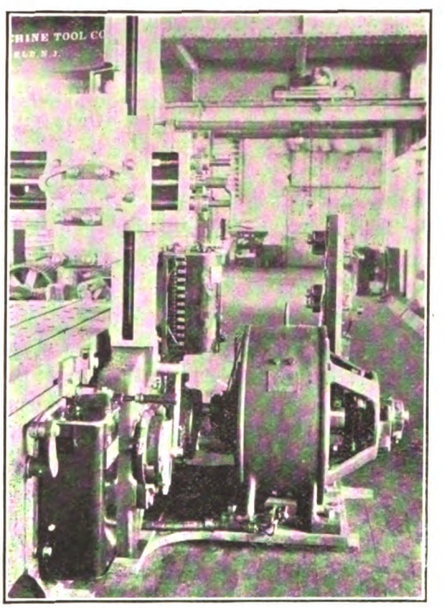
The Electric Controller and Supply Company, of Cleveland, Ohio, holds the patents for a direct-connected, variable-speed motor drive for planers, which it has recently placed on the market. The illustration shows the drive attached to a 36-inch by 36-inch by 12-foot Pond planer, which was exhibited at the St. Louis World's Fair. The company was awarded a gold medal for the drive.

When the modern high-power tool steels were put upon the market it soon became evident that all classes of machine tools must be made heavier and stronger if advantage was to be taken of the heavier cuts at faster speed thus made possible.

The lathe was the first tool taken up by most builders and by means of combinations of back gears a great range of speeds was obtained. There are, however, many jobs such as the facing of piston heads, flange couplings, etc., where a given number of revolutions per minute gives a high cutting speed at the periphery but an exceedingly slow cutting speed when nearing the centre, making it desirable to be able to change speed at will without stopping the lathe, as this invariably leaves a mark on the work. Another and more important reason for wishing to change speed without stopping is that no operator can judge accurately just what cutting speed the tool will stand before starting, so it is desirable to be able to start slowly and increase to the maximum that tool and machine will stand.

The individual direct motor drive with a controller giving speed variation by means of field and armature resistance was applied with greater success than any of the various mechanical devices. This drive was simplified and perfected by the development of the variable-speed motor giving the whole range of speeds necessary, with full rated horse-power throughout, without the use of any change gears. It has been used with perfect success for the lathe, boring mill, drill press, milling machine and small shaper, but with less success for planers and large shapers, for here it is necessary to provide for reversal.

There are a number of belt drives built using motors and mechanical change speed clutch devices, intermediate speed variations being obtained by motor control. A heavy pulley or flywheel is used to furnish the extra power required at reversal. The motor is usually mounted on top of the housing which necessitates the belts running vertically, and therefore very tight. The slippage, inevitable with heavy work at high speeds, and the constant reversals are ruinous to belts, so that it is not possible to take full advantage of the cuts and speeds which the modern tool steels will stand. Constant-speed motors with mechanical, hydraulic



ELECTRIC DRIVE AND CONTROL FOR PLANER.

or magnetic friction clutches for reversing, and change gears for varying the cutting speed have been used with some success, especially for the smaller sizes. At best, however, these devices give but a few set speeds, and as the clutch can transmit its full rated power only at the speed for which it was designed, no variation by means of motor control is possible. It requires some time to change the gears and then perhaps the operator must use the lowest speed because the tool will not quite stand the next step.

It is evident that to get maximum output from a planer, as from other tools, we must have a wide range of cutting speeds in small steps from the lowest to the highest. This has been accomplished by gearing a variable-speed motor direct to the driving shaft, and by means of a reversing switch, operated by dogs adjustably mounted on the platen of the planer, working in conjunction with a set of stopping and accelerating switches, the motion of the motor is reversed at either end of the stroke. The operation of the controller is such that the driving motor will reverse and accelerate the platen of the planer just as rapidly as is consistent with the power of the motor. The maximum current which can flow to the motor is absolutely limited, so that there is no sparking or undue mechanical straining at the instant of reversal.

The speed controller is provided with a marked dial showing the cutting speed. To obtain the desired speed it is simply necessary to turn the handle to the proper notch, and this speed can be changed at will without stopping the planer. A similar speed controller for the return stroke is provided if desired. Cut and return stroke speeds are entirely independent.

The platen may be reversed by hand for setting up work and for adjusting the dogs for proper length of stroke. A shifter lever attached to the reversing switch is used for this purpose and the operator can stop the planer instantly by putting it in the central position. This shifter motion is carried to the far side of the table as is usual for belted planers, so that any machinist accustomed to operating a belted planer can operate a planer equipped with this drive without further instruction. The accelerating controller is automatic and requires no attention whatever from the operator.

The illustration shows the motor geared to the cross shaft, accelerating board just beyond the motor, small speed controller on the housing convenient to the operator and reversing switch with its shifter handle actuated by the dogs on the platen.

Variations of cutting speed through a range of two and one-half to one are obtained with single voltage direct current, and of five to one with two voltages direct current, with corresponding ratios for the various multivoltage systems.

The drive can be applied to any planer, old or new, does away with all belts or clutches and will undoubtedly make possible increased output of from 50 to 200 per cent over the regular belt-driven planer.

Digitized by Google

Cutler-Hammer "Compound" Starting and Regulating Rheostats.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has brought out a line of starting and regulating rheostats which are shown in the accompanying illustrations. Figs. 1 and 2 show a starter which has an underload release only, in the "off" and operative position,

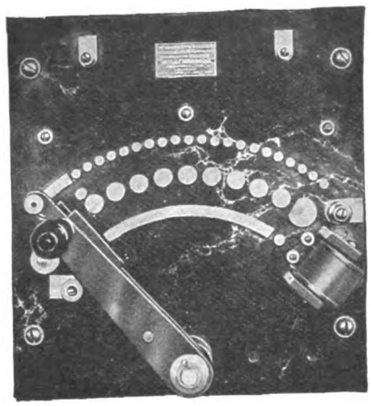


FIG. 1.—STARTING AND REGULATING RHEOSTAT, WITH UNDERLOAD RELEASE—"OFF" POSITION.

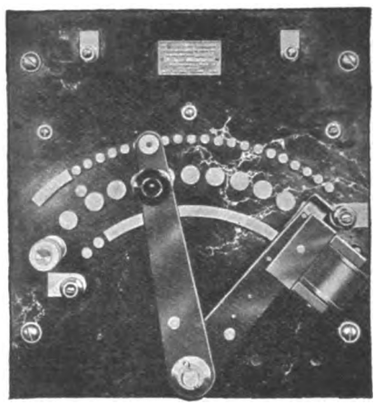


FIG. 2.—STARTING AND REGULATING RHEOSTAT, WITH UNDERLOAD RELEASE—OPERATIVE POSITION.

and Figs. 3 and 4 show a starter with both underload and overload release, in the "off" and operative position.

This type of controller is intended for the operation of machine tools or similar apparatus, in which the operator is within reach of the controlling handle, the speed regulation being effected entirely by means of shunt-field control. The objects sought in design were the provision of a large number of field regulating points, the elimination of possibility of the motor

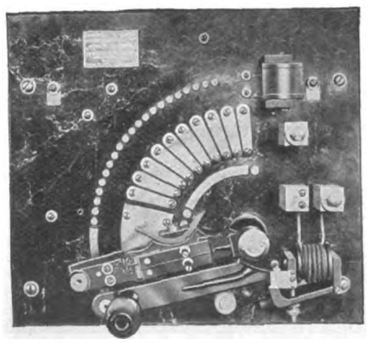


FIG. 3.—STARTING AND REGULATING RHEOSTAT, WITH OVERLOAD AND UNDERLOAD RELEASE—"OFF" POSITION.

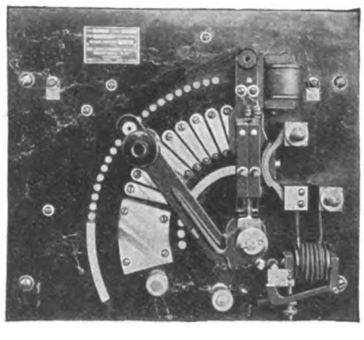


FIG. 4.—STARTING AND REGULATING RHEOSTAT, WITH OVERLOAD AND UNDERLOAD RELEASE—OPERATIVE POSITION.

starting on weakened field, the operation of the device with a single lever in a simple and natural manner, and the returning of all parts to the starting position automatically under conditions necessitating this action.

The apparatus consists of a motor starter of approximately standard construction, and a series of field buttons controlled by a field resistance lever mounted on the same hub post as the starter lever and cooperating therewith.

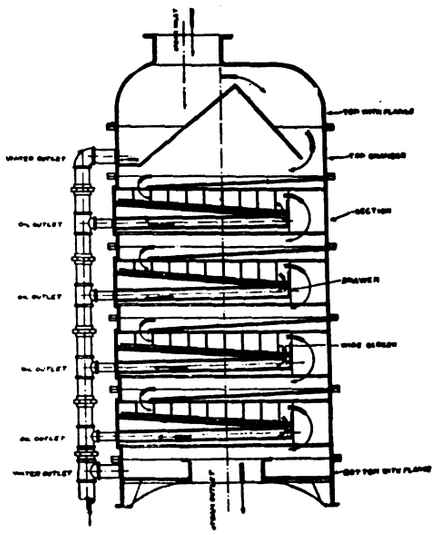
In operation, the motor is started and brought to speed by moving the handle to the right, this handle being attached to the field regulator lever which is mechanically connected to the starter lever so as to move them as one piece in starting the motor. During this operation of starting, the field resistance is short-circuited by an auxiliary contact mounted on the starter lever and a curved sector located just below the armature contacts. When the two levers have been moved to the position in which all resistance is cut out of the armature circuit, a keeper on the starter lever is attracted by the retaining magnet, and the starter lever is held in this position. At this time also the auxiliary contact above referred to has left the curved sector, thus removing the short-circuit from the field resistance. The field lever is now free for movement over the field rheostat buttons at the will of the operator, and may be left at any desired point, thus regulating the speed of the motor as desired. If the retaining magnet is deenergized either by failure of voltage or by operation of overload release devices, the starter lever is released and returns to the starting position, carrying with it the field rheostat lever.

The controllers are arranged with an armature resistance for starting duty only. The field resistance is for two to one speed variation, but three to one and four to one speed variations are furnished if desired. They are made in sizes from one-half to thirty horse-power, and for 110, 220 and 500 volts.

The "Loew" Grease and Oil Separator.

The Loew Supply and Manufacturing Company, Cleveland, Ohio, has completed a line of specialties which is known as the "Loew" grease and oil separator, the "Loew" combination feed-water heater and oil separator, the "Loew" combination closed feed-water heater and oil separator, the "Loew" standard straight-tube heaters, "Loew" steam separators, and "Loew" exhaust heads. The grease and oil separator is shown in the accompanying illustration.

Steam enters at the top and passes downward through the separator, as



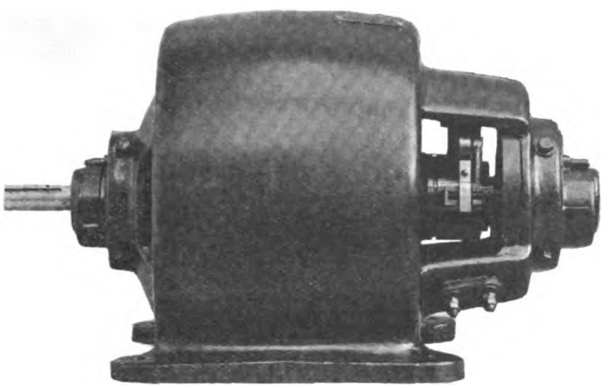
THE "LOEW" GREASE AND OIL SEPARATOR.

shown by the arrows. In its passage it is deflected sharply downward several times, striking baffle plates and drawers of fibrous material. The sharp incline of the plate opposite the steam inlet precipitates the first collection of grease and oil to the discharge pipe. The steam then strikes the baffle plates, and then a drawer which is filled with fibrous material and covered with a coarse wire screen, the latter having three small screens placed at right angles, to guide the oil to the fibre underneath. The grease and oil are absorbed by the fibre, and drip through it to the ribbed bottom of the drawer, whence they run rapidly to the outlet pipe. This process is repeated a number of times until the steam finally passes out of the outlet at the bottom. The separator is built in sections, and as many drawers can be added as desired, thus increasing the capacity of the apparatus materially.

Digitized by Google

Westinghouse Bipolar Motors for Direct-Current Circuits.

A line of direct-current motors to be known as the type R has been produced by the Westinghouse Electric and Manufacturing Company to meet the demand for thoroughly reliable and highly efficient machines of small power which shall be easy to install, convenient to operate, require a minimum of attention and give continuous service throughout a long life. They are constructed in sizes from one-sixth to one and three-quarters horse-power and wound for 110 and 220 volts. The fields are shunt-wound. The motors will carry their rated full loads continuously without injurious heating. Commutation is practically sparkless between no-load and an overload of fifty per cent or more and within this range, the brushes, once set, require no readjustment for change of load. In appearance these motors are exceedingly handsome, with graceful outlines and a baked enamel finish which presents a smooth and lustrous surface, pleasing to the eye as well as durable and effective.



WESTINGHOUSE TYPE R MOTOR.

The yoke, brackets and poles are cast in one piece, a construction which gives a compact machine. The bore of the bearing housing supports is the same as that of the field poles. Accordingly, the armature can be removed by simply taking out one bearing housing and this may be done without removing the pinion or pulley, unless it is larger in diameter than the bore of the field poles. The front end bracket is formed by three arms, which afford protection to the commutator, but leave openings through which ready access to the brushes may be obtained. The two poles project inward in a horizontal plane and are magnetized by machine-formed coils. These coils are treated with both a weatherproof and an insulating compound, which ensures them against ordinary dampness as well as accidental grounds or short-circuits. They are covered with a number of thicknesses of tape to guard against mechanical injury. The coil supports are small L-shaped pieces of sheet brass which are fastened to the poles by screws and which hold the coils firmly in place.

The bearings are of the ring self-oiling type, with linings of phosphor-bronze, mounted in separate housings which may be adjusted in any position, so that the oil reservoirs hang vertical whether the motor be set upon the floor or suspended from the wall or ceiling. The housings are so designed as to entirely prevent the leakage of oil. Creeping of oil along the shaft is also prevented by the use of a properly designed oil-thrower or wiper which protects the commutator and armature. The oil reservoirs are of ample capacity and the oil rings are easy to inspect, as they may be seen from the opening in the bearing housing.

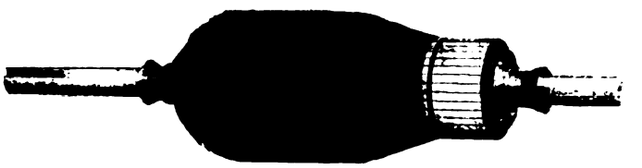
These motors are usually furnished without bed-plates, but may be supplied with bed-plates of the universal type, equipped with drip-pans and belt-tighteners and arranged for wall or ceiling suspension as well as for floor mounting.

The armatures are of the slotted drum type with imbedded coils which are retained in the slots by hard fibre wedges, without band wires of any kind. The armature cores are formed of circular punchings of carefully annealed soft steel, treated to secure high magnetic quality and freedom from ageing. Every precaution is taken to keep down the core loss of these machines, and their operating characteristics remain practically constant during life. The armature cores are mounted upon shafts which are so designed that pulleys or pinions may be secured with keys. The leads to the commutator are adequately protected by a covering of treated cloth and tape and are thus tied down and so firmly held in place that there is practically no danger of a broken lead.

The brush-holder arms are mounted upon rings which are supported at three points inside the motor frame. The individual holders are of the sliding type with the rod construction and possess many features of especial merit. Pressure on the brush is exerted by a coiled spring in such a manner as to give the carbon a uniform pressure throughout its width. The carbons are held radial at all times, there being no swivel action during the operation of the machine. A quick acting spring takes up any vibration that might otherwise occur and thus ensures continual contact between brush and commutator and obviates jumping or chattering of the brushes. There are two brushes on each motor, set diametrically opposite each other and easily reached through an opening in the front end bracket.

The commutators are built up of hard-drawn copper bars assembled upon brass bushes. They are made without necks.

The terminals are of the brass bolt and nut construction and are located on the two lower arms of the front end brackets. The bolt or stud is threaded on both ends and is brought through insulated bushings and clamped into position by a nut on either side of the arm. These nuts are properly insulated by Vulcabeston washers. Another nut on either end of the stud serves to fasten the leads. No porcelain or other breakable material is used in the construction of these terminals. They are easily accessible and are largely protected from accidental short-circuit or other injury by their position.



ARMATURE OF WESTINGHOUSE TYPE R MOTOR.

The starting rheostats furnished with these motors are of the most approved design, with automatic no-voltage release. They are exceedingly small and compact and of the best possible construction, and are fireproof throughout. The resistance is of the bar-wound type with porcelain insulation to ground, and is thoroughly ventilated. The adjustment is such that the motor starts without jar or abnormal rush of current.

Electric Locomotive Destroyed by Fire.

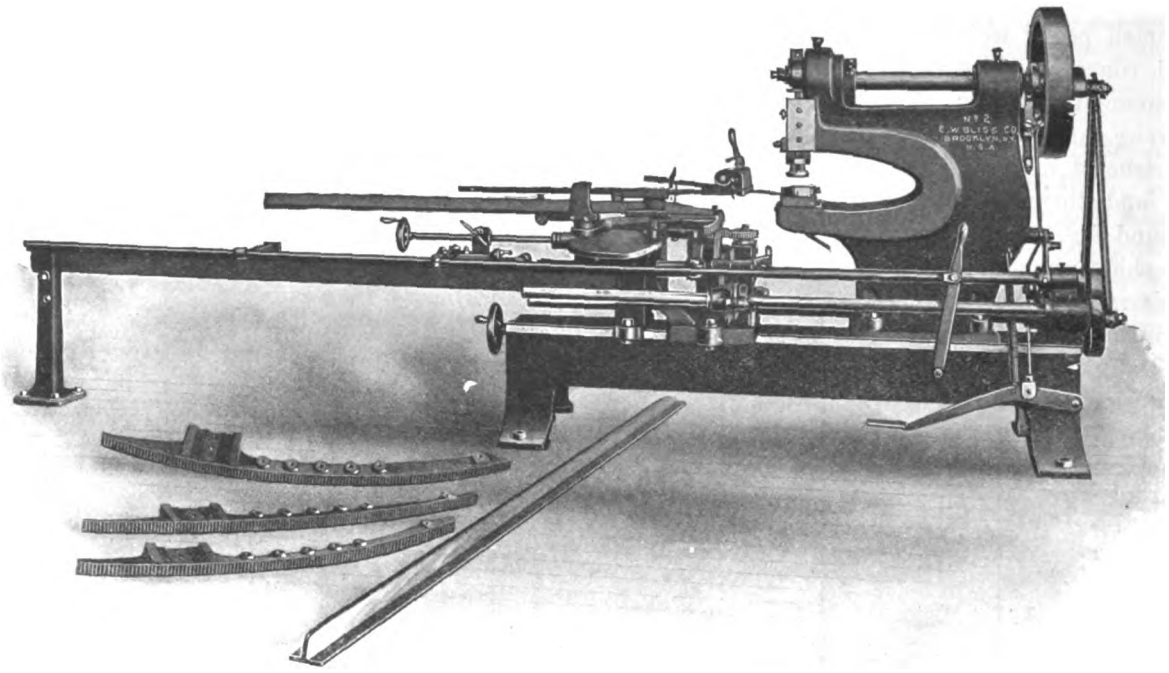
The large electric locomotive built for the New York Central & Hudson River Railroad Company by the General Electric Company was almost totally destroyed by fire at the substation at Hoffmans Ferry, four miles west of Schenectady, N. Y., on February 19.

Digitized by Google

A New Armature Disc and Segment-Notching Press.

The accompanying illustration shows the latest type of automatic armature disc and segment-notching press built by the E. W. Bliss Company, 41 Adams street, Brooklyn, N. Y. This machine possesses several unique features which will be of interest to dynamo-electric machine designers. The machine is fitted with a special device for notching the segment. This segment attachment can be rapidly removed and the press arranged for notching plain round discs of any diameter from five to sixty-one inches, and of any number of notches from 12 to 224.

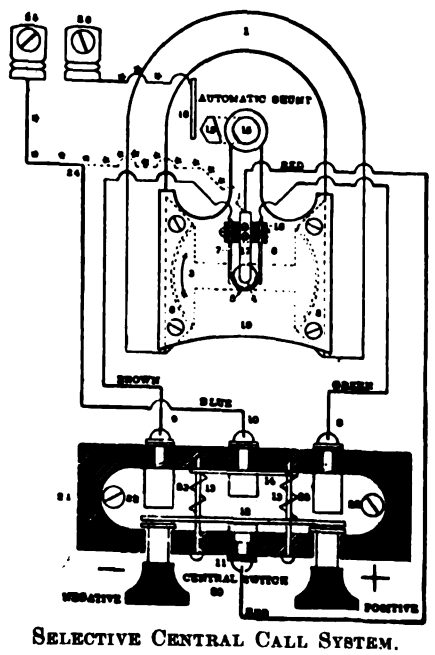
When fitted with the segment-notching device, the machine will notch segments up to those used for the largest generators, and the change from one size of segment to another is easily and quickly made. Each segment, having a different radius, requires a separate sector gear. Several of these sector gears are shown in the illustration, lying upon the floor near the machine. To make a change it is only necessary to remove the two nuts holding the sector gear and place a new one in position. The correct centre for the segment is obtained by moving the table carrying the support for this sector the proper distance from the centre of the slide holding the punch or punches, as the case may be. Provision has been made so that this can be quickly and accurately accomplished. The press will punch one, two, three and even five notches at a time, and will stop automatically when the required number of notches has been cut.



A New Armature Disc and Segment-Notching Press.

The T. & A. Selective Central Call System.

In the accompanying illustration is shown the selective central relay made by the T. & A. Selective Call Company, of Geneseo, Ill. This is a device intended to be used on party lines, and which will enable any station on a party line to call other stations on the same line without calling the central, or to call the central at will. This is accomplished by means of a relay which will respond to a direct current or a unidirectional current, but not to the alternating current given by the usual magneto call generator.



Selective Central Call System.

The relay consists, in the main, of a movable coil suspended by means of flexible wire between permanent magnets. To this coil is attached a forked arm which makes contact with a second rod, which, in turn, releases the drop contact. This relay, resembling, as it does, a D'Arsonval galvanometer, is not deflected when an alternating current is passed through it. It will be deflected, however, by a unidirectional current flowing in one direction. If a unidirectional current is passed in the other direction through the relay it will not operate it, but this may be used to operate a second similar relay placed at a second central. Thus, the relay makes possible the operation of a party line so that any station on the line can call any other station on the same line without calling the central, or any station can call either of two centrals at will. When one station desires to call another on the same line, the usual magneto call is given. This, however, does not throw the drop at either central. If it is desired to call the central, a push-button is firmly pressed, and the generator crank turned. This sends a unidirectional current over the line in the necessary direction to throw the drop at the central with which communication is desired. This, of course, can be made to operate a buzzer, and thus attract attention when so desired.

The relay may be used either in series or bridging. When used in the latter way a retardation coil is connected in circuit, which is very opaque to voice currents and enables the relay to be left permanently in circuit.

The same relay and generator equipment which is used on ground circuit bridged lines is used on straight metallic circuit lines. For old telephones having good generators, but which give only alternating current, a commutator is furnished, which supplies the unidirectional currents necessary for operating the relay.

Digitized by Google

Small Engine-Driven, Revolving Field Alternators.

The General Electric Company, Schenectady, N. Y., has brought out a line of small engine-driven alternators. This type of alternator is shown in Fig. 1. The machines are furnished either with or without direct-connected exciters.

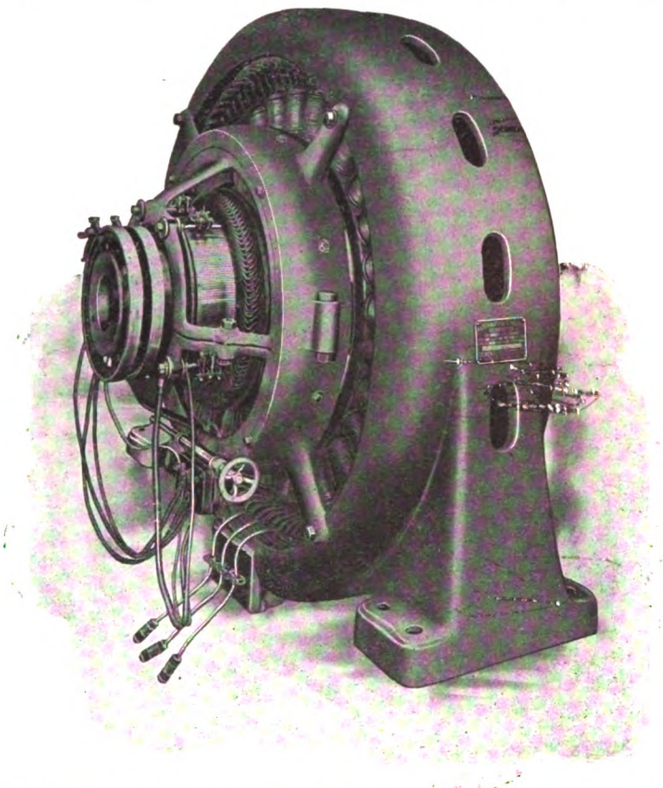


FIG. 1.—REVOLVING FIELD ALTERNATOR WITH DIRECT-CONNECTED EXCITER.

The armature frames are mounted on an extension of the engine subbase. The armature coils are shown in Fig. 2. The teeth of the armature punchings are supported against vibration by steel fingers, and protection is furnished the armature coils by an extended spider frame. The armature may be slid to one side until it clears the revolving field, thus giving good access to both armature and field for inspection or repair.

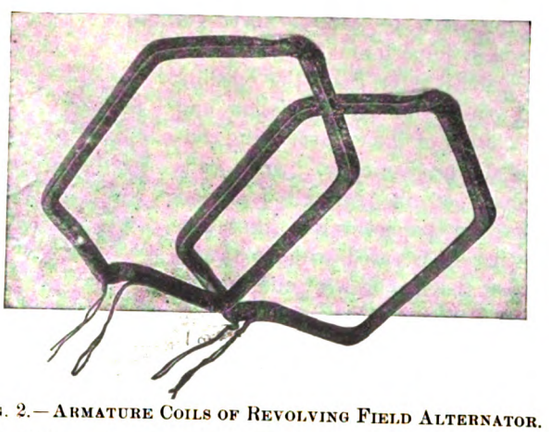


FIG. 2.—ARMATURE COILS OF REVOLVING FIELD ALTERNATOR.

The revolving field and spider are shown in Fig. 3. The spider is cast in one piece with the rim, and the poles are bolted to the rim. The collector rings are of cast iron, split in two pieces. They are supported by insulated pins on a small cast-iron shell on the shaft.

The armature of the direct-connected exciter used with the machine is mounted on the shaft close to the revolving field. The magnet yoke of the exciter is bolted to the armature frame. In order that it may be easily removed, it is split in two pieces.

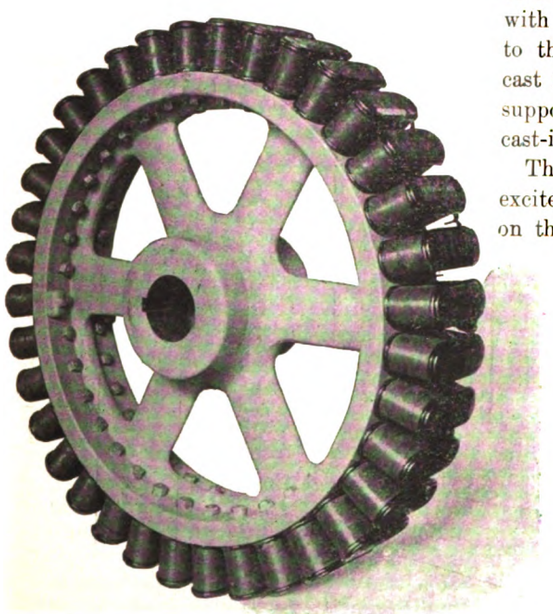


FIG. 3.—REVOLVING FIELD AND SPIDER OF ALTERNATOR.

On machines with direct-connected exciters the brush-holders for the exciter commutator and generator collector rings are supported by a brush-holder yoke which is part of the exciter. Machines without direct-connected exciters have the brushes for collector rings supported by a yoke which is mounted in a groove in the outboard bearing.

The machines are designed for either two or three-phase work. No change is necessary except in the armature coils and punchings. The exciter and all accessories are the same for both. The machines will carry their full rated capacity at two or three-phase, non-inductive load with a temperature rise not exceeding forty degrees centigrade above that of the surrounding air in any part of the machine. They are designed to carry twenty-five per cent overload for two hours with a temperature rise not exceeding fifty-five per cent above that of the surrounding air.

Machines with three-phase windings will carry seventy-five per cent of their rated polyphase capacity in a single-phase current with the same temperature rise as given for two and three-phase ratings.

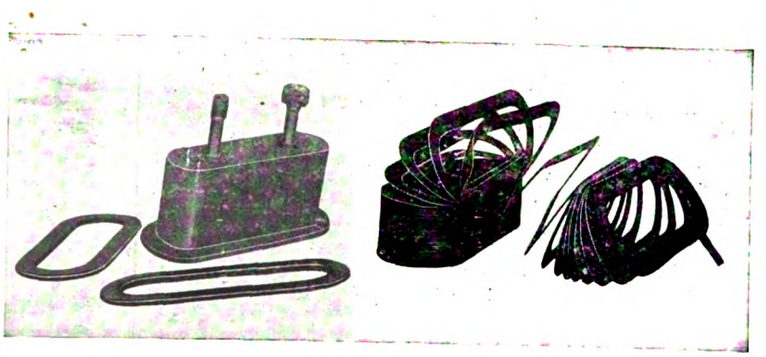


FIG. 4.—FIELD COILS OF REVOLVING FIELD ALTERNATOR.

Standard designs are for the following potentials: three-phase—240, 480, 600, 1,150 and 2,300 volts; two-phase—240, 480, 1,150 and 2,300 volts.

Digitized by Google

Air-Compressors at the St. Louis World's Fair.

The Laidlaw-Dunn-Gordon Company, 114 Liberty street, New York city, exhibited at the St. Louis World's Fair two large compressors in Machinery Hall. These compressors furnished all compressed air used at the exposition, and were both sold before the closing day. The larger one goes to shaft No. 3 of the Doe Run Lead Company, at Central, Mo., and the smaller one to the city of Columbia, Mo., for the air-lift water-supply system. The first machine received the only grand prize awarded at the exposition to air-compressors. It has a capacity of 1,300 cubic feet of free air when running at 125 revolutions, and is distinguished by several novel features, the most important of which is the Cincinnati valve gear, the opening and closing of the admission and the closing of the exhaust being controlled mechanically, while the opening of the exhaust is determined by poppet valves, thus permitting high speed without throttling of the air and wear and rattling of the valves. The smaller machine is fitted with mechanically moved inlet valves and is rated at a displacement of 500 cubic feet per minute. Its good workmanship and perfect operation at the exposition so much impressed the officials of the city of Columbia that they countermanded an order on another manufacturer in order to take this compressor.

Steam Turbine Plant in the Klondike.

The Westinghouse companies have entered an order for the equipment of a power-house for the electrical operation of gold-dredging boats on the Alaskan rivers. The plan involves some interesting features. The Canadian Klondike Mining Company, composed of a number of Detroit capitalists, has ordered a 400-kilowatt turbo-generator, to be driven by a 600-horse-power Westinghouse-Parsons steam turbine. The dredge boats are being built by the Marion Steam Shovel Company, Marion, Ohio. On these boats there will be installed induction motors, aggregating a total of about 500 horse-power, and varying in size from seven and one-half horse-power to 100 horse-power.

The power-house will be located at Dawson City, and the dredges will operate on the Yukon river and its tributaries. Lines for transmitting power will be strung from the station to the boats wherever they may be working.

Two Telephone Specialties.

The Yonkers Specialty Company, Yonkers, N. Y., has placed on the market two specialties shown in the accompanying illustrations. Fig. 1 shows the "New York" ground clamp for connecting telephone and telegraph wires to pipes or cables. This clamp consists of a strap of soft tinned copper, in combination with a brass clamping plate and a tightening screw. The screw is provided with a nut and washer to accommodate the ground wire. By means of this device a firm and permanent electrical connection is effected between the ground wire and the pipe. This connection is more secure than a wrapped joint, and the total cost is considerably less.

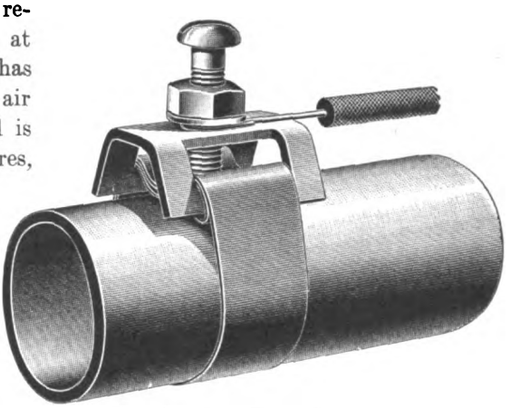


FIG. 1.—NEW TYPE GROUND CLAMP.

Fig. 2 shows the "Metropolitan" cable clip for supporting aerial cables. The steel wire loop is heavily galvanized, and the band which encircles both cable and supporting strand is of zinc. This clip is so designed that, as the strain increases, the clip holds more tenaciously. The clips are designed to withstand a strain of 400 pounds.

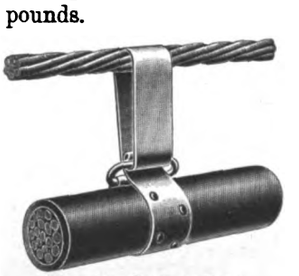


FIG. 2.—CABLE CLIP.

In applying this clip, the hooks which engage with the wire loops are bent up tightly, either with the fingers or by means of pliers. The bend of the zinc strap over the supporting strand is made so that the lower loop which encircles the cable is drawn tightly about the cable.

The studs impressed upon the zinc prevent longitudinal displacement.

The standard size of hanger is seven and one-half inches long, and fits twenty-five and fifty-pair cables. Special sizes are made to fit larger cables, as desired.

Extensions to the Carnegie Institute Building at Pittsburg.

The extensions to the Carnegie Institute Building at Pittsburg, Pa., are rapidly nearing completion. They represent an expenditure of $5,000,000, and are the gift of Mr. Andrew Carnegie. The new building almost obscures the original structure, which itself, a previous gift of Mr. Carnegie, cost $3,000,000. Its width on Forbes street is 400 feet and its depth is 600 feet.

In addition to the portion devoted to the library, within the building are to be found art galleries, a museum, a music hall, a lecture room, a restaurant and the general offices required for the supervision and operation of these many divisions. In the basement will be the modeling and casting rooms for the art department, and workshops, where the repairs necessary for the maintenance of the building will be carried out. The printing office and bindery used in connection with the library, and the large lighting and heating plant necessary for illuminating and warming the building are also situated in the basement.

The heating and lighting plant when completed will form a very interesting example of an installation that both in workmanship and appearance will be of very high quality, the specifications on these points being very rigid.

The contract for the electric generators has been let to the National Electric Company, Milwaukee. It consists of five 300-kilowatt, twelve-pole, 125-volt, direct-current, engine-type generators, running at 120 revolutions per minute. All visible bolts will be nickel-plated and the field coils taped on the outside and finished with a wrapping of fish-net cord. The terminal boards will be of Vermont marble. The total net weight of each generator will be about 55,000 pounds, the armature and commutator accounting for 18,000 pounds. On the final test the generators will be expected to withstand a momentary overload of seventy-five per cent without flashing and to operate from no-load to twenty-five per cent overload without shifting the brushes.

The architects, Messrs. Alden & Harlow, have based their designs for the building on the leading institutions of this type, both in Europe and in this country.

The World's Output of Lead.

United States Consul Abraham Smith, at Victoria, B. C., has compiled some statistics showing the annual output of lead for the entire world. For the year 1903 the total amount was 910,000 English tons. For 1902 it was 902,400 tons, and for 1901 it was 875,000 tons. As a producer of lead, the United States leads, the output for 1903 being 266,691 tons. Spain comes next with 172,521 tons, and is followed by Germany, with 141,558 tons. No other country had an output as great as 100,000 tons.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

ELECTRICITY IN COAL MINES—The Colorado Fuel and Iron Company, Denver, Col., has decided to use electric power in the operation of all its coal mines, and it is estimated that nearly $200,000 will be expended for electrical appliances.

A NEW COMMERCIAL CABLE—The Commercial Cable Company is about to begin the construction of a third transatlantic cable. The route that the cable will follow has been determined, and bids for the work have been asked. It is stated that no new stock will be issued on this cable.

LARGE BRITISH POWER PLANT—A company with a capital of £5,000,000 is seeking parliamentary authority to set up electric power stations in London and a part of the county of Essex. There will be, it is expected, 100,000 horse-power in each station at Greenwich, Silverton and Fulham. These will supply power to large and small consumers.

NEW COLORADO POWER PLANT— The Continental Electric Power and Irrigation Company proposes to construct a power and water plant at Empire, Col. A storage capacity of 125,000,000 cubic feet of water, sufficient for the irrigation of 2,500 acres of land, is planned. A large dam will be built, and a power plant installed. Two generators of 600 horse-power will be the initial layout, and it is expected that a maximum of 3,000 horse-power will be obtained.

CINCINNATI TELEPHONE COMPANY INCREASES CAPITAL STOCK—The stockholders of the Cincinnati & Suburban Bell Telephone Company, at an annual meeting held on February 15, voted to increase the capital stock from $4,000,000 to $5,000,000. The following board of directors was chosen: C. H. Kilgour, C. P. Taft, John Kilgour, George Bullock, B. S. Cunningham, W. A. Blanchard, B. L. Kilgour and C. J. French. The directors reelected John Kilgour as president, and B. L. Kilgour as vice-president and general manager.

LIGHTING COMBINE PLANS—A special meeting of the stockholders of the United Electric Light and Power Company was held on February 14, in Baltimore, Md., to act on the consolidation of the Wenstrom Electric Company, of Baltimore city, with the United Electric Light and Power Company. The new company formed by the merger of the Wenstrom company with the United Electric Light and Power Company takes over the majority of the stock of the Consolidated Gas Company. The name of the combined company is the Consolidated Gas, Electric Light and Power Company. The capitalization is $12,700,000.

EXPERIENCE WITH THREE-CENT FARE UNSATISFACTORY IN CLEVELAND—President Horace E. Andrews, of the Cleveland Electric Railway Company, has issued a statement to the city council of Cleveland, Ohio, covering the low street-car fare experiments. Two weeks' trial of the three-cent fare within a two-mile limit showed a loss per day of $764 in the company's earnings. This loss was sustained on only eighteen and one-half per cent of the company's total fares, and for thirteen out of twenty-four hours of the day. At the expiration of the three-cent fare for a two-mile ride, the company put into operation a four-cent, no-limit ride without a transfer, for eight days. The result showed a loss of $1,375 per day, as compared with the company's earnings for the same service for the same number of days prior to the low-fare experiments.

MEXICAN ELECTRICAL NOTES—On February 5, a fire originating beneath the platform of the main switchboard destroyed the greater part of the Mexican Electric Works, Mexico City. The switchboard was a total loss, and three engines and dynamos were badly damaged. The city was in total darkness during the entire night. Arrangements were immediately made to put into operation any of the apparatus which had not been damaged, and to secure extra power from the generating company at San Ildefonso. A company has been organized for the purpose of establishing an electric power plant on the Quebrada river, in the state of Durango, Mexico. The electrical energy to be generated will be used to operate factories in that part of the state. William McKenzie, of Toronto, Canada, and associates have arranged for the purchase of a concession for electric car lines in Monterey, Mexico.

PERSONAL MENTION.

MR. BUFORD ADAMS, manager of the Missouri & Kansas Telephone Company at St. Joseph, Mo., has been appointed field manager of the Wisconsin Telephone Company.

MR. F. E. LEONARD, manager of the Butte office of the Rocky Mountain Bell Telephone Company, has been promoted to take charge of the Salt Lake City, Utah, office.

MR. DUNCAN MACALLISTER has resigned as president and director of the Metropolitan West Side Elevated, Chicago, Ill., his resignation to take effect at the annual meeting on April 4.

MR. H. W. WEBB has been elected president of the Maryland Telephone Company, *vice* David E. Evans, resigned. Mr. Webb has been vice-president and general manager of the company for some time.

PROFESSOR ERNEST RUTHERFORD, of McGill University, Montreal, Canada, has been appointed Silliman lecturer at Yale University for 1905. Previous Silliman lecturers have been Professor J. J. Thomson and Professor C. S. Sherrington.

DR. CHARLES P. STEINMETZ, in an address before the Albany Institute, Albany, N. Y., is quoted as saying that the ultimate results of the successful experiments with electric locomotives will be an electric trolley service between Albany and New York.

MR. S. L. NELSON, formerly general manager of the Fort Wayne & Southwestern Traction Company, has been appointed executive head of the lines constructed and operated by the Appleyard syndicate. A reorganization of this company is to be effected. Mr. Nelson's headquarters will be at Wabash, Ind.

MR. GEORGE H. GALE, of Schenectady, N. Y., one of the many capable young men on the literary staff of the General Electric Company, has succeeded to the duties of Mr. E. H. Mullin, deceased, and will spend half of each week in New York city, in charge of the publicity department of his company.

MR. H. BERGGRAF, a Norwegian engineer, has recently invented a new electrical apparatus for sea-sounding. This is accomplished by an acoustic method. The depths are also registered graphically upon a revolving drum. The operation of the device depends upon the time which sound takes to travel to the bottom and return.

MR. VINTON A. SEARS, Boston, Mass., in a recent letter to the daily press, suggests that the reasonably complete development in the United States of telephone equipments will require over 8,000,000 telephones. This is based upon ten per cent of the population becoming subscribers. This basis is already considered too low for the future by many operating engineers.

MR. ERNEST H. DAVIS, president of the National Electric Light Association, has recently taken an active and conspicuous part in the municipal ownership campaign which has centered around New York city. In a recent statement he protested vigorously against the figures given by the engineering committee which reported to Mayor McClellan on the cost of a city lighting plant. Mr. Davis contends that incandescent lighting service, if supplied from a municipal lighting plant, would not cost less than 12.88 cents per kilowatt-hour, and that private companies now quote twelve cents per kilowatt-hour, and in some buildings six cents. He also says that the cost of $75.40 per year for an arc light should be, according to the figures cited in the report, $97.35, the entire cost, inclusive of subway, real estate and lost taxes, amounting to $140, the present maximum price.

Digitized by Google

TELEPHONE AND TELEGRAPH.

MIXERSVILLE, IND.—The Brookville Telephone Company is extending its line through Mixersville to Oxford.

SUPERIOR, WIS.—The People's Telephone Company has completed connections through the Consolidated Company, of Minneapolis, with Grand Forks, N. D.

ROSEBURG, ORE.—The Peel & Glide Telephone Company has been organized to build a telephone line to Roseburg. H. L. Engles is president, Frank Livingston, secretary, and Leslie Lily, treasurer.

NEW YORK, N. Y.—The Ocean Steamship Company, plying between New York and Savannah, and Boston and Savannah, and comprising eleven ships in its fleet, has installed wireless telegraphy on all its vessels.

PHILADELPHIA, PA.—The Conestoga Telephone Company, in Berks County, has extended its line to White Bear, Geigertown, Joanna, Morgantown, Churchtown, Bearville and Cedar Lane, connecting with Reading.

JACKSON, MISS.—The Cumberland Telephone and Telegraph Company has purchased the Citizens' Long-Distance Telephone Company, which has a number of lines in the eastern part of Mississippi and the western part of Alabama.

STILLWATER, MINN.—Rural telephone lines connecting with the Northwestern company's exchange in Stillwater have been established, and farmers living near Houlton are about to install a line to connect with the same exchange.

FORT WAYNE, IND.—The Bell Telephone Company has completed the work of equipping the Fort Wayne & Wabash Valley Traction Company's lines between Fort Wayne and Logansport with a complete telephone system, both for despatching trains and for general business.

SCRANTON, PA.—The State Telephone Company has instituted suit against the Interstate Telephone and Telegraph Company for $1,000,000. The declaration alleges that the defendants violated a contract which bound them to construct and operate 500 miles of toll line.

ERIE, PA.—Work has been started on an extension of the Waterford telephone line from West Greene, along the Lake Pleasant road, to Erie. This line will bring a large number of farmers into communication with the outside world, and add to the value of the Waterford exchange.

BALTIMORE, MD.—The contract for 100 telephones used by the United Railways and Electric Company has been awarded by the executive committee to the Maryland Telephone and Telegraph Company. The service will be connected with the largest private branch in the Baltimore telephone service.

FORT WAYNE, IND.—The county commissioners have granted the Home Telephone Company a franchise to erect poles along all of the roads leading from Fort Wayne to the north in Allen County. Franchises were granted on the Goshen road, the Lima, Hicksville, St. Joe, Maysville, Coldwater, Auburn and Winchester roads.

AUSTIN, MINN.—At the annual meeting of the new Tri-State Telephone Company these officers were elected: president, A. O. Dinsmore; vice-president, Thomas Revord; secretary and treasurer, James Keenan; directors, C. A. Sterling and C. H. Webber. A dividend of six per cent in cash and eight per cent in stock was declared, payable April 1.

ALBANY, N. Y.—A certificate has been filed with the secretary of state, announcing that the Madison Mutual Telephone Company, of Solsville, Madison County, has increased the amount of its capital stock from $1,000 to $5,000, divided into shares of ten dollars each. The certificate is signed by A. H. Holland, L. R. Bridge and H. L. Brooks.

ST. JOSEPH, MO.—A deed of trust has been filed in the recorder's office by the Kansas City Long-Distance Telephone Company to the Commonwealth Trust Company, securing that company by a first mortgage. Five per cent gold bonds for $1,500,000 were issued by the Telephone company, and the entire amount was taken by the Trust company.

SAN DIEGO, CAL.—Work on an extension of the telephone line from San Diego to Imperial has been commenced by the Sunset Company. The wires will be strung from San Diego across the mountains and desert, the line being built by way of Julian. The line has already been completed as far as Julian, which is eighty-seven miles from Imperial.

MONTROSE, PA.—At the annual meeting of the stockholders of the Montrose Telephone and Telegraph Company the following officers and directors were elected: directors, J. F. Butterfield, M. S. Dessauer, F. I. Lott, E. C. Rogers and C. L. Stone; officers. J. F. Butterfield, president; C. L. Stone, secretary, treasurer and general manager. The meeting adjourned until March 29, at which time a vote will be taken on the question of increase of capital stock.

OAKS CORNERS, N. Y.—The residents of Oaks Corners have organized a home telephone company. The new company will have connections with the Independent company. Directors have been elected by the new organization as follows: Frank Hood, J. B. Vandervere, Charles Parker, Milton Gerow, Charles Pardee, Stephen A. Smith, Horace Peck. The directors have elected these officers: president, F. A. Hood; vice-president, S. A. Smith; secretary and treasurer, J. B. Vandervere.

ALLENTOWN, PA.—The directors of the Consolidated Telephone Companies, of Pennsylvania, have elected the Hon. R. E. Wright as president; Charles W. Kline, of Hazleton, vice-president; C. M. W. Keck, secretary and treasurer. S. E. Wayland resigned as general manager, and the office was abolished. The duties of the place were put upon a superintendent and assistant superintendent. Charles West, of Wilkesbarre, was elected superintendent, and Charles A Mans, of Hazleton, assistant.

ST. LOUIS, MO.—The annual stockholders' meeting of the Kinloch Telephone Company was held recently, when the old directors were reelected. They are William F. Nolker, Rolla Wells, August Gehner, Philip Stock, Adolphus Busch, C. Marquard Forster, Julius S. Walsh, William D. Orthwein, William J. Lemp, Charles H. Turner, Sam. M. Kennard, Henry Nicolaus and Breckinridge Jones. Most of the stock was voted at the meeting. The company expects to start the erection of its new exchange building at Eleventh and Locust streets within a short time.

NORWICH, N. Y.—The Union Telephone Company has made arrangements with the Central New York Telephone Company, whereby it is connected with the latter company's lines, and for an additional cost of two dollars per year the Union's subscribers may have the use of the Bell system to all points. The Union company now has 100 subscribers in Sidney, and two hundred more in the following near-by villages: Bainbridge, East Guilford, Unadilla, Unadilla Center, Sidney Center, Youngs, Trout Creek, Northfield, Rockdale, Mt. Upton, Rockwell's Mills, Latham's Corners, White Store and Holmesville.

WASHINGTON, GA.—At a meeting of the stockholders and directors of the Wilkes Telephone and Electric Company, J. A. Moses was reelected president for the next fiscal year, with Boyce Ficklen, secretary and treasurer. Reports from the officers of the company showed a gratifying improvement in the business of the past year. New lines have been built in all directions from Washington, reaching every country store in the county, and putting the farmers in closer relation to the county seat than ever before. The company owns about 100 miles of lines, which form a network in the territory tributary to Washington. At the conclusion of business a dividend of forty-three per cent was ordered paid to the stockholders of the company.

NASHVILLE, TENN.—Two bills concerning the telephone business of the state have been prepared. The charges fixed are: in exchanges of over 8,000 subscribers, $4 a month; residence, $2.50; over 3,500, business, $3.50; residence, $2; over 1,000, business, $3; residence $1.75; less than 1,000, business, $2; residence, $1.50. For party lines a reduction of twenty per cent for each additional telephone is required. Long-distance rates shall not exceed one-half cent per mile during the day, and not over half that at night. Discriminations are not allowed, and the companies are required to

Digitized by Google

permit other companies to connect with their lines. The railroad commission is empowered to adjust rates and charges, correct abuses and suppress extortions.

ERIE, PA.—A new telephone line is being built from Arbuckle to Wattsburg.

LOGAN, UTAH—The Utah Independent Telephone Company is preparing to extend its lines to Logan.

SARATOGA, TEX.—The Southwestern Telephone Company is preparing to install an exchange in Saratoga.

ST. JOHNSVILLE, N. Y.—The Interstate telephone line has been extended from Newville to Cramer's Corners, near Starkville.

ANGOLA, N. Y.—The W. E. Guest Telephone Company, of Evans Center, has purchased a new switchboard and added a number of new telephones.

SUPERIOR, WIS.—The People's Telephone Company has been granted permission to issue bonds to the amount of $100,000. The company's system will be improved.

NASHVILLE, ILL.—The rural telephone line from Nashville to Addieville is announced a certainty by the promoters, and work on the same will be commenced as soon as possible.

MILL CREEK, I. T.—The city council of Mill Creek has granted a twenty-year franchise to the Sulphur Telephone Company. The exchange is expected to be in operation within ninety days.

HELENA, MONT.—The Rocky Mountain Bell Telephone Company will install a common battery system in Helena, and also contemplates the addition of another story to its exchange building.

SALT LAKE CITY, UTAH—A force of Independent Telephone Company employés is erecting telephone poles and stringing wires on the State road, the present destination being Provo. An exchange will probably be established in Lehi.

HAMILTON, OHIO—The Home Telephone Company, of Hamilton, has made an offer for the purchase of the Bell Telephone Company's interests in Hamilton, and negotiations are now pending for the consolidation of the two companies.

HUNTSVILLE, ALA.—Wires for a new system of telephones connecting Huntsville with Jeff, Monrovia, Rep, Kelly and other towns northwest of Huntsville are being put up by private parties. The new system will be connected with the Bell exchange.

INDEPENDENCE, ORE.—Connections with the Polk County rural telephone and Independence have been completed. Independence is now connected with Falls City, Dallas, Perrydale, King's Valley, Lewisville, Corvallis, Airlie and through Yamhill County.

GENESEO, N. Y.—The Livingston County Telephone Company has completed its exchange in Geneseo. The company is connected with over 60,000 subscribers of independent lines in western New York, among them the Home company, of Rochester, and the Frontier company, of Buffalo.

NEW HAVEN, CT.—At the meeting of the stockholders of the Southern New England Telephone Company, the following directors were elected: Morris F. Tyler, Samuel E. Merwin, A. Heaton Robertson, James English, John W. Alling and Max Adler, of New Haven; Thomas Sherwin and Frederick P. Fish, of Boston, Mass.

NEWBURGH, N. Y.—Vincent A. Murray, who is agent for the Hudson River Telephone Company, has made arrangements with the company whereby he leases the mileage, equipment and operating systems of the telephone exchanges of Cold Spring and Garrison, now controlled by the Hudson River Company. Mr. Murray's lease is for five years and takes effect March 1.

BATAVIA, N. Y.—Stockholders of the Stafford Telephone Company held their annual meeting on January 28. The treasurer's report showed the company to be in a satisfactory condition financially. The following directors were elected: Charles J. Call and Howard Bell, three years; Walter Daniels and Jay Lathrop, two years; J. A. North, G. H. Torrey and Dr. Ganiard, one year. At the close of the stockholders' meeting the directors reelected officers as follows: Charles J. Call, president; Dr. Ganiard, secretary; Howard Bell, treasurer.

ALLENTOWN, PA.—At a meeting of the Consolidated Telephone Companies of Pennsylvania the office of general manager, held by C. E. Wayland, of Scranton, was abolished. The duties of that office will hereafter devolve on a superintendent and assistant superintendent, new positions to which Charles West, of Wilkesbarre, and Charles A. Mons, of Hazleton, were elected respectively. These officers were elected: Robert E. Wright, Allentown, president; Senator C. W. Kline, Hazleton, vice-president; C. M. W. Keck, Allentown, secretary and treasurer.

HERKIMER, N. Y.—At a meeting of the stockholders of the County Telephone Company, of Herkimer, the following were elected directors: George W. Fuller and Fred Zoller, of Rochester; W. I. Taber and Robert Earl, Herkimer; James Conkling, of Ilion; T. Harvey Ferris and Charles H. Poole, of Utica. The directors elected these officers: president, Robert Earl; vice-president, James Conkling; secretary, Charles H. Poole; treasurer, W. I. Taber; engineer, Edward Cline. The company has telephones in Ilion, Frankfort, Mohawk and Herkimer.

ELECTRICAL SECURITIES.

The market continued to show the firm undertone that has characterized it since the beginning of the year. Notwithstanding the elimination of the activity of a number of very large interests, due to departures to other financial centres, the changes in price values were not extensive, and at the end of the week values were slightly higher, if anything. Speculative influence is largely dominated by the expectation of a decision in the Northern Securities case. It is highly possible that the verdict which will be handed down by the Supreme Court in a very short time now may send the whole case back to the lower courts. It is hoped, however, that, whatever decision may be reached, it will be final, and will mean an end of this litigation. It is not unlikely that before the court can render its decision a harmonious agreement may be reached between the rival interests. With this matter once settled it is understood that a number of pending railway deals of considerable magnitude will be undertaken. The state of trade in general remains but little improved over the situation for the past month. At a number of recent meetings of sales managers and representatives of territory throughout the entire country the fundamental note has been one of expectancy of large business. There is, however, considerable disappointment in the activity shown so far this year. While it has been quite satisfactory, it has not been what was expected from the extravagant predictions made during the last few months of last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 18.

New York:	*Closing.*
Brooklyn Rapid Transit	62¼
Consolidated Gas	204¼
General Electric	186¾
Interborough Rapid Transit	216
Kings County Electric	200
Manhattan Elevated	173
Metropolitan Street Railway	121⅜
New York & New Jersey Telephone	146
Westinghouse Manufacturing Company	190

At the annual meeting of the New York Edison Company retiring directors were reelected.

Boston:	*Closing.*
American Telephone and Telegraph	142¾
Edison Electric Illuminating	250½
Massachusetts Electric	55¼
New England Telephone	136
Western Telephone and Telegraph preferred	103

The Boston Elevated Railway Company has petitioned the railroad commissioners for authority to issue $7,500,000 bonds to fund floating debt for construction and equipment and the purchase of real or personal property, as may be necessary for the operation of its road.

The instrument output of the American Telephone and Telegraph Company for the month ended January 30 is as follows: gross output, 130,634; returned, 37,700; net output, 92,934, as compared with 53,790 for the same period in 1904. The total number outstanding is 4,573,498.

Philadelphia:	*Closing.*
Electric Company of America	12
Electric Storage Battery common	82½
Electric Storage Battery preferred	82½
Philadelphia Electric	10⅜
Philadelphia Rapid Transit	29⅜
United Gas Improvement	113⅛

Chicago:	*Closing.*
Chicago Telephone	143
Chicago Edison Light	162
Metropolitan Elevated preferred	61
National Carbon common	43½
National Carbon preferred	112½
Union Traction common	13
Union Traction preferred	50

Digitized by Google

ELECTRIC RAILWAYS.

MADISONVILLE, OHIO—The Cincinnati & Columbus Traction Company has begun work on the roadbed of its proposed route between Madisonville and Madeira.

FREMONT, OHIO—The county commissioners have granted a franchise to the Lake Erie, Bowling Green & Napoleon Railway to construct a line in Woodville township.

CANAJOHARIE, N. Y.—A large number of men in Otsego, Schoharie and Montgomery counties are interested in the construction of an electric road from Milford through Cherry Valley and Sharon Springs to Canajoharie.

PORTLAND, ORE.—The Portland Consolidated Railway Company will build an interurban line between Portland and Hillsboro. Work will commence as soon as the most feasible route can be selected, and the work of construction commenced.

PORTLAND, ORE.—Right of way has been secured for an extension of the Oregon Water Power and Railway Company from Cedarville, two miles west of Gresham, to the Columbia river opposite Washougal, through Fairview and Troutdale.

LEAD, S. D.—It is stated that the Burlington Railway Company will extend the narrow-gauge electric trolley line from Lead to Terry, a distance of about three and one-half miles. This will give passenger service to the mining camps in the Bald Mountain district.

CINCINNATI, OHIO—Incorporation papers for the Cincinnati Northern Traction Company, which is to lease the Cincinnati, Dayton & Toledo, have been forwarded to Columbus. The capital is $500,000, and the incorporators are W. H. McAllister, Nat. S. Keith, D. J. Downey, Dane Stevens and S. C. Cooper.

SEATTLE, WASH.—The Seattle Electric Company has reached an agreement with the government for the building of an electric car line to Fort Lawton. The work will be begun as soon as a franchise can be secured from the city. A question of freight and passenger rates to and from the fort has stood in the way of an agreement being reached for two years.

OCEANSIDE, CAL.—John McCafferty, of Pasadena, a well-known mining man and promoter, is looking into the project of an electric line from San Bernardino to Oceanside. Mr. McCafferty has been going over a projected route which follows substantially the line of the Southern California Railway, except that it enters Fallbrook by a different way in order to avoid the Temecula canyon.

BLOOMDALE, OHIO—A proposition has been made to the Bloomdale town council by the Toledo, Bowling Green & Southern Traction Company for the extension of its line from Jerry City to Bloomdale and on to Fostoria. The company asks the town to sell $200,000 worth of bonds, the proceeds to be used in the construction of the road. The town is also asked to secure certain rights of way.

WILKESBARRE, PA.—The Lehigh Traction Road and the Wilkesbarre & Hazleton Railway Company have passed into the hands of a new management. The new officers are: A. Markle, general manager; C. B. Houck, general superintendent; A. F. Harger, superintendent of transportation. The retiring officers are: general superintendent, George Thompson; assistant superintendent, J. J. McNellis; secretary, E. S. Doud.

BOSTON, MASS.—Another double-track electric road between Boston and Providence is being projected, its promoters being three Boston men, Edwin F. Thayer, Frederick C. Lane and Charles H. Blood. The road will do a passenger and express business, and is designed to run through Hyde Park, Milton, Canton, Sharon, Foxboro, Mansfield, the Attleboros and Seekonk. It is to be known as the Boston & Providence Street Railway.

JOPLIN, MO.—The Spring River Power Company, of Joplin, announces that it will build an electric line from Baxter Springs to Galena, a distance of eight miles. Most of the right of way has been secured, and work of laying the rails will begin at once. The road will be in operation by August. The line will connect at Galena with the Southwest Missouri Electric Railway. The Spring River Power Company has just completed a $500,000 dam at Lowell.

MEMPHIS, TENN.—It is reported that a survey is to be made for an electric line from Nashville to Memphis, the work to be undertaken by Charles F. Henry, of Indianapolis, who is engaged in the construction of a network of trolley lines for the South. Surveys have already been made for lines from Louisville to Nashville and from Nashville to Birmingham. It is said that Atlanta and several other cities in the South are contemplated in the general scheme.

BATH, N. Y.—The construction of the cross-county electric line between Hammondsport and Hornellsville is said to be assured. The route is surveyed and the right of way secured, and arrangements for the incorporation of the company as the Hornellsville & Lake Keuka Electric Railroad are now being made. New York parties will finance the deal. The certificate of incorporation will shortly be filed, after which it is expected work will be commenced upon the road.

RICHMOND, IND.—By the terms of the franchise granted by the county commissioners to the Indianapolis, New Castle & Toledo Traction Company, the company is prohibited from charging more than two cents per mile fare. No fares less than five cents will be accepted, however. The company is granted two years in which it is to have the line built and cars operating in Richmond. The line of the company passes through Wayne, Webster, Clay, Center and Jefferson townships in Wayne County.

ASHEVILLE, N. C.—Within the next thirty days contracts will be let for the first electric freight railway in the South, which is to be built out of Asheville into the mining districts of Madison and Yancey counties, N. C., by the George D. Miles Company. The road will cost $1,000,000. It will be equipped with a $60,000 electric locomotive. The main purpose of the road is to provide an outlet for the mines in the Madison and Yancey districts, in which the company is interested, and which it proposes to develop very extensively.

SPRINGFIELD, OHIO—The Springfield, Troy & Piqua Electric Railway Company, owned by the Bushnell syndicate, has closed a deal by which that road, the Dayton & Troy, the Western Ohio and the Fort Wayne & Lima electric lines will work in harmony with the Clover Leaf, a steam road, on through business to Toledo and St. Louis. Passengers will be handled from Springfield to Troy over the Bushnell line; from Troy to Lima over the Dayton & Troy, and the Western Ohio from Lima to Delphos over the Fort Wayne & Lima, connecting at Delphos for Toledo and the west for St. Louis.

NASHVILLE, TENN.—The Nashville & Columbia and the Nashville & Gallatin electric railways, which recently changed hands at Nashville, Tenn., have been consolidated under the name of the Nashville Interurban Company, with $100,000 capital. The directors are E. B. Stahlman, John A. Pitts, James H. Connor, Joseph Frank, Nat. Baxter, Hilary Howse, John T. Landis, W. J. Whitthorne, of Columbia, and D. K. Spillers, of Gallatin. Mr. Stahlman was president of the Nashville & Columbia and Mr. Baxter was president of the Nashville & Gallatin line. The new company is to take up immediately the work of building the roads.

BANGOR, ME.—According to a bill introduced at Augusta the Bangor, Orono & Old Town Railway, the Bangor, Hampden & Winterport Railway, and the Bangor Street Railway will all be merged into one company; the Old Town Electric Company will be absorbed, and in all probability in the near future the Bodwell Water Power Company will be acquired by the Bangor Railway and Electric Company, which will be the new name for the Public Works Company. It is simply a plan to consolidate properties which are now controlled by the Public Works Company, all excepting the Bodwell Water Power Company, and which will be bonded to the extent of about $1,000,000.

FINDLAY, OHIO—The lease of the Toledo, Bowling Green & Southern Traction Company to the Toledo Urban & Interurban Railway Company for a term of ninety-nine years has been filed in the county recorder's office. The lease is for the entire line of the Toledo, Bowling Green & Southern road from Perrysburg to Findlay, and includes the road and all the property owned, such as lots, franchises, etc., together with the power-house at Findlay. The rental is based on the capital stock of the lessor, which is $1,500,000. The first year the rent shall be one-half of one per cent, or $7,500, and for ten years it shall increase a certain per cent each year until ten years shall have elapsed, when four per cent shall be paid, or $60,000 per year. This sum shall be the yearly rental thereafter during the life of the lease. The Toledo Urban & Interurban company shall also complete the power-house at Findlay at a cost of $200,000.

Digitized by Google

ELECTRIC LIGHTING.

WESTWOOD, N. J.—Poles have been erected for an electric line from Westwood to River Vale.

ALBION, MICH.—The council has granted a thirty-year franchise to Albion Electric Light Company.

ATWOOD, ONTARIO—W. F. Forrest, of Atwood, will install a plant to furnish electric lights to the village.

LA CROSSE, WIS.—The Wisconsin Light and Power Company has been granted a franchise to operate in La Crosse.

ST. LOUIS, MO.—The St. Louis city council has passed a bill providing for lighting by contract of that part of the city south of Keokuk street.

OGDENSBURG, N. Y.— A movement has been started toward the equipment of electric lighting plants for several hotels and large buildings in and near Ogdensburg.

RUTLAND, VT.—Work on the foundation of the Chittenden Power Company's new plant at Mendon is progressing rapidly. The plant will be ready for operation July 1.

WILLARD, UTAH—At a mass meeting of Willard citizens it was unanimously decided to take steps toward obtaining from Brigham City electricity for light and power.

LIVINGSTON, MONT.—The electric light poles, wires and franchise belonging to A. O. Newton have been sold to T. M. Swindlhurst, of Livingston, representing H. L. Frank, of Butte.

CHICAGO, Ill.—The North American Company has bought the Union Electric Light and Power Company in St. Louis, Mo., and is reported to have about closed a deal for the purchase of the United Railway Company.

PITTSFIELD, MASS.—Announcement has been made that Z. & W. M. Crane have signed contracts for the installation of a large water-power plant at the stone mill in the Renfrew district, to cost between $75,000 and $100,000.

NORWICH, CT.—The Uncas Power Company, of Norwich, has petitioned the Connecticut legislature for incorporation, with the purpose of establishing a water-power plant to generate electricity for sale in Norwich and New London.

STAMFORD, N. Y.—The Walton Electric Light Company is preparing to install a new 175-horse-power Corliss engine. This is made necessary by the increasing demands made upon the company for lights. A new dynamo will also be added.

SANTA BARBARA, CAL.—The merchants of Santa Barbara have organized a new company under the name of the Merchants' Mutual Light and Power Company. This enterprise is the result of the objections and complaints being made against the present system.

PHILADELPHIA, PA.—The Wyoming Valley Electric Company, which has absorbed the companies supplying gas and electricity to Plymouth, Nanticoke, Kingston, Edwardsville, Dorranceton, Luzerne and adjacent townships, has recorded a mortgage for $1,000,000 to secure a bond issue.

LEESBURG, VA.—W. E. Crosen & Company, of Leesburg, have applied to the council of Manassas, Va., for an exclusive franchise for the erection and maintenance in that town of a system of electric lights during a period of fifteen years. The proposed plant will have a capacity of 750 sixteen-candle-power lamps.

PAWTUCKET, R. I.—The directors of the Narragansett Electric Lighting Company have organized for the coming year All of the officers were reelected as follows: Marsden J. Perry, president and general manager; Arthur H. Watson vice-president; Arthur B. Lisle, assistant general manager; E. A. Barrows, secretary and treasurer.

ROME, GA.—At a meeting of the Rome city council a committee was appointed by the mayor to prepare a bill to be presented at the next session of the legislature, authorizing the city to build and operate an electric light plant. The city council has had the matter under consideration for some time. It will cost about $20,000 to build and equip the plant.

LITTLE ROCK, ARK.—J. B. Gray, of England, reports that he has closed a contract with the Martin-Reynolds Electric Company, of Little Rock, by which it will install an electric light plant at England within ninety days. It will be a $5,000 plant, and at first there will be fourteen street arc lights. The plant will be owned and operated by the city.

TEKAMAH, NEB.—At a regular meeting of the Tekamah city council an ordinance was passed providing for the submission to the qualified electors of the city of a proposition to issue bonds in the sum of $10,000 for the purpose of purchasing or installing an electric lighting system and plant, to be owned and operated by the city in connection with the present system of waterworks.

EASTON, PA.—The plant of the Lehigh-Northampton Gas and Electric Company, at Catasaqua, will be overhauled, modernized and enlarged. The improvements will require several months' time. William W. McKee, the receiver, is arranging for the work. Two new engines of 200 and 400-horse-power capacity, a new Stirling boiler, improved condenser, water heater, pumps and switchboard will be installed, and a third wire run through the boroughs of Alliance and Coplay, to afford better service.

NORTHAMPTON, MASS.—At their annual meeting the stockholders of the Northampton Electric Lighting Company elected the following directors: C. H. Pierce, J. T. Stoddard, Frank Lyman, C. E. Gould and George S. Graves, of Florence, the latter being elected to fill the vacancy caused by the death of Samuel B. Fuller. C. H. Pierce was elected president of the board of directors and C. E. Gould secretary and treasurer. About $18,000 was expended in improvements during the past year.

GRAND RAPIDS, MICH.—At the annual meeting of the Vincennes Light and Power Company these directors were chosen: Edward M. Deane, Dwight Smith, Dudley E. Waters, J. Boyd Pantlind, Walter C. Winchester and Claude Hamilton, Grand Rapids; C. A. Peck, Kalamazoo; George E. Berdeen, Oswego; Harry B. Wales, James W. Emerson, Charles E. Bierhaus, Royal E. Purcell, W. H. Vollmer and J. L. Bayard, Jr., Vincennes. The report of the company shows good earnings for the ten months of its existence.

GUTHRIE, OKLA.—The Guthrie Light and Power Company has filed a certificate of an increase of its capital stock from $150,000 to $250,000 which was decided upon at a meeting of the officers and directors on January 10, 1905. The company also filed an amendment of articles of incorporation with the following officers: Thomas H. Smith, of Denver, Col., president and treasurer; Robert Sohlberg, of Guthrie, vice-president; J. R. Cottingham, of Guthrie, secretary. The directors are Thomas H. Smith, of Denver, and U. C. Guss and J. R. Cottingham, of Denver.

MIDDLETOWN, OHIO—A ten-year contract for street lighting has been signed between the Middletown board of public service and the Middletown Electric Light and Power Company. According to the terms of the contract the company agrees to erect a tower, 150 feet high, with four large lamps which are to be lighted every night; to light the city building and the waterworks building free of charge; to erect 113 modern street lights and to light each for $60 per year, a total cost of $6,780 per year. In ten years the city must pay $67,800 for the lighting of its streets. The plant of the lighting company will be ready to commence operations on or before April 10.

GRAND RAPIDS, MICH.—At the annual meeting of the Grand Rapids Edison Company these officers and directors were reelected: Daniel McCool, president; McGeorge Bundy, vice-president; Thomas F. Bechtel, secretary-treasurer, and A. F. Walker, general superintendent. The directors are Daniel McCool, McGeorge Bundy, Thomas F. Bechtel, Harvey J. Holister and George C. Peirce, Grand Rapids; B. T. Becker, F. G. Bigelow and Gordon Bigelow, Milwaukee; H. N. Higinbotham, Chicago; K. K. McLaren, Jersey City, and E. R. Coffin, Schenectady, N. Y. The business for the year 1904 has been most satisfactory to the stockholders, it is stated, showing a considerable increase over the previous year. At the meeting the purchase of additional apparatus to increase the capacity of the several plants was authorized. This apparatus is to be of a type embodying all modern features, and enabling the production of current at a minimum cost. The additions contemplated will involve an expenditure of about $100,000.

Digitized by Google

NEW INCORPORATIONS.

RICHFIELD, OHIO—West Richfield Telephone Company. $10,000.

TOPEKA, KAN.—Macksville, Prattsburg & Nora Telephone Company. $1,000.

NEW YORK, N. Y.—The Health-Apparatus Company has been formed to manufacture electric healing devices.

CHICAGO, ILL.—Chicago & State Line Railway. $10,000. Incorporator: H. R. McCullough, Lake Forrest, Ill.

CHICAGO, ILL.—Wadeford Electric Company. $2,500. Incorporators: J. W. Castle, George Lackie, F. S. McClory.

ASHLAND, ORE.—Jacksonville Electric Company. $10,000. Incorporators: C. R. Ray, A. E. Reames and Peter Diesch.

NEW YORK, N. Y.—Kerr Electric Company. $1,000. Directors: D. A. MacIntyre, O. B. Goldsmith, A. L. Davis, New York city.

LITTLE ROCK, ARK.—Waldron Telephone Company. $2,000. Incorporators: C. E. Forrester, J. E. Frisby and J. O. Johnson.

MARINGOUIN, LA.—Plaquemine Electric Light and Power Company. $30,000. Directors: J. H. Savage, M. Dick and V. M. Barber.

WASHINGTON, D. C.—Empire Light and Power Company. $500,000. Incorporators: D. S. Fletcher, N. A. Smith and K. M. Fletcher.

HARRISBURG, PA.—Rohrerstown, Landisville & Mount Joy Street Railway Company. $60,000. President, Charles B. Keller, of Lancaster.

MAINE, N. Y.—Nonticok Valley Telephone and Telegraph Company. $1,000. Incorporators: William Clark, W. E. Dyer and D. Dudley, Maine.

EAST ST. LOUIS, ILL.—Ozark Mountain Electric Railway Company. $5,000. Incorporators: John Nimes, F. W. Hackman, Jr., and E. W. Hartman.

DULUTH, MINN.—Duluth Electric and Construction Company. $50,000. Incorporators: Charles A. Hutchinson, Harold E. Pierce and Van S. McKenny.

UTICA, N. Y.—Franklin Springs Electric Light Company. $5,000. Incorporators: F. DeW. Smyth, D. DeW. Smyth, Utica, N. Y.; Ed B. Stanley, Clinton, N. Y.

METUCHEN, N. J.—Metuchen Gas and Electric Light Company. $50,000. Directors: A. F. Rittenmeyer, Patrick Convery, Robert Carson and L. D. Johnson.

LUFKIN, TEX.—Lufkin Electric Light and Power Company. $30,000. Incorporators: S. W. Henderson, G. F. Hackney and J. S. Henderson, all of Lufkin.

PALMYRA, N. Y.—Palmyra Gas and Electric Company. $25,000. Incorporators: C. C. M. Hunt, C. McLouth, Palmyra, N. Y.; G. S. Sheppard, Penn Yan, N. Y.

HARTFORD, CT.—Sterling Manufacturing Company. To manufacture electricity. $50,000. Incorporators: L. B. Penfield, F. W. Baker and M. J. Hogan.

ALBANY, N. Y.—College Hill Electric Light Company. $5,000. Incorporators: Charles B. Rogers, Utica, N. Y.; Joseph Riedd, Samuel J. Saunders, Clinton, N. Y.

BUFFALO, N. Y.—Iroquois Electric Company. To manufacture electricity. $1,000,000. Incorporators: Edmund Hayes, W. H. Hotchkiss and G. K. Birge, Buffalo.

AURORA, ILL.—Fox River Light, Heat and Power Company. Changed to Western United Gas and Electric Company, and capital increased from $500,000 to $6,500,000.

TRENTON, N. J.—Madison River Power Company. $6,000,000. Incorporators: Pressley E. Risland, Allen J. Nichols, William S. Brayton, Charles R. Gauter and Albert S. Ridley.

EDWARDSVILLE, ILL.—Jerseyville Illuminating Company. $1,000. Incorporators: Owen Ford, of St. Louis; J. N. C. Shumway, of Taylorville, and H. A. Shepherd, of Jerseyville.

CLARKSVILLE, TENN.—The Clarksville Electric Street Railway Company. Changed to Clarksville Railway and Light Company, and capital increased from $20,000 to $250,000.

CANTON, OHIO—Sandy Valley Light, Heat and Power Company. $25,000. Incorporators: William L. Davis, Grant B. Wells, John L. Allman, Charles Frey and Harrison B. Webber.

PARIS, ILL.—Paris Traction Company. $5,000. Incorporators: Andrew J. Hunter, F. L. Kidder, Charles P. Hitch and Hugar L. Hodges, of Paris, Ill., and John J. Cummings, of Chicago, Ill.

TRENTON, N. J.—The Alaska Fuel, Power and Transportation Company. $1,000,000. Incorporators: W. H. Duval, of Allenhurst, N. J., and J. Warren Dickson and A. C. Shentone, of New York.

ST. CLOUD, MINN.—Commercial Telephone Company, of Belgrade, Minn. $50,000. President, T. J. Anderson; vice-president, Chris Borgerding; secretary, J. F. Chisholm; treasurer, Alexander Ridgeway.

CHICAGO, ILL.—Chicago Edison Light Company; $2,500; incorporators: Clayton R. Taylor, Percy B. Eckhart and Thomas G. Deering. Edison Electric Illuminating Company; $2,500; same incorporators.

PORTLAND, ORE.—Portland, Sandy & Mount Hood Electric Railway. $10,000. Incorporators: Seneca Smith, Portland; Napoleon Davis, Eastern Multnomah; George L. Story, Guy G. Willis and A. S. Done.

JACKSON, MISS.—Durant-Lexington Electric Railway Company. Organized to build an interurban line between the towns of Lexington and Durant. $200,000. Incorporators: Chester Jones, Truman Jones and W. O. Glines.

ZANESVILLE, OHIO—Zanesville, Cambridge & Northern Traction Company. $10,000. President, Frank McCormac, of New Concord; Samuel Nicholson, of Coshocton, secretary, and H. A. Sharpe, of Zanesville, treasurer.

PORTLAND, ME.—The Chapman Electric Neutralizer Company has been incorporated with a capital of $500,000, of which $500 is paid in. The officers are: president, F. C. Payson; treasurer, R. C. Payson, both of Portland.

RALEIGH, N. C.—The Andrews Light and Power Company, of Andrews. To construct and maintain waterworks, electric light and power plants, telephone plants, etc. $100,000. Incorporators: J. Q. Barker, E. G. Henneman and others, Andrews.

AKRON, OHIO—Wadsworth & Western Traction Company. To build an electric line from Barberton to Wadsworth. $10,000. Incorporators: Byron W. Clendening, George H. Heffner, William A. Ault, Charles S. Johnson, Samuel Cunningham and H. S. Davidson.

MOLINE, ILL.—Rock Island, Moline & Davenport Railway Company. $5,000. Incorporators: C. G. Hipwell, E. J. Daugherty, E. S. Ausderheide and J. W. Walsh, of Davenport, and John W. Greene, Stuart Spaulding, C. E. Soule, Jr., and William A. Rawson, of Chicago.

NEW YORK, N. Y.—The Connecticut Dynamo and Motor Company has been incorporated with a capital of $17,000 to manufacture electrical appliances. The incorporators and directors for the first year are D. McDonald, H. J. Brewer and J. P. Munn, all of New York city.

SPRINGFIELD, ILL.—East St. Louis, Waterloo & Chester Suburban Railway Company. To construct a road from East St. Louis to Waterloo and Chester. $25,000. Incorporators: Thomas M. Chase and Tyron J. Woodward, of St. Louis, Mo.; James P. Slade and A. P. Garrett, of East St. Louis, and Edward F. Schonening, of Columbia, Ill.

EAST ST. LOUIS, ILL.—St. Louis, Freeburg & Fayetteville Railroad Company. To build a road from Belleville to Fayetteville, both in St. Clair County, Ill. $10,000. Incorporators and first board of directors: E. A. Ambs, of O'Fallon, Ill.; George Geisler and A. Vogler, of St. Louis, Mo., and Adolph A. Wolf and Peter Yaeger, of Freeburg, Ill.

SPRINGFIELD, ILL.—Central Illinois Interurban Railroad Company. To construct a road from Peoria to Pekin, Mason City, Springfield, Havana and Lincoln. $5,000. Incorporators and first

Digitized by Google

board of directors: John B. Abbott, Paul A. Enlows, Fritz Hindahl, Claude L. Stone and Otto S. King, all of Mason City.

SPRINGFIELD, ILL.—Red Budd Light and Power Company. $20,000. Incorporators: J. A. Hamilton, A. B. Daab and L. D. Turner, Jr.

NEW YORK, N. Y.—Rose Telephone Company. $15,000. Incorporators: H. K. Rose, M. J. Rose, South Kortright, N. Y.; C. E. Hanford, Hobart, N. Y.

LINCOLN, NEB.—Sidney Electric Service Company, of Sidney; to establish a power plant for commercial purposes. $10,000. Incorporators: M. C. Callahan and C. Callahan.

YOUNGSTOWN, OHIO—The Cleveland, Youngstown & Ohio River Railroad Company. $200,000. Incorporators: Thomas E. Connell, Frederick B. Hamilton, James J. McNally.

ALBANY, N. Y.—Brooklyn Telegraph and Messenger Company; to maintain a telegraph, telephone and messenger service in Brooklyn. $100,000. Directors: M. N. MacDonald, A. E. Grinnell, E. W. Hunt, L. MacDonald, Albert T. Leonard and A. F. Kelley, of Brooklyn, and M. G. Clum, of Yonkers.

WAUKEGAN, ILL.—Watseka & Kankakee Traction Railway Company; to be constructed from Watseka, Iroquois County, to Kankakee, Kankakee County, Ill. $25,000. Incorporators and first board are David Magill, George W. Hoyt, Walter H. Hogan, O. F. Morgan and Robert L. Harrell, all of Watseka, Ill.

NEW COMPANIES.

HARRISBURG, PA.—The Hulton Electrical Company, of Scranton, has been organized with a capital of $20,000.

AUGUSTA, ME.—The International Electric Appliance Company, of Augusta, has been incorporated to manufacture electrical appliances. The capital is $50,000. I. L. Fairbanks, of Augusta, is president and treasurer.

PHILLIPSBURG, N. J.—The Electrical Specialty Manufacturing Company has been incorporated by Clarence Walters, F. K. Moyer and W. H. Walters, with a capital of $60,000. The company will do a general electrical business.

BOSTON, MASS.—The Charles N. Wood Electric Company has been incorporated with a capital of $50,000. Charles N. Wood is president, Walter E. Geer is treasurer and Nathan L. Wood is clerk. The directors are the above named.

DERBY, CT.—The Automatic Electric Time Switch Company has been organized to manufacture a device by which electric lights may be automatically switched on or off at any desired hour. The company has elected these officers: president, E. M. Rogers, of New Haven; vice-president, A. W. Piper, of Derby; secretary, C. E. Hoyt; treasurer, Charles L. Hoyt.

ENGINEERING SOCIETIES.

PENNSYLVANIA STATE COLLEGE BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—On Wednesday evening, February 15, the Pennsylvania State College branch of the American Institute of Electrical Engineers discussed the paper on modern central station design, by J. E. Moultrop.

SOCIETE BELGE D'ELECTRICIENS—The January issue of the monthly bulletin of the Société Belge d'Electriciens contains several interesting papers. M. H. Haller and H. Hoern describe some recent hoisting machines. M. J. Carlier describes methods and apparatus for measuring time, distances, speed and acceleration. The headquarters of the society are at 42 rue d'Isabelle, Brussels.

OBITUARY NOTICES.

MR. ALBON MAN, one of the pioneers in the development of the incandescent lamp, died at the Hotel St. George, Brooklyn, on Saturday, February 18. He was seventy-eight years of age. Mr. Man was a practising lawyer, with offices in the Morris Building, 68 Broad street, New York city. He was a graduate of Union College.

MR. WILLIAM K. ACKERMAN, formerly president of the Illinois Central Railroad, died at his home in Chicago, Ill., on Tuesday morning, February 7, in his seventy-third year. Mr. Ackerman was born in New York city January 23, 1832. In 1891 Mr. Ackerman was selected as auditor for the World's Columbian Exposition. During the mayoralty of John P. Hopkins he was city comptroller of Chicago. He was the author of several publications relating to railroads, among them being "Early Railways of Illinois," and "Notes on Railway Management." He was also a frequent contributor to magazines and newspapers. Mr. Ackerman was a member of the Chicago Club.

MR. EUGENE F. PHILLIPS, the founder of the American Electrical Works, died of heart failure on the morning of Wednesday, February 22, at his home in Providence. Mr. Phillips was one of the best known manufacturers of insulated wire and copper wire in the United States, and was a pioneer in this field. His company has grown from a small beginning, until it is one of the largest, Mr. Phillips commencing business in his own name in 1870, and in 1882 organizing the American Electrical Works. The company has a large branch factory in Montreal, and agencies in many of the large cities. Mr. Phillips's two sons, Frank N. Phillips and E. Rowland Phillips, were active in the management of the American Electrical Works, the former having been president for several years. Mr. Phillips was very widely known, was a gentleman of commanding character and highly popular throughout the entire electrical field. He inaugurated the famous Rhode Island clambakes for the electrical fraternity, and for many years invited his electrical friends to meet him annually and enjoy a bake at some one of the famous Rhode Island clubs at Providence. His death will be very widely and deeply mourned. He leaves a widow, two sons and one daughter.

LEGAL NOTE.

COMMON BATTERY AUTOMATIC SIGNAL BOARD DECISION—In the circuit court of the United States for the Northern District of Illinois, Southern Division, in the suit in equity of the Western Electric Company, complainants, *vs.* the Galesburg Union Telephone Company and Howard Knowles, defendants, Judge Seaman handed down an opinion dismissing the bill for want of equity. The bill was for alleged infringement of letters-patent No. 669,708, issued March 12, 1901 (on application filed February 28, 1895), to Charles E. Scribner, for apparatus for telephone switchboards.

INDUSTRIAL ITEMS.

THE REYNOLDS DULL FLASHER COMPANY, Chicago, Ill., through Egbert Reynolds Dull, announces that on February 14 a suit in equity was instituted in the United States Circuit Court for the Northern District of Illinois, by Egbert Reynolds Dull, against the Reynolds Electric Flasher Manufacturing Company, Chicago, and Christian F. Ziegler, for alleged infringement of Sinclair patent No. 566,874, and Dull patent No. 780,641, praying an injunction and award of damages. The Sinclair patent covers broadly the combination of a cam, a knife switch and a reducing gear in train. The Dull patent covers the combination of a knife switch, a carbon auxiliary and a gravity drop in flashing devices.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., announces that Mr. Walter Fairchild has been placed in charge of the New York office at 135 Broadway. Mr. Fairchild formerly represented the Bullock Electric Manufacturing Company in this city, and prior to that was the New York representative of the Stanley Electric Manufacturing Company. Mr. Robert S. Hopkins has been appointed New York city sales agent, with headquarters at 135 Broadway. Mr. J. Frank Perry has been appointed sales engineer of the National Electric Company. His field of operation has been largely through New England, but he has been connected with large power installations in all parts of the world. Mr. Perry is at the present time in California, representing the interests of the National Electric Company.

THE AMERICAN VITRIFIED CONDUIT COMPANY, New York city, is distributing a rather striking booklet, which it has named "Pointers." It contains a table for making preliminary estimates of the cost of laying conduits, and describes the various

Digitized by Google

types of conduits which it manufactures. A partial list of the users of the conduits made by this company is also given.

THE LECLANCHE BATTERY COMPANY, 111-117 East One Hundred and Thirty-first street, New York city, will be pleased to send its new circular, descriptive of the "Gonda" wedge cell.

W. GREEN & COMPANY, 6 Maiden lane, New York city, are issuing a circular calling attention to their "Imperial Solderene," which they say is a preparation which will take the place of soft solder and acids in electrical, dental and jeweler's work.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., is mailing its general catalogue for 1905. The volume has been thoroughly revised, and contains considerable new matter. A number of tables are given, and these, together with other general information, make it a valuable book of reference.

THE KRYPTOL GESELLSCHAFT, LIMITED, 56 Unter den Linden, Berlin, N. W., is distributing a price-list of hot plates, combustion furnaces, drying ovens, etc., which are heated by Kryptol, which is a new resistance material for heating by electricity. This substance was described in the ELECTRICAL REVIEW of October 29, 1904.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, 919 Liberty street, Pittsburg, Pa., is distributing its net price catalogue of field coils, armatures coils, armatures, switchboards, etc. These catalogues are being distributed to the electrical trade from Pennsylvania to the Gulf of Mexico. Any company which has been missed in the distribution should apply at once to the company.

THE F. H. STEWART ELECTRIC COMPANY, 275 North Seventh street, Philadelphia, Pa., now occupies the whole building—four floors and basement—at this address. In addition to this large building the company has a large warehouse. The F. H. Stewart company is carrying a very much increased stock, these facilities being necessary because of a rapidly increasing business.

THE HARVARD ELECTRIC COMPANY, 60 West Van Buren street, Chicago, Ill., is distributing several illustrated catalogues and price lists. The company is the manufacturer of fuses, cut-outs, distributing boards, terminals, heat coils, cable hangers, magnet winders, connectors, paper sleeves and other electrical specialties. This material is listed in these catalogues, which will be sent upon request.

THE L. B. ALLEN COMPANY, INCORPORATED, 1335 Columbia avenue, Chicago, Ill., is calling attention to its soldering compounds and specialties in a unique manner, mailing a heavy tag to its patrons which bears on the reverse side nine statements addressed to the electrical field. The card calls attention to the Allen soldering stick, soldering salts, fluxes, commutator lubricant, metal polish and self-fluxing solder.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has issued a comprehensive price list of its standard motors and generators. This price list is of side-pocket size, and contains complete lists of the various types of motors regularly furnished for various applications, in sizes from one-sixteenth to fifteen horse-power, and dynamos from one-half to ten kilowatts. Copies of this price list may be obtained by communicating with the company.

THE D. T. WILLIAMS VALVE COMPANY, Cincinnati, Ohio, was incorporated several weeks since. It is now very busy installing the new machinery. A portion of this equipment was secured in Cincinnati and the remainder was purchased in the East. This machinery is all of the latest and most approved design. The building that it is remodeling is 100 by 191 feet, and will accommodate 100 men. The company will manufacture a full line of valves, lubricators, oil and grease cups, etc.

THE LORD ADVERTISING AGENCY, Scranton, Pa., has issued the first edition of "Lord's List of Trade Papers." This list has been prepared for the convenience of present and prospective trade paper advertisers. The endeavor has been made to list only those papers which are of advertising value to manufacturers of machinery, appliances and materials used in technical industries. The book contains a selected list of trade papers in the lines mentioned, and will, no doubt, prove a valuable compendium on classified trade paper advertising.

THE EDISON ELECTRIC ILLUMINATING COMPANY, Brooklyn, N. Y., under the title "Five Thousand Dollar Bills," has published a very interesting pamphlet, showing typical instances to the use of incandescent lamps in and around the borough or Brooklyn, and calling attention to a few subscribers to the Edison lighting and power service whose bills for current are annually upward of $5,000, and whose aggregate consumption is in excess of $325,000 a year. A number of fine half-tones, showing night views of various scenes, are added to the book. There are also illustrations of interior effects, which are instructive and interesting.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, will be pleased to send, upon request, a small pamphlet entitled "Pipe and Boiler Coverings and Their Uses." This pamphlet describes various forms of abestos and magnesia sectional pipe covering, and tells of their use and value for both steam and hot-water pipes, and for protecting pipes from freezing. Prices of coverings, elbows, tees and valves are listed. The annual meeting of the H. W. Johns-Manville Company was held in the company's office, New York city, on January 16. The following officers were elected: J. G. Cannon, chairman of the board of directors; T. F. Manville, president; C. B. Manville, vice-president; Charles Hathaway, vice-president; C. W. Gladwin, vice-president and treasurer; H. E. Manville, secretary. The directors are the officers and H. W. Johns, William H. Porter and C. R. Manville.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has closed a contract for electrically equipping the large cotton mill of the Dwight Manufacturing Company, of Chicopee, Mass. The equipment is upward of 130,000 spindles, comprising both ring spindles and mule spindles and about 3,500 looms, and is at the present time driven by water and steam, the water power being supplied from the Chicopee river, on which the mill is located. It is intended to operate a portion of the mill continuously by motors and other parts are to be operated by electric drive in case of low water. The present contract provides for the following apparatus to be delivered and erected by the Westinghouse company; one 440-volt alternating-current generator, 900-kilowatt rated capacity, to supply three-phase current at a frequency of sixty cycles. This generator is to be direct-connected to a C. & G. Cooper 26 and 52-inch by 48-inch stroke cross-compound condensing engine; one twenty-five-kilowatt exciter direct-connected to Westinghouse engine; one twenty-two and one-half-kilowatt motor-driven exciter. There will also be provided a four-panel switchboard to control generator, exciters and six feeders. The electric power plant is to be placed in a new building, to be built as an addition to one of the present engine houses The following Westinghouse type C motors wound for sixty cycles, three-phase, will be located in the various parts of the mill: two 200 horse-power, 580 revolutions per minute; six 100 horse-power, 580 revolutions per minute; three 75 horse-power, 690 revolutions per minute; three 50 horse-power, 850 revolutions per minute; two 40 horse-power, 850 revolutions per minute. The complete equipment of the new plant is from the plans of Messrs. Lockwood, Greene & Company, of Boston. The Westinghouse company has also closed a contract with the United Railways and Electric Company, of Baltimore, Md., for an alternating-current generator to be rated at 5,000 kilowatts. It will be of the flywheel type, with tnirty-two poles, and will run at ninety-four revolutions per minute. The generator will be wound for 13,000 volts, three-phase, with a frequency of twenty-five cycles. The 5,000-kilowatt generator now on order is to have the same characteristics and to run in parallel with the five 2,000-kilowatt generators which the Westinghouse company has installed in the Pratt street station in Baltimore. The company has sold to the La Belle Iron Works, at Steubenville, Ohio, a direct-current engine-type generator, to be rated at 1,000 kilowatts, the voltage to be 250. The contract includes also a switchboard of blue Vermont marble. The Westinghouse apparatus already installed in this plant includes alternating and direct-current generators with a total rated capacity of 1,250 kilowatts, a 300-kilowatt rotary converter and over 200 motors, not including those used on the cranes, ranging in size from 1 to 300 horse-power. About two-thirds of these are Westinghouse type C alternating-current motors.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 9. NEW YORK, SATURDAY, MARCH 4, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
- Signs of Spring 355
- Is the Steam Locomotive Doomed? 355
- Inventions and Investments 355
- Isolated Plants or Central Station Power for Factories 356
- A Government Light and Power Plant 356
- Electrical Methods of Measuring Temperature 357
- The Mystery of Electricity 357

India-Rubber in 1904 358
The Annual Report of the Mackay Companies 358
Effect of Load-Factor on Cost of Power, by E. M. Archibald 359
Condensers for High Vacuum 362
The Largest Municipal Electric Plant in New England, by Alton D. Adams 363
The Annual Report of the Cuyahoga Telephone Company 367
Faraday Society 367
Two-Motor *versus* Four-Motor Equipments, by N. McD. Crawford 368
Fuel Economy in Steam Power Plants (II.), by William H. Booth and John B. C. Kershaw 371
Technical Education in France 372
The Municipal Electric Plant in New York City 373
Peculiar Photographic Action 374
Railway Signal Systems, by Azel Ames, Jr 374
Amusement Telephones 374
Report of the Directors of the New York & New Jersey Telephone Company 375
American Institute of Electrical Engineers 376
Dinner of the Electrical Contractors' Association 377
Economics of Transmission Problems, by F. A. C. Perrine 378
Automobile Freight Line between Lima and Callao 379
Australian Tramway Systems, by John Plummer 379
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 380
ELECTRICAL PATENTS 382
INDUSTRIAL SECTION:
- The Best Manufacturing Company's Valves 383
- Dull's Carbon Type Flasher 384
- Portable Electrically Driven Grinders and Drills 384
- Pole-Cable Terminals 385
- Los Angeles Pacific Railroad 385
- An Automatic System of Refrigeration 385
- Closing Bulkhead Doors by Electricity 386
- Induction Motor in a Tannery 387
- An Important Decision Sustaining the Tesla Patents 388

CURRENT ELECTRICAL NEWS 390

SIGNS OF SPRING.

March is the first spring month, and although, according to the calendar, spring does not come until toward the end of the month, every one watches eagerly for signs of spring as soon as February has passed.

One of the first signs of spring which reaches the electric trade is the appearance of circulars describing the newest types of electric fans. These have already made their appearance, indicating that now is the time for the supply houses to begin thinking of their spring and summer orders.

The electric fan has hosts of friends and very few enemies, and is always a welcome addition to an office equipment or home furnishings. Even now, when we are not yet out of the grip of winter—for, as we write, snow is falling—this little forerunner inspires us with the hope that spring will be on time, and that this winter will soon be merely a memory.

IS THE STEAM LOCOMOTIVE DOOMED?

Is the steam locomotive doomed? Will not every steam locomotive now in operation soon be consigned to the scrap heap? Will not locomotive works have to go out of business, or turn their energies in other directions, such, possibly, as the building of electric locomotives? How many times these questions have been asked of late, and how often attempts have been made to answer them.

Of course, no general answer can be made to any such questions, but for some time to come the problem will be mainly one of dollars and cents, and while the electric locomotive will find plenty of work to do, the steam locomotive will, we believe, hold its own over the greater part of the railway systems of this country. That this opinion is held by prominent railway engineers has been shown by some recent large orders for steam locomotives. The latest of these was announced the early part of this week, when information was given out that the Baltimore & Ohio Railroad Company had authorized the purchase of 250 steam locomotives. One hundred and seventy-five of these are locomotives of the largest size; thirty-five are modern passenger locomotives. This company evidently expects to use steam locomotives for a time, at least, although it was the first road to employ the electric locomotive for hauling standard passenger and freight trains.

INVENTIONS AND INVESTMENTS.

We Americans have a way of patting ourselves on our backs, figuratively speaking, because we believe that we alone of all peoples recognize the true value of the scrap heap. We pride ourselves on always keeping in the front rank of progress and because we do not hesitate to condemn an old machine when one of a newer type is procurable. No effort is spared to keep our industrial plants in step with the inventor, who, in turn, is carrying the art forward as rapidly and as far as possible.

Now, undoubtedly, this spirit had been an important factor in carrying the country to the position it now occupies, and it will keep us in the front in the future. But it is also true that the principle of scrapping may be carried to excess. It may not always pay to discard an old machine and install a new, however efficient the latter may be. Although, considered alone, the new device may seem to offer a profitable investment, it must not be forgotten, that, in general, it must also pay, in part at least, for the scrapped machine. Only when a profit can be figured out on this basis, should the change be made. This profit need not be in the form of decreased cost of operation; it may be either improvement in the quality or increase in the quantity of the product.

Nor can it be assumed that the equipment of every new plant should be only of the best and latest. It is of little use to install

Digitized by Google

the most efficient machinery if it must be operated inefficiently. Taking as a basis of computation the cost of the cheapest equipment that will do the work satisfactorily, every additional expense for better machinery must be shown to be a profitable investment under the conditions in which it will be used.

The position, which should be taken by every engineer in behalf of his employers, is not antagonistic to the inventor. If the latter has a device which best fulfils the requirements of the case, it will be used. The inventor should recogniz the correctness of the principle and not expect the engineer or investor to throw out an old machine simply because the newer is a little better. The latter must be enough better to make the change profitable, and it is the inventor's business to prove this to the satisfaction of the man who is asked to buy.

ISOLATED PLANTS OR CENTRAL STATION POWER FOR FACTORIES.

While the electric drive brings great advantages in factories, it does not follow that it is always advisable for a factory to install its own generating plant. Factory operators, under the old system, have had control of their power supply, and probably hesitate somewhat before relying upon an outside source; but an examination of the problem would seem to show that, in many cases at least, it would be better to purchase power than to install and operate a plant at the factory.

One of the advantages—possibly the chief advantage—of purchasing power will be the greater reliability secured. A large station can be depended upon more surely for a continuous supply of electrical energy than can the most carefully operated isolated plant, for it spares no expense to secure reliability. It is well known that certain of our largest stations have not been without power in their mains for ten years or more. This is attained not only by careful design, but by the large size of the generating units installed, as well as that of the entire station.

Another important consideration which should have much weight with the operator is this, if he buys his power he has the care of his own plant removed from his shoulders, and therefore has more opportunity to improve the operation of his factory. It is by attention to details that the best performance is obtained, and it is not good policy to force a man who should put his entire thought upon the factory itself to be burdened with the cares of a power plant as well.

Other advantages which may be secured by purchasing power, rather than installing a plant at the factory, are these: the power available is not limited by a small equipment; the factory may be enlarged and additional motors installed practically at will, while in an isolated plant the available output of the latter always limits the growth of the factory until an increase can be made which will justify an addition to the generating plant.

Eliminating the isolated plant will often set free space which can be utilized for additions to the factory proper, or for other purposes. If a new factory is to be installed, the money which would otherwise be invested in the generating plant may be more profitably used to increase the size of the factory itself. Further, for a new factory there is freer choice of site when power is to be purchased than when it is to be generated.

As against these advantages, there may be the increase in the cost of power when purchased rather than generated. This may or may not be important. It is probable, in many cases, that power can be purchased more cheaply than it can be generated, and in making a comparison, the factory operator should be honest to himself, and charge against his generating plant everything which should properly be charged. The factory load is, in general, a desirable one for the central station, since it comes in the daytime, and overlaps the peaks of the station, if at all, for a few months only. For this reason advantageous rates can be secured from the central station. Even assuming the cost of power to be somewhat more, the cost of the power itself is only a small part of that of operating the factory, and the slight increase in this would, in many cases, be unimportant compared with the advantages which may be gained by purchasing power. The principal of these, as mentioned above, are increased reliability and concentration of effort. To secure the best results it is highly important to have no interference with the work of the factory, and therefore the factory should devote itself to doing its own work, and not to the secondary work of generating power.

A GOVERNMENT LIGHT AND POWER PLANT.

The Treasury Department has issued a pamphlet setting forth preliminary plans for a light, heat and power plant which it is proposed to install in Washington, D. C., for supplying certain government buildings. The estimates have been carefully made, and a number of alternative plans have been studied. Evidently a great deal of care has been devoted to preparing the report. The object of installing this plant is to reduce the expense of the government. It is said that a previous undertaking of a similar character, though of less magnitude, reduced the expense to the government by about $7,000 per year.

Assuming that the estimates given in this report are correct —and we have no means of checking them, and no disposition to doubt them—on the face of it the installation of such a plant would seem to be desirable; but there are other things to be considered. The government work at Washington is getting more and more cumbersome, and every undertaking of this character adds to the burden of the officials there. Such a plant would be taken care of by an engineer retained for that purpose. This man would be responsible to some one over him, and the duties of the latter would thereby be increased. This may be a small matter in this particular case, but if the government starts generating its own electricity, why should it not make its own gas or its own paper, or any of the thousand and one things which it to-day purchases? The principle involved is one of doubtful expediency, if looked at in this way; and is not this the proper way to look at it? If there were no other way of obtaining the necessary power, the situation would be different, but no such reason is given in the report. The argument for the plant is based simply on the saving of expense, and none of the larger problems involved is considered. The desirability of having the government enter into competition with private interests may be questioned. Although the situation at Washington is different from that elsewhere, the increasing tendency for the federal, state and municipal governments to enter into the business of supplying power for lighting buildings or operating railway systems, or other such businesses, even though they be more or less of a public nature, is one which, we believe, is greatly to be deplored.

Digitized by Google

ELECTRICAL METHODS OF MEASURING TEMPERATURE.

Exact methods are important in scientific research. They are highly desirable, as well, in industrial applications. This is being realized more and more every day, and no doubt the ease with which accurate electrical measurements are made has done much to bring this about.

Until recently, in furnace processes or all processes where high temperature were used, the manufacturer has been at a disadvantage, for there was no readily available method of measuring accurately such temperatures. It was usual to rely upon the judgment of an expert who had devoted years of his life to a particular process. Such experts doubtless acquired great skill, but there is always a possibility of error, which may cause a loss, and even disaster. In some industries methods have been used which indicate approximately the temperature within the furnace, but while acting as rough guides, such methods are far from satisfactory.

To-day there are available two simple and accurate methods of measuring temperatures, both depending upon electrical effects. In one the change in resistance of a wire with change in temperature is measured. In the other, the electromotive force set up in a thermoelectric couple is measured, and from this the temperature of the couple is determined. These measurements may be made with simple apparatus. They may be made at any time, and thus guide the operator in his work. Each of the two methods has some advantages which are worth noting.

The resistance method is possibly the more accurate of the two, since a greater effect is produced for a given change in temperature, and, further, the zero method of obtaining readings adds to the accuracy of the determination. A pyrometer of this description may have a high sensibility; it may be even more sensitive than the air thermometer, since the change in resistance for each degree change in temperature can be made to be greater than the corresponding change in the volume of air. The electrical resistance pyrometer is suitable for measuring temperatures of enclosures, since the indication is that of the average temperature of the wire. The device, however, is somewhat more complex than a thermoelectric pyrometer, because its construction must be such as to eliminate the errors due to change in the resistance of the wires connecting the instrument with the galvanometer. Pyrometers of this kind may be used for a long time without any change in their constants. They are easily calibrated when once the characteristic of the resistance wire is known, but it is well to note that the variation in resistance is not directly proportional to the change in temperature. In other words, the characteristic is curved, and not a straight line.

The thermoelectric pyrometer is a simpler device than the resistance pyrometer. It is less sensitive, but should be sufficiently accurate for almost any industrial purpose. It is particularly well adapted for determining the temperature at a point. Excellent pyrometers of both these types may now be obtained from instrument makers. If, however, this expense does not seem to be justified, a simple, but satisfactory, thermoelectric pyrometer is easily made. The usual materials used for the couple are platinum and platinum-rhodium, but other metals or alloys, though less sensitive, may be satisfactory for the purpose. Any type of galvanometer or low-potential reading instrument can be used and the apparatus is readily calibrated. There is no reason to-day for any laboratory being handicapped by the lack of a satisfactory pyrometer.

THE MYSTERY OF ELECTRICITY.

In a recent lecture before the New York Electrical Society, President H. H. Vreeland, of the New York City Railway Company, spoke, incidentally, of the peculiar feeling which the public has for anything electrical. Electricity is usually spoken of as the most mysterious force known, and this feeling is played upon by the unscrupulous, who, by attributing to electricity the virtues they claim for their wares, deceive many who would not give the article in question a moment's consideration if the word "electricity" were not connected with it. Now we know more about electrical energy than any other form—that is to say, we are able to produce it, control it, transmit it, and make it perform useful work with greater ease than we can any other form of energy. We know more about this branch of physics possibly than any other, and, in fact, the stupendous amount of energy which has been expended in electrical research during the last quarter of a century has extended our knowledge in practically all sciences. Yet in spite of this, electricity is considered mysterious. Now, is it not more mysterious to have ever present a force which we can not change, which acts we know not how, the effect of which we can not get away from, and which we can not direct? No one has explained why the apple falls, but we satisfy ourselves with the statement that it falls because the earth draws it to itself. But no one considers the force of gravity mysterious.

One explanation of this peculiar situation may lie in the newness of electrical phenomena. Gravity we have always had with us. So far as we know, the apple has always fallen when loosened from the tree, and that it continues to do so is not at all surprising. It is true we have had, since the beginning, electrical effects such as lightning and the action of charged bodies upon one another, but it is only recently that man has learned to control electrical energy and to do with it practically what he wills. As yet the newness of this new servant to man has not worn off. Things are done now which were thought impossible, if thought at all. Given electrical energy in a controllable form, to the man who does these things the method of doing them is simple, but the general public has not yet lost its feeling of awe for all things electrical.

Of course, it is true that no one can give any final explanation of how and why electrical energy acts, but is it not less mysterious to have a force directed along a wire, than to have one acting through space filled with we know not what?

Digitized by Google

India-Rubber in 1904.

The growing demand for india-rubber for use in manufacturing in the United States is illustrated by some figures just presented by the Department of Commerce and Labor through its bureau of statistics. They show that the value of india-rubber imported into the United States has grown from ten million dollars in 1884 to forty-four millions in 1904, and that the total value of india-rubber imports in the period 1884-1904 is, in round terms, about 440 millions of dollars. This increase in the value of rubber imported is due in part, however, to an advance in price, the average value per pound of the imports of crude rubber (including gutta-percha) having been in 1884 forty-three cents, and in 1904, seventy cents. The total quantity of rubber imported in a crude state in 1884 was 23,672,563 pounds, and in 1904, 61,889,758 pounds.

A comparison of the importations of rubber in 1904 with those of 1884 suggests not only the growing demand in the United States for this article, but the recognition of the importance of husbanding the rubber resources of the world. In 1884 the only rubber imports were crude rubber and gutta-percha. In 1904, however, there were not only crude rubber and gutta-percha, but also about fifteen million pounds of "gutta joolatong" or East Indian gum, a product of Borneo, which in certain lines of manufacture is utilized instead of india-rubber; and in addition to this sixteen million pounds of old and scrap rubber fit only for remanufacture. Thus it would appear that the rapidly growing demand for rubber and the consequent danger that it may in time exceed the supply are suggesting to the manufacturers and others engaged in this industry the importance of husbanding of resources as far as possible.

Brazil, of course, supplies the largest share of the rubber imports of the United States. Of the sixty-two million pounds of india-rubber imported in 1904, thirty-four and one-half million pounds came from Brazil, while the bulk of the remainder came, apparently, from Africa. The original sources, however, of the large rubber imports other than those from Brazil, are somewhat problematical, since twenty-two million pounds are reported by the bureau of statistics as imported from Europe; though as no European country produces india-rubber in any considerable quantities it must be assumed that it was brought by those European countries from some other part of the world, and that probably it originated in Africa and other of the colonies of the European countries. From the United Kingdom the imports of rubber have grown from six and one-half million pounds in the fiscal year 1893 to nine and three-quarter millions in 1903; from Germany, whose chief colonial possessions are in Africa, the imports of rubber have grown from one and one-half million pounds in 1893 to nearly three millions in 1903; from Belgium, whose colonial possessions are exclusively in Africa, the growth has been from thirty thousand pounds in 1893 to five millions in 1903; and from Portugal, whose chief colonial possessions are also in Africa, the imports have grown from one and one-half million pounds in 1893 to a little over two million pounds in 1903.

The Central American states also supply considerable quantities of rubber, the imports from Nicaragua being nearly one million pounds per annum, and the total from the other Central American states amounting to about 300 thousand pounds annually. From Mexico the quantity imported in 1904 amounted to 366,104 pounds, against 120,415 pounds in 1894. Colombia and Ecuador supply each about one-half million pounds annually, and the British East Indies about one-half million pounds.

The following table shows the quantity of india-rubber imported in each year, and the value of india-rubber, gutta-percha, and gutta joolatong imported annually from 1884 to 1904:

Calendar Year.	Imports of Crude India-Rubber. Pounds.	Imports of Crude India-Rubber, Gutta-Percha, and Gutta Joolatong. Dollars.
1884.....	*23,672,563	10,194,385
1885.....	*25,432,350	9,697,239
1886.....	*31,147,825	14,180,301
1887.....	*31,102,061	14,389,499
1888.....	*34,484,033	14,228,358
1889.....	*32,138,257	12,503,254
1890.....	34,353,417	16,719,604
1891.....	37,401,634	18,461,175
1892.....	37,469,715	18,921,432
1893.....	39,634,706	17,214,390
1894.....	35,370,889	16,187,738
1895.....	41,766,774	19,345,072
1896.....	34,059,909	15,779,726
1897.....	42,159,126	21,834,947
1898.....	44,236,070	26,069,128
1899.....	54,408,495	34,397,320
1900.....	49,337,183	28,720,165
1901.....	55,142,810	28,345,025
1902.....	50,865,902	25,516,269
1903.....	55,744,120	35,762,943
1904.....	61,889,758	44,477,230

*Includes gutta-percha.

The Annual Report of the Mackay Companies.

In the annual report to the shareholders of the Mackay Companies, issued Friday, February 24, Clarence H. Mackay, John I. Waterbury, T. Jefferson Coolidge, Jr., and William W. Cook, trustees, present facts and figures showing the various enterprises controlled by the organization to be in a flourishing condition, while plans are in progress which will further increase their prosperity.

"The Mackay Companies," says the report, "owns the entire capital stock of the Commercial Cable Company ($23,000,000), and also shares of the capital stock of other cable, telephone and telegraph companies in the United States, Canada and Europe. All of these are dividend paying.

"In addition it has $820,323.70 in cash and cash assets.

"It has no debts.

"Its authorized capital is $50,000,000 preferred shares and $50,000,000 common shares, of which there are outstanding $35,968,700 preferred shares and $41,380,400 common shares.

"Quarterly dividends have been regularly paid on the outstanding preferred shares and the first semi-annual dividend on the common shares was paid January 10, 1905.

"The Mackay Companies has, in connection with the increase of the capital stock of the Commercial Cable Company, paid to the Commercial Cable Company the entire cost of the fifth submarine cable to Europe, the laying of which is rendered necessary by the growth of the company's business and the rapid service demanded by the public. This fifth cable will be put in operation during the coming summer.

"The increase in the capital stock of the Commercial Cable Company has been made solely to the Mackay Companies and entirely for the benefit of the shareholders of the Mackay Companies. The Commercial Pacific Cable Company is completing arrangements for laying submarine cables to Japan from Guam, and to China from Manila. These two new cables will be put in operation during the present year. Transfer offices have been opened in Boston, Montreal and Toronto, and arrangements have been made for the establishment of a transfer office in New York city."

The following table of accounts is presented:

Profit and loss account for the period December 19, 1903, to February 23, 1905:

RECEIPTS.	
Dividends received from investments in other companies	$1,643,676.98
DISBURSEMENTS.	
Dividends paid to shareholders of the Mackay Companies	$1,559,843.28
General expenses, including rent, office expenses, engraving, trustees' compensation in full to date, etc	20,035.01
Balance carried forward	63,798.69
	$1,643,676.98
ASSETS.	
Investments in other companies, including the entire capital stock of the Commercial Cable Company ($23,000,000) and 14,692 shares in thirty other cable, telegraph and telephone companies	$76,602,574.99
Cash	340,338.70
Other cash assets	479,985.00
	$77,422,898.69
LIABILITIES.	
Preferred shares issued	$35,968,700.00
Common shares issued	41,380,400.00
Reserve for expenses	10,000.00
Balance, profit	63,798.69
	$77,422,898.69

Digitized by Google

EFFECT OF LOAD-FACTOR ON COST OF POWER.[1]

BY E. M. ARCHIBALD.

The great desideratum for an electrical system is a high load-factor with consequent greatest return on investment; load-factor being the ratio of average to maximum load. All the factors of expense included in cost of power to the consumer are then operating at maxi-

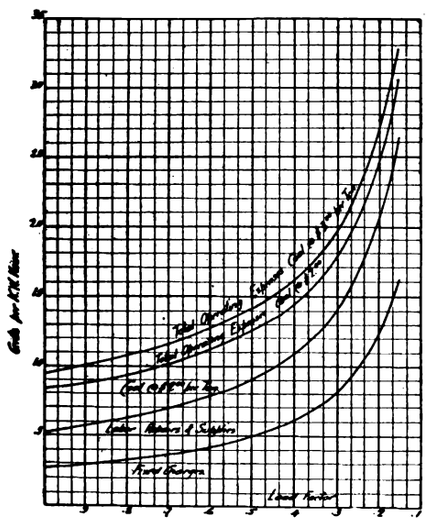


FIG. 1.—OPERATING EXPENSES OF 900-KILOWATT CONDENSING STEAM PLANT, PEAK LOAD, 750 KILOWATTS.

mum economy, and cost of power is at a minimum.

The lighting of residences and offices produces a peak in the late afternoon and evening, with but little load the remainder of the twenty-four hours; consequently the average load on the plant with lighting only is very small and the load-factor low. A commercial motor load in connection with lighting will increase the average load even though causing a greater peak. The addition of a street railway load still further increases the day load, but in consequence of the heavy demand load during the rush hours, when the public is going to and from business, which occurs at the peak of the lighting load, the peak load on the plant is greatly increased. This heavy peak, with but a small average load over the twenty-four hours, produces a low load-factor, and a portion of the machinery being shut down the greater part of the time, higher rates must be paid by the consumer to secure a certain return on first investment than when the load-factor is higher.

Evidently, when the load-factor is 100 per cent, that is when the load is constant throughout the twenty-four hours, and all the machinery is in continuous operation, the cost of power per kilowatt-hour is a minimum, and the greatest return on investment is realized. Customers having a steady load or with high average load are greatly desired and may be offered better rates than all others. It will be the endeavor of this paper to determine the decreased cost of power with increasing load-factor.

The storage battery is evidently a means in the hands of the power producing company of increasing the average load on the machinery. By charging the battery during light load and discharging during periods of heavy load, a more constant load on the generating apparatus is produced, with consequent better efficiency, and at the same time acting as a reserve in case of accident in the power plant. Unfortunately the battery is expensive, and a loss occurs in its operation which greatly reduces the higher efficiency secured by the increased load-factor. The great benefits obtained by its use are reserve capacity and voltage regulation, enabling the use of more efficient lamps.

The storage battery, however, has not been considered in what follows, even where it might be desirable, but rather a plant is assumed of certain maximum capacity for the peak load, and we are to determine what effect various load-factors have on the cost of power produced.

The various expenses involved in the

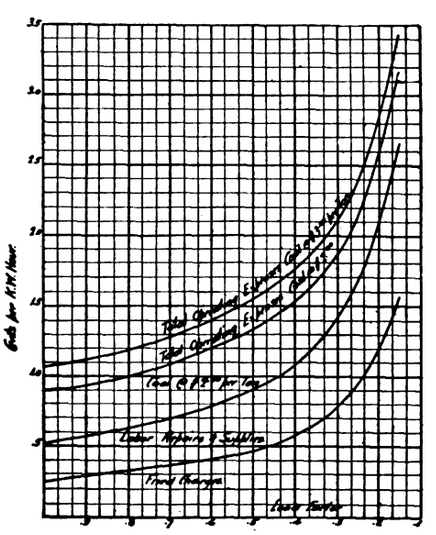


FIG. 2.—OPERATING EXPENSES OF 900-KILOWATT NON-CONDENSING STEAM PLANT, PEAK LOAD, 750 KILOWATTS.

cost of power to the consumer are as follows: (1) management; (2) distribution; (3) production.

For a given system with given peak load the cost of management is practically constant, no matter what the load-factor.

The cost of distribution is constant with various load-factors in so far as the fixed charges and maintenance are concerned. The losses in distribution, however, vary, these consisting of losses in lines, transformers if alternating current is used, meters, losses in grounds and losses from theft of current; all decrease the output and accordingly increase the cost to the consumer. While it is possible to determine fairly accurately the losses in lines, transformers and meters with varying load-factors, the losses from

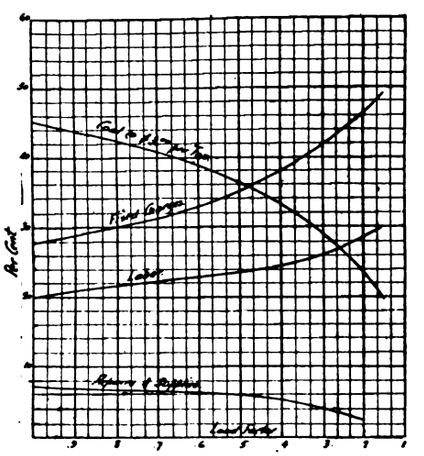


FIG. 3.—RATIO OF INDIVIDUAL ITEMS OF OPERATING EXPENSES TO TOTAL OPERATING EXPENSES, 900-KILOWATT CONDENSING STEAM PLANT, PEAK LOAD, 750 KILOWATTS.

grounds and theft are indeterminate and require constant attention to keep them within certain limits. Yet as a rule these latter will become a smaller percentage of the total output the higher the load-factor.

There yet remains for consideration the effect of the load-factor on the actual cost of production of energy.

The higher the load-factor, the greater is the amount of power produced, the longer does the apparatus operate most efficiently, the lower the ratio of fixed charges to total operating expenses and consequently the lower the cost of power per unit.

To determine exactly in what proportion the cost of power is decreased, it will be necessary to assume a plant, determine the fixed and variable charges and thereby the cost per kilowatt-hour at various load-factors.

Let us take for example a plant with a peak load of 750 kilowatts. Allow three units of 300-kilowatt capacity each, so that in case of a breakdown to one, the other two may take care of the peak with an overload of twenty-five per cent on each and sufficient boiler capacity for the same contingency. No provision is allowed for stokers, coal-handling appa-

[1] Read at annual meeting of the Canadian Society of Civil Engineers, Montreal, January 24, 25, 26.

Digitized by Google

ratus or economizers; plant assumed to be on the water front providing sufficient water for condensing purposes.

Curves are also plotted for a second plant of the same capacity as the first, but operating non-condensing; in both cases either water or railroad connections

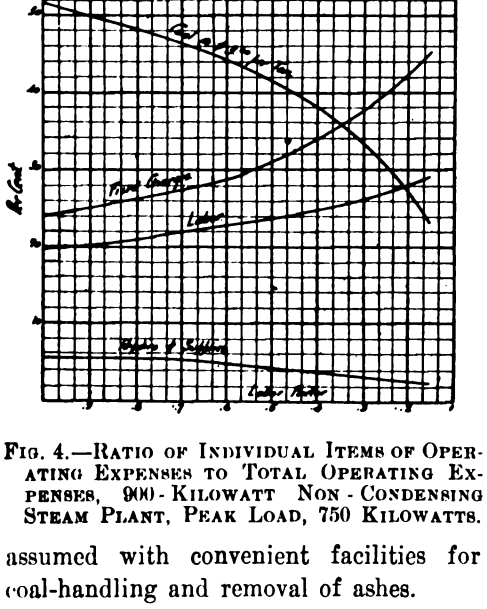


FIG. 4.—RATIO OF INDIVIDUAL ITEMS OF OPERATING EXPENSES TO TOTAL OPERATING EXPENSES, 900-KILOWATT NON-CONDENSING STEAM PLANT, PEAK LOAD, 750 KILOWATTS.

assumed with convenient facilities for coal-handling and removal of ashes.

First cost of plant complete:

Condensing, $118,425, equivalent to $131.60 per kilowatt.

Non-condensing, $114,625, equivalent to $127.40 per kilowatt.

Fixed Charges.	Condensing.	Non-Condensing.
Interest at five per cent	$5,921.25	$5,731.25
Taxes and insurance at two per cent.....	2,368.50	2,292.50
Depreciation machinery ten per cent.....	7,710.00	7,305.00
Building three per cent	1,122.00	1,134.00
Total	$17,121.75	$16,462.75

The above first cost being for 100 per cent load-factor, there will be a varying reduction due to the decreased boiler capacity required on lower load-factors. A point is reached below which it is not advisable to further decrease the boiler capacity as the peak load must be taken care of and sufficient reserve provided for accidents and repairs; this point being taken in this case at forty per cent load-factor. The effect of this reduction is to diminish the fixed charges at forty per cent load-factor by $1,000 per year, or about six per cent of the total. From these figures the lower line in Figs. 1 and 2 is plotted and indicates the effect of fixed charges on the cost of power.

The remaining items of expense are what are generally termed operating charges and are variable with load-factor. These consist of (1) labor, oil and waste, supplies, water and repairs; (2) fuel.

The cost of labor varies to a certain extent with load-factor, but a minimum number of men required to operate the plant is reached at about forty per cent load-factor, below which this item remains constant. The cost of oil and waste, supplies, water and repairs varies almost directly with load-factor as the greater number of hours per day that the machinery remains in service, the greater do these expenses become, and *vice versa*. The second line in Figs. 1 and 2 is for these charges reduced to the kilowatt-hour basis and is added to the fixed charges curve; the difference between the two curves, therefore, represents the cost of labor, oil and waste, supplies, water and repairs.

The cost of fuel, usually coal, per unit of power generated, varies with some power of the load-factor less than one, depending upon the number and efficiency of units employed both in the engine and boiler rooms, also upon the cost per ton of coal, its heating value, and upon the ability of the fireman to get the best results; it is of the utmost importance to watch this item carefully, as greater economy can be secured in the cost of coal per kilowatt-hour than in any other item of expense. The calorific value of the coal should be tested from time to time and compared with the number of pounds used per kilowatt-hour.

The coal considered is assumed to contain 12,000 British thermal units per

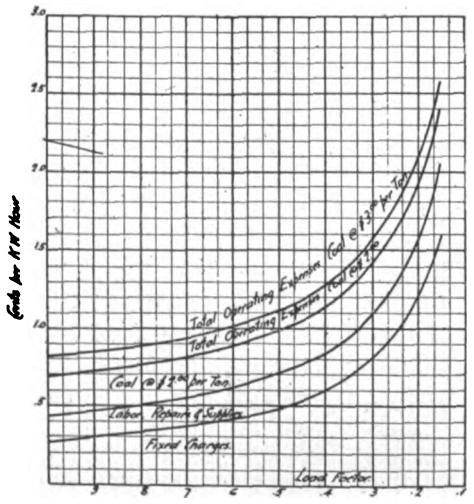


FIG. 5.—OPERATING EXPENSES OF 1,800-KILOWATT CONDENSING STEAM PLANT, PEAK LOAD, 1,500 KILOWATTS.

pound and two curves are plotted in Figs. 1 and 2 when the cost is $2 and $3 per ton respectively, the results being added to the two previous curves plotted. These figures of fuel cost per kilowatt-hour are above the average usually obtained and can only be secured by constant attention in the boiler room; for instance, at forty per cent load-factor in the first case one kilowatt-hour is generated from 3.5 pounds of coal from the pile.

The ratio of the individual items of expense to total operating expense is shown by Figs. 3 and 4 for the condensing and non-condensing plants respectively with coal at $3 per ton de-

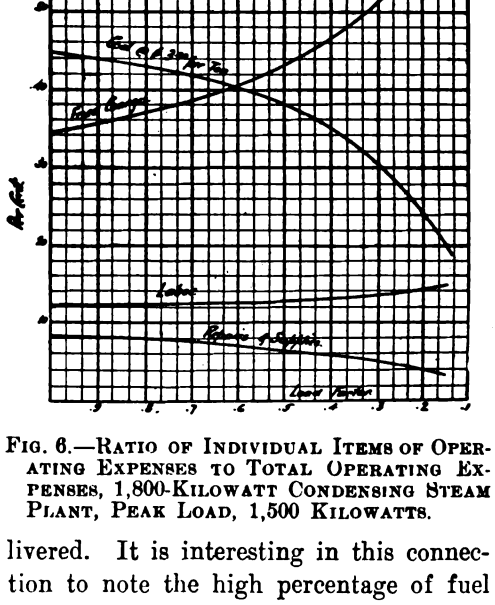


FIG. 6.—RATIO OF INDIVIDUAL ITEMS OF OPERATING EXPENSES TO TOTAL OPERATING EXPENSES, 1,800-KILOWATT CONDENSING STEAM PLANT, PEAK LOAD, 1,500 KILOWATTS.

livered. It is interesting in this connection to note the high percentage of fuel cost; in the average plant this percentage will be still higher than that shown, but this indicates how great a factor is the cost of fuel particularly with high load-factors. For low load-factor the fuel is subordinated by the fixed charges, which is by far the heaviest item.

Having thus determined the cost of power for a plant with a peak of 750 kilowatts, we shall consider briefly a larger plant and ascertain what extra economies may be secured. This plant we shall assume to have a peak load of 1,500 kilowatts and a maximum capacity of 1,800 kilowatts, divided into three units of 600 kilowatts each. Stokers are used, but no economizers or coal-handling apparatus; the boilers are in a single line parallel to the engine room, and coal is dumped from the car into a chute, whence it falls to the floor of the boiler room.

First cost of this plant at 100 per cent load-factor is $241,125, equivalent to $134 per kilowatt. Fixed charges, using the same per cent for interest, depreciation, taxes and insurance as in the previous case become $36,318.75 per year. Curves are plotted in Fig. 5 for fixed charges, labor, supplies and repairs, and fuel, the latter being plotted for the two prices $2 and $3 per ton as before.

With all these curves before us it might be well to make some deductions as to the advisability of further expenditures in

Digitized by Google

the power plant in coal-handling apparatus and economizers, or in general, any apparatus that tends to increase the economy.

The higher the load-factor the greater becomes the ratio of variable to fixed charges, and extra investment is advisable to secure the greatest economy possible. Extra investment in coal-handling apparatus and economizers will reduce the cost of labor and fuel in greater proportion than fixed charges are increased; the economizers also provide greater boiler capacity and purer feed water, reducing cost of repairs.

On the contrary when the load-factor on a system is low, the fixed charges are the governing factor in the cost of power, and extra expenditures must be carefully considered, particularly so if fuel is cheap.

Having thus discussed the effect of load-factor on the cost of producing power, we shall next turn to the cost of management and distribution. While it is beyond the scope of this paper to fully consider these costs, yet it was thought advisable to indicate by a curve, including all the various costs approximately, how the load-factor influences the cost to the consumer. This is done very generally, as no two cases are alike; the cost of distribution is more variable with different

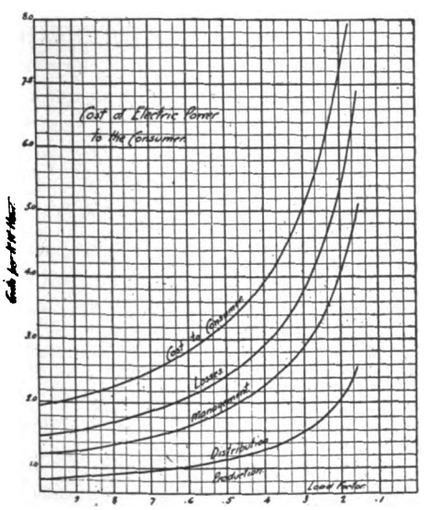


FIG. 7.—COST OF ELECTRIC POWER TO THE CONSUMER.

systems than is the cost of power, depending on the conditions of distribution, conduit or pole-line construction and the extent and density of the territory to be covered.

We shall allow that $50,000 per year covers all fixed charges, maintenance and attendance on the distributing network; $35,000 per year for management, dividends on stock and miscellaneous expenses. For total losses thirty per cent of the output is allowed; this is taken constant for all load-factors, for while the percentage of known losses varies directly with load-factor, the percentage of indeterminate losses by grounds and theft varies inversely as the load-factor. The actual losses from grounds are constant, hence percentage loss by grounds varies inversely as load-factor; losses from theft usually occur with customers having a short hour load, and the greater the amount of such load connected, the greater this loss. A customer having a long hour load runs a greater chance of detection than others. Hence, the above statement holds that the total percentage loss will be constant. Further, this lost power reduces the amount of sales, therefore affecting all the expenses included in cost to customer.

Fig. 7 shows a series of curves plotted for the 1,800-kilowatt steam plant, the lower line representing cost of production; the second, cost of distribution; third, cost of management, and fourth the effect of distribution losses on cost of power, this last being the final cost to consumer.

Coal is expensive, and from the nature of things will increase in price, and it behooves us to investigate any methods of producing power which are more economical in the use of fuel than the steam engine, and naturally turning to the gas engine we will next proceed to make a comparison between a steam plant and a gas plant generating producer gas for use in gas engines, and from such comparison deduce some general results.

As is well known the gas engine has a very much higher thermal efficiency than the steam engine, which fact, together with the fewer number of auxiliaries required, would naturally lead one to suppose that a greater economy could be secured in the production of power.

Difficulties, however, are encountered at the outset in the kind of fuel that may be used successfully in the gas producer. While the gas generated from anthracite coal is very successful in the operation of gas engines, the gas from bituminous coal contains tar which, when carried through the valves into the cylinders of the engine, clogs the valves and carbonizes under the intense heat to which it is subjected in the cylinder, preventing successful operation. Some manufacturers claim to have succeeded in removing the tar or preventing its formation, but the burden of proof still rests with them.

The overload rating of the gas engine is different from the steam engine in the ratio of about fifteen to fifty per cent. Hence in designing two plants, steam and gas, for equal overload capacities, it is necessary either to use gas engines of twenty-five to thirty-five per cent higher normal rating, with consequent poorer economy at normal load; or add an extra engine and generator sufficient to take care of the extra overload capacity of the steam

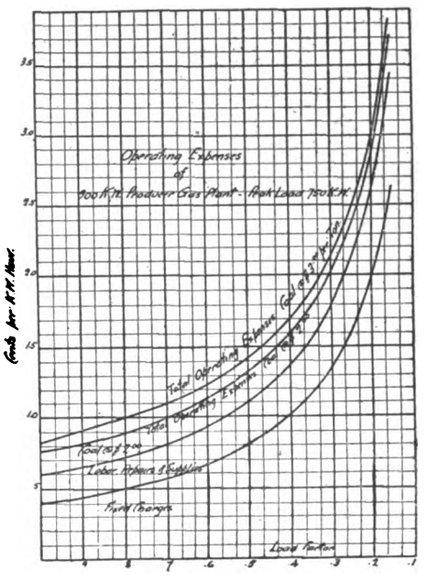


FIG. 8.—OPERATING EXPENSES OF 900-KILOWATT PRODUCER GAS PLANT, PEAK LOAD, 750 KILOWATTS.

engine over the gas engine. For example, in designing a gas plant of 900-kilowatt capacity with a peak load of 750 kilowatts, allowing the same reserve as in the steam plant considered previously, three engines of 530 brake horse-power each will be required with an aggregate normal brake horse-power of 1,590 and maximum brake horse-power of 1,830, as compared with three 450 indicated horse-power equivalent to 410 brake horse-power engines aggregating 1,230 normal brake horse-power and 1,840 maximum brake horse-power; or three gas engines of 410 brake horse-power each and an additional engine of 360 brake horse-power aggregating 1,830 brake horse-power on maximum load (from a practical standpoint, this additional engine would be made of the same capacity as the rest, the cost being the same). In the first case at normal load on the generators the engines are thirty per cent underloaded with consequent poor efficiency; in the second case the first cost will be greater, due to the extra generator and increased size of building required.

Allowing the same reserve capacity in producers, and with three 530 brake horse-power gas engines direct-connected

Digitized by Google

to 300-kilowatt generators running at 100 revolutions per minute, the first cost becomes $167,650, equivalent to $186 per kilowatt.

FIXED CHARGES.

Interest at five per cent on $167,650	$8,382.50
Depreciation on machinery ten per cent	13,340.00
Depreciation on buildings three per cent	1,005.00
Taxes and insurance two per cent	3,353.00
Total	$26,080.50

The storage capacity at 100 per cent load-factor is small, about 20,000 cubic feet, and is provided more for uniformity of gas than for storage. In case of accident to one producer, a second may be under way producing gas inside half an hour. The question of storage is important, particularly at small load-factors when storage may be provided for the peak and a constant load maintained on the producers. In a plant of this size where the number of producers actually required is not over two with a third for reserve, it is more advisable to use the same number of producers for all load-factors and a small amount of storage for uniformity of gas and sudden peaks. Further, the extra storage capacity required for small load-factors costs about the same as an extra producer.

The operating costs for oil, water, repairs and supplies have been taken practically the same as for steam, as there are insufficient reliable data at hand on this subject at the present time.

Cost of labor is somewhat cheaper—for the type of producers considered only one man is actually required.

In Fig. 8 are given curves for cost of power with varying load-factor for this 900-kilowatt gas plant.

A comparison of Figs. 1, 2 and 8 shows a greater economy for the gas plant at the higher load-factors, but poorer economy at low load-factors due to the influence of the heavy fixed charges.

The higher the cost of coal the greater is the economy of the gas over the steam plant at high load-factors.

It must be remembered that the fuel economy in the case of the steam plants is taken considerably higher than the average and can only be secured by constant and careful attention to all the details around a power plant; in the gas plant the fuel at fifty per cent load-factor is taken at 1.4 pounds coal per brake horse-power-hour, which is somewhat higher than the manufacturers will guarantee. No matter how the fuel costs may vary from those given in these curves, they are relatively of far greater importance when the load-factor is high than when it is low.

Condensers for High Vacuum.

At a recent meeting of the Leeds local section of the Institution of Electrical Engineers, of Great Britain, a paper was read by Mr. J. D. Baile, entitled "Condensing Arrangements in Central Stations." The paper was divided into two parts. The first described the various forms of condensing apparatus; the second gave results of tests made recently. These were quoted to support the author's contention that in all but exceptional cases it is not difficult to maintain a vacuum of not less than twenty-eight inches. Where the condensing arrangements are made properly, this may be done without the use of abnormal amounts of cooling water, of a moderate temperature.

It is desirable that the exhaust steam connections should be short and as direct as possible. Extra length of exhaust pipe does not materially affect the vacuum, provided the area of the pipe be ample and the joints thoroughly air-tight, but each bend involves loss. All valves should have full throughway, as any contraction is equivalent to reducing the area of passage at that point, and introduces friction. At some tests recently made at the Battersea Electricity Works, there was found to be a drop of vacuum from engine exhaust to condenser of one and one-half inches of mercury, of which eight-tenths of an inch was due to the non-return valve. The flanges of exhaust pipes should be faced across in the lathe. The author has found that woodite rings make an excellent joint. They are rather costly, but keep tight and are durable. A light and satisfactory exhaust pipe may be made of riveted sheet steel, a quarter to three-eighths of an inch thick, galvanized, and with flanges riveted on. All joints of the pipe itself or of the flanges to the pipe should be calked.

The tests included condensing apparatus of the Holuton colliery, the Neppsend works, the West Bromwich plant, and the Manchester plant. The Houlton plant consisted of an ejector condenser with a centrifugal circulating pump driven by an electric motor. The temperature of the cooling water was 67.6 degrees Fahrenheit. The vacuum at the condenser was 26.17 inches of mercury with the barometer at 30.05. The cooling water required was 68.75 pounds per pound of steam, the total power generated being 314.4 kilowatts. The power required to drive the pumps was 7.1 per cent of the total. The head against which the pump operated was 47.5 feet.

The Neppsend works use a surface condenser. There is a three-throw air-pump and a centrifugal motor-driven circulating pump. The condenser has 3,000 square feet of cooling surface. The temperature of the condensing water is 65.3 degrees Fahrenheit. A vacuum of 27.7 inches of mercury is maintained with the barometer at 29.9. The cooling water required is thirty pounds per pound of steam. The total power generated is 1,610 kilowatts. That required to drive the pumps is 2.3 per cent of the total. The circulating pump operates against a head of twenty feet.

At the West Bromwich station a surface condenser is used. The temperature of the feed water is fifty-one degrees Fahrenheit, and the vacuum maintained is 28.2 inches of mercury with the barometer at 29.8. Fifty pounds of cooling water are required for each pound of steam. The total power generated is 446 kilowatts, and 2.5 per cent of this is used for driving the pumps. The head against which the circulating pump operates is fifteen feet.

The Manchester station has a jet condenser with wet and dry air-pumps. The circulating pump is centrifugal, and is driven by a motor. The temperature of the cooling water is eighty-two degrees Fahrenheit, but a vacuum of 26.66 inches of mercury is maintained with the barometer at 29.5. The cooling water per pound of steam is fifty pounds, and 2.2 per cent of the total power is required to drive the pumps. The circulating pump operates against a head of forty feet. The total power generated is 1,822 kilowatts.

Tests made at Crown Point, Leeds, gave vacua varying from 29.1 inches to 28.4 inches, as the load varied from 110 to 265 kilowatts. The barometer was at 30.25, and the temperature of the injection water was forty-six degrees Fahrenheit.

Tests conducted at Darby gave vacua varying from 28.4 to 28.7 inches. The temperature of the injection water was about fifty-five degrees, and the barometer was at thirty. The load was 240 kilowatts.

It is thought that these results support the author's contention, that the maintenance of vacua of twenty-eight inches or more is neither impossible in practice, nor costly.

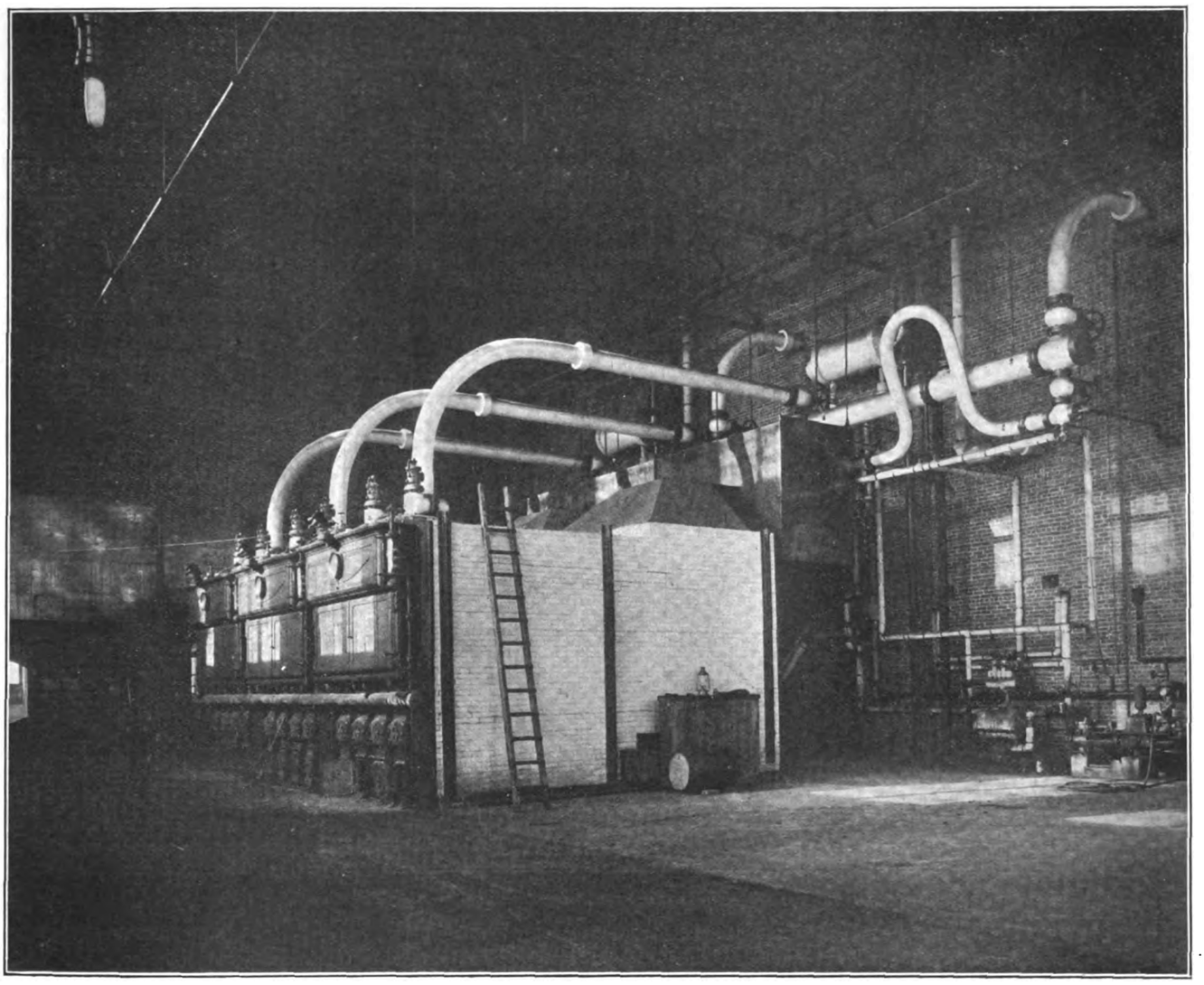
The Armour Institute of Technology has recently received a full line of samples of conduits from the Fibre Conduit Company, of Orangeburgh, N. Y. These samples, representing the various kinds of conduits used in telephone work, have been placed in the telephone laboratory of the institute.

Digitized by Google

The Largest Municipal Electric Plant in New England.

By Alton D. Adams.

TAUNTON, Mass., has the largest municipal electric plant in New England, and the commercial load is perhaps greater than that of any similar plant in the United States. Municipal plants sometimes continue to use antiquated apparatus and uneconomical methods of operation long after they ought to be abandoned, but Taunton has entirely discarded an old-style electric equipment that it bought several years ago, and has erected a new plant of the most modern sort.



Boiler Equipment, Municipal Electric Light and Power Plant, Taunton, Mass.

Taunton river, which finds its way to open water through Narragansett bay, is navigable as far as the city of the same name, for fairly large craft, and its water is suitable for use in boilers as well as in condensers. On the bank of this river, at a point little more than a mile distant from the business centre of Taunton, the new electric plant of that city is located. At the old plant the ground area was too restricted, the supply of water from Mill river was unsuitable for boilers and insufficient for condensing, and the belt-driven apparatus was of the divers types common in stations designed fifteen years ago. Transportation to and from the old plant was possible only in carts.

With the new plant all this is changed. Coal barges come directly to the station. The river water is used for both steam and condensing purposes, the main generators are of a single type, direct-connected to their engines, and there is ample room for future extensions. With this change in the generating plant, the frequency on the alternating lines has been reduced from about 133 to 60 cycles per second; open direct-current arc lamps for street lighting have been replaced by enclosed arcs on constant-current alternating lines, and the greater part of the power load consists of induction motors. During the time when all of these changes were going on an increasing load had to be carried, so that the transfer from the old to the new plant was gradual, but the latter was started in September, 1903, and is now carrying the total load.

The site of the new generating station fronts on the Taunton river with a wharf 250 feet long and eighty feet wide.

The new station is a one-story brick building, 46 feet high, 109 by 120 feet in ground area, and has a basement with a concrete floor, and a plank, tar and gravel roof on steel trusses. At one side of the boiler room there is a brick coal pocket 22 by 86 feet on the ground and 15 feet high, that takes coal through

Digitized by Google

hatchways at the top. Within the building a twenty-inch brick wall divides it into two nearly equal parts. One of these halves of the station contains the engines and electric equipment, and the other is divided into a space about 55 by 100 feet for the boiler room, and a space about 20 by 55 feet for offices and a testing room. This office portion is finished in two stories.

The engine foundations rise ten feet above the basement floor, and the floor of the generator room is level with the tops of these foundations. In the boiler room the floor level is nearly the same as that in the basement. At one side of the boiler room, but outside of it, is the round brick chimney, 154 feet high and with a flue ninety inches in diameter. This chimney will give sufficient draught for a boiler capacity of 2,000 horse-power. Three water-tube boilers of the Heine make and rated at 300 horse-power each are now in use, and there is enough space in the boiler room to more than double this capacity. Firing under these boilers is done by hand, and all three connect with a horizontal steel flue that runs to the chimney. Pipes pass from the boilers through the brick wall and into the engine room and basement, and are arranged in a very desirable way, as may be noted from the plans. Connected with the piping of each engine is a Bulkley siphon condenser.

At the present time two main generating units have been erected in the engine room which measures 50 by 100 feet, but there is ample space for a large increase of capacity in the station as now built. Each of these units is made up of a 400-kilowatt, 2,300-volt, sixty-cycle, two-phase alternator, direct-mounted between the high and low-pressure cylinders of a compound vertical engine. Each of these engines is rated at 625 horse-power minimum and 825 horse-power maximum, when run condensing, and they were made by the McIntosh & Seymour Company. The engines and their direct-connected generators operate at 150 revolutions per minute. In the same room with the main generators are two exciting dynamos, one driven by a direct-connected engine and the other by an induction motor. One exciter, driven by a General Electric upright engine at 450 revolutions per minute, is rated at 200 amperes and 125 volts. The other exciting dynamo is direct-connected to a fifty-horse-power, fourteen-ampere, 2,080-volt, sixty-cycle, two-phase induction motor that has a speed of 720 revolutions per minute, and this dynamo is rated at 280 amperes and 125 volts. On a line parallel with that of the main generators stands a marble switchboard of thirteen panels in a steel frame, twenty-four feet long and seven feet high. This board carries nine hand-lever oil switches for the main generators and the 2,300-volt distribution circuits, three recording watt-meters, and a full line of indicating instruments. In the basement beneath the engine room there are three constant-current transformers, each rated at thirty kilowatts, 2,200 volts and sixty cycles, primary, and at 6.6 amperes on the secondary side. All of the above-named electrical equipment, generators, exciters, motors, transformers and switchboard, was made by the General Electric Company. A hand-power crane of the Reading make spans the entire width of the engine room, and has a range equal to the length of the latter.

Two classes of distribution go from the new generating station just considered, the 2,300-volt, sixty-cycle, two-phase circuits, and the series lines from the constant-current transformers, for arc lighting on the streets. A part of the 2,300-volt circuits are employed for the general distribution of light and power, and the remainder go from the generating station to the substation near the business centre of Taunton. The substation equipment occupies the building formerly used as a generating station, and from this point 500-volt direct current for motors, constant direct current for commercial arc lamps, and 6.6-ampere alternating current for arc street lamps are distributed. A brick building two stories high and 48 by 105 feet in ground area houses the substation equipment. For the supply of direct-current motors a 550-volt, 112-ampere, bipolar dynamo is belt-driven by a seventy-five-horse-power, 2,080-volt, twenty-ampere, two-phase induction motor. A similar motor, rated at fifty horse-power, 2,080 volts and fourteen amperes, is direct-connected to a Brush arc dynamo that has a capacity of eighty-five nominal, 2,000-candle-power lamps. Current from this dynamo is used exclusively for the operation of commercial arc lamps. There are also in this substation six constant-current transformers, each rated at thirty kilowatts, 2,200 volts primary, and 6.6 amperes secondary. These transformers, together with those of the same type at the generating station, nine in all, are devoted to the operation of street lamps, both incandescent and enclosed arcs.

All electric supply in Taunton, which had a population of 31,036, in 1900, is drawn from the city plant, but this has no connection with the street-car system. During the last four years there has been a large increase of the electric service, and this is especially true of the two latest years when loads have been carried in part at first and then entirely at the new station. On November 30, 1900, some of the main data of electric distribution in Taunton were as follows:

Number of commercial customers..	173
" incandescent lamps connected	6,558
" commercial arc lamps.	85
Total horse-power of motors.....	53
Number of meters in use.....	113
" transformers in use...	127
" arc street lamps.....	247
" tons of coal burned in year	1,898

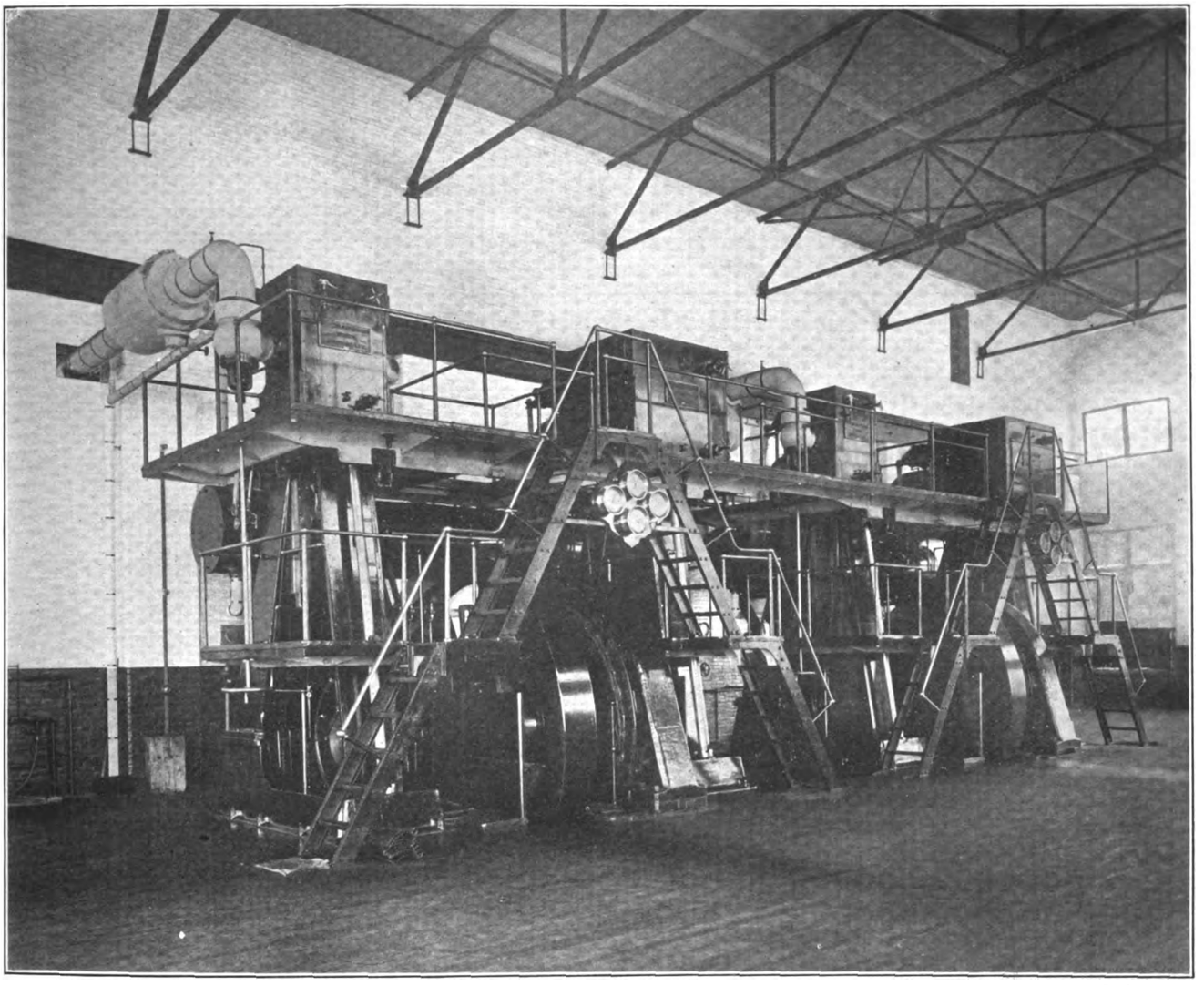
In contrast with the above figures the conditions of electric supply on November 30, 1904, were as follows:

Number of commercial customers	264
" connected incandescent lamps.....	10,000
" commercial arc lamps	73
" meters in use.....	274
" arc street lamps.....	261
" incandescent street lamps	9
" transformers	153
Total horse-power of motors.....	530
Tons of coal used during year....	3,570
Average price per ton.....	$4.56
Number of poles in lines.....	1,166
Miles of line wire.....	91

The most notable items of increase in load during the four years in question are the incandescent lamps and motors. For the former the increase was fifty-two per cent, and the motor load was ten times as great in the latter as in the earlier year. Most of this motor load has come on during little more than one year, since the new station went into operation, on September 14, 1903. On November 30, 1902, the capacity of connected motors was only ninety horse-power, and it could have increased but little before the new station began to operate, because the rating of the power generator of the old plant was only eighty horse-power. During two years the motor load thus ran up from ninety to 530 horse-power. This rapid increase in power service is still going on, and at the present time the motor load of the electric system amounts to 738 horse-power, of which 110 horse-power is supplied with 500-volt, direct current, and 628 horse-power with two-phase, sixty-cycle current in induction motors. Among the users of electric motive power are a number of rather large manufacturing plants. One of these, a factory where printing-presses are made, uses motors of 250-horse-power rating besides the equivalent of 350 incandescent lamps. During the period in question the connected load of the electric system has been brought entirely onto a

Digitized by Google

meter basis for commercial service, and the number of meters in use has increased from 113 to 274. It is to be noted that only 153 transformers were in use, in 1904, compared with 127, in 1900, in spite of the large increase of load. This is due to the fact that in the change from 133 to 60 cycles per second on the alternating lines large transformers were substituted for groups of smaller ones in many instances, so as to reduce core losses. Increase of the electric output is not measured by the rise in the number of commercial customers from 173, in 1900, to 264, in 1904, because many of the customers added to the system are factories and other large users of light or power. A better test of the rise in commercial business is found in the gross income derived from private consumers of electric light and power. During the year ending November 30, 1900, the total electric income from commercial service, both light and power, was $22,-700.23, but for the year ending November 30, 1904, this income amounted to $37,-514.53. Here again the important influence of the change from the old to the new generating plant is illustrated, for the year ending November 30, 1903, showed a gross electric income of $27,-683.17 from private consumers, so that the fiscal year ending November 30, 1904, the first in which the new generating station operated during more than two months, showed a gain of thirty-five and one-half per cent in commercial income over the previous year. Of this gain, nine and one-half per cent represented the increase of income from commercial lighting, and 286 per cent the increase of income from power service. During the year ending November 30, 1900, the income from power service was only eight per cent of the entire commercial income, but for the year ending on the like date of 1904, the income from power service was twenty-eight per cent of the total paid by private consumers. For the operation of its 261 arc and nine incandescent street lamps the city of Taunton appropriated $9,166.65, in the fiscal year of 1904, so that on this basis the total income of the electric system from light and power service amounted to $46,-681.18. These street lamps have been operated all night and every night since April 11, 1904. The new generating station, from which all electric supply is now drawn, operates twenty-four hours daily for commercial service. For the operation of the entire electric system the city employs seventeen men, as follows: a manager, one bookkeeper, one electrician, four dynamo tenders, one patrolman, a chief engineer, three assistant engineers, three firemen, one trimmer for arc lamps, and one lineman. During the fiscal year of 1904 there was paid to these men $16,923.13. This item does not include all the wages of persons engaged in special repairs at the station and on the lines.



ENGINE AND DYNAMO EQUIPMENT, MUNICIPAL ELECTRIC LIGHT AND POWER PLANT, TAUNTON, MASS.

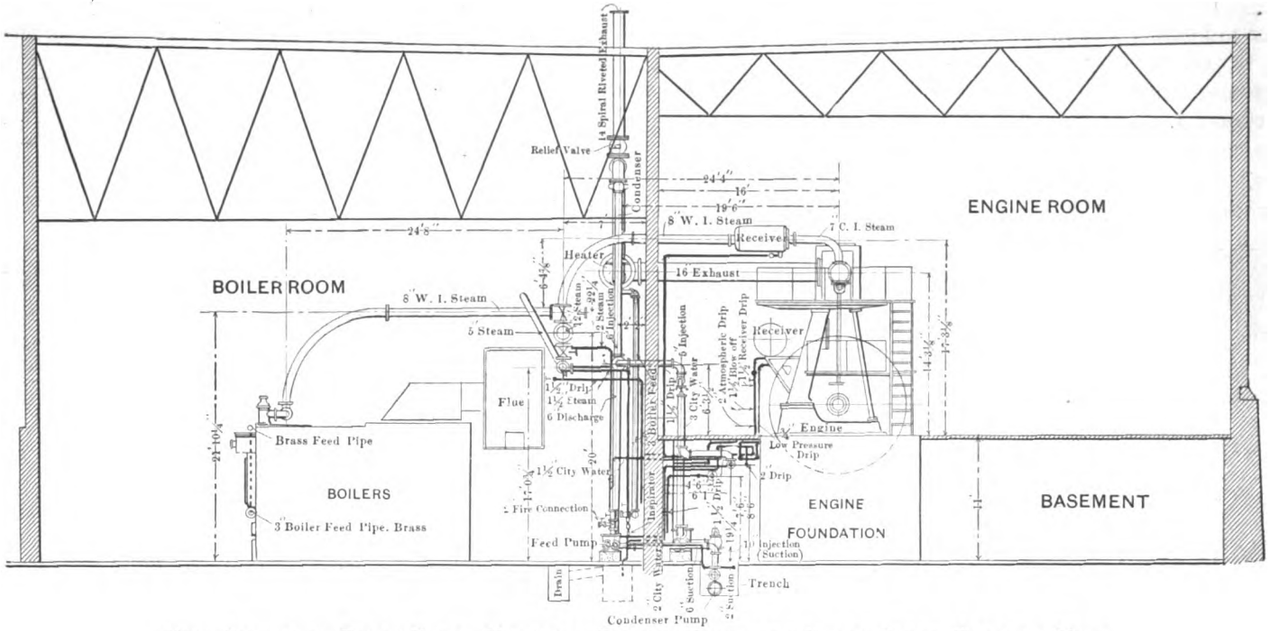
Moderate prices for electric service and a scale of discounts to large consumers

Digitized by Google

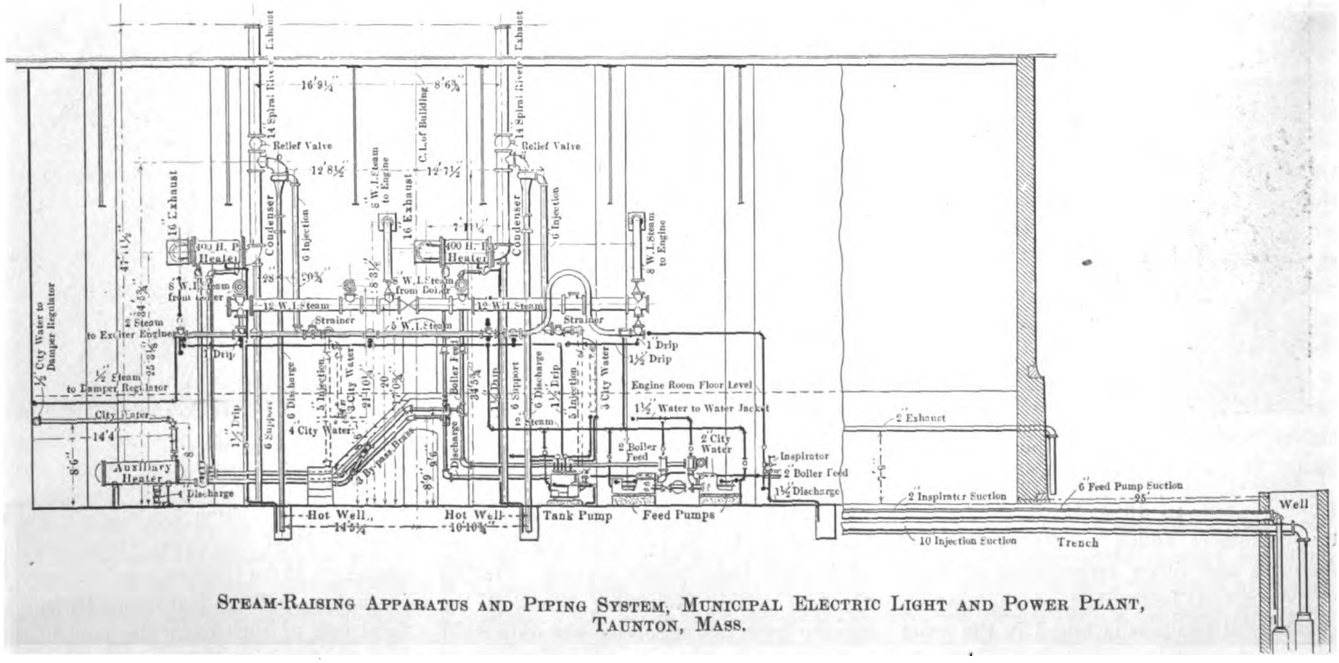
have had much to do with the success of the Taunton plant in commercial business. Another important factor has been the general adoption of meter rates, and the uniformity of charges to all persons that receive the same service. The full meter rate for incandescent lighting at Taunton is twenty cents per kilowatt-hour. If bills are paid by the twentieth of each month a discount of ten per cent on amounts between five and ten dollars, fifteen per cent between ten and fifteen dollars, twenty per cent between fifteen and twenty dollars, twenty-five per cent between twenty and thirty dollars, and thirty per cent between thirty and fifty dollars is allowed. On monthly bills of more than fifty dollars, discounts that range up to fifty per cent are granted, thus reducing the net price of energy for incandescent lighting to ten cents per kilowatt-hour. Incandescent lamps are renewed free. For power service the full rate is six cents per kilowatt-hour, and discounts reduce this to four cents for large consumers.

Besides the municipal electric plant, Taunton contains a coal gas plant that distributes gas of seventeen candle-power. This plant is owned by a private corporation that showed a gas income of $83,884.81, with gas at $1.30 per 1,000 cubic feet, during the year ending June 30, 1903. As a result of its operations in that year, the latest for which the figures are available, the gas company showed an excess of $33,927.63 for earnings over expenses, and of this amount $12,800 was paid out in a dividend of eight per cent on the capital stock. It is interesting to note here that the electric plant has been owned and operated by the city since July 1, 1897.

As the new generating station is more than a mile from the old one, a large amount of line construction and change was necessary to connect the loads with the latter. In order to make these changes and give constant service both stations were operated during several months. One series circuit at a time was



CROSS-SECTION OF POWER-HOUSE, MUNICIPAL ELECTRIC LIGHT AND POWER PLANT, TAUNTON, MASS.



STEAM-RAISING APPARATUS AND PIPING SYSTEM, MUNICIPAL ELECTRIC LIGHT AND POWER PLANT, TAUNTON, MASS.

Digitized by Google

equipped with enclosed alternating instead of open arc lamps, and was then disconnected from the old and connected with the new plant in a single day. In like manner, each of the 2,200-volt circuits for commercial lighting had its transformers of 133 cycles changed for those of sixty cycles, and its connections broken at the old plant and made at the new between daylight and dark of a single day. While this transfer of loads was going on neither the street lighting nor the commercial service was interrupted for a single day.

For the construction and equipment of the new generating station, the reconstruction of the distribution lines, and the purchase of new meters, arc lamps and transformers, the city of Taunton issued its bonds to the amount of $175,000, bearing interest at three and one-half per cent, in 1902, and these bonds were sold at par. The real estate on which the new station is located, which is ample for a far greater generating capacity than the present one, all improvements on this real estate including the wharf, coal pocket and station building, together with the complete steam power and electric equipment of 800 kilowatts capacity, as above described, cost a little less than $140,000, or about $175 per kilowatt of capacity in main generators. Nearly all of the $35,000 remaining from the bond sale was expended for some of the apparatus named at the substation, so that the total cost of the changes in lines and equipment, and of the new power plant complete has been within the $175,000 estimated and appropriated for the purpose. In the matter of insurance the city follows a conservative policy. On the generating station a fire policy of $25,000 and a policy of $35,000 against boiler accidents are carried. There is also an employers' liability policy of $10,000.

At the old station, now used only as a substation, the steam-power plant includes one engine of sixty-five, one of 300, and one of 400-horse-power rating, three return tubular boilers of 150-horse-power capacity each, and a full equipment of pumps, heaters and condensers. Besides the eighty-horse-power, 500-volt generator, and the eighty-five-lamp arc dynamo, now operated by induction motors, the old station contains two alternators of 120-kilowatt and one of thirty-five-kilowatt capacity, and five forty-five-lamp and one 120-lamp arc dynamos. From this it may be seen that the generating capacity of the new station, with its 1,250 horse-power in steam engines and 800 kilowatts in main generators, is nearly twice that of the old. All of the generating equipment at the old station, save the two motor-driven dynamos, is to be dismantled and sold.

Success of the municipal electric plant in Taunton is due in a large degree to the efforts of Mr. Abner Coleman, its manager. Since Mr. Coleman undertook the management of the plant, in the fiscal year of 1901, the old system of flat rates has been replaced by charges on a meter basis. Rates for light and power have been reduced, and a sliding scale of charges according to the amount of energy used per month has been introduced. Two-phase current at sixty cycles has displaced that of single phase and 133 cycles per second, thus making the distribution of power on a large scale to induction motors practicable. Enclosed arcs have replaced the old double-carbon street lamps. Last, and most important, a modern generating plant of the most approved type and location has been put into operation instead of the ancient equipment formerly in use. The plans for this new plant were made by Mr. Coleman while engaged in his regular duties as manager.

The Annual Report of the Cuyahoga Telephone Company.

The annual report of the Cuyahoga Telephone Company, Cleveland, Ohio, shows that the company has had the most successful year in its history. The total assets are now $5,753,684.47, and the total liabilities, $5,727,292.32. During the past year the gross earnings of the company were $435,274.02, compared with $396,490.20 in 1903. The expenses for the past year were $220,748.79, against $194,191.90 for the preceding year. The net earnings for the year were $196,532.65, a gain of over $13,000 as compared with the preceding year. The surplus is $26,392.15, compared with $15,401.09 a year ago. The company has elaborate plans for extension during 1905, and contemplates expending nearly $850,000 for this purpose. It also proposes to increase the number of telephones by at least 6,000. In March, 1904, when the new switchboard of the company was cut in, the number of subscribers was 10,260. In January, 1905, the number was 14,370.

At the annual meeting, the following board of directors was chosen: W. H. Lamprecht, Henry Everett, R. A. Harman, Calvary Morris, E. W. Moore, C. W. Wason, F. M. Stearns, H. R. Newcomb, F. S. Dickson, P. H. McIntosh and C. A. Otis, Jr.

Faraday Society.

The eleventh ordinary meeting of the Faraday Society was held on Monday, January 30, 1905, at the Institution of Electrical Engineers, London, England, Professor A. K. Huntington being in the chair.

Mr. John G. A. Rhodin read a paper entitled, "Mass Analysis of Muntz's Metal by Electrolysis, and Some Notes on the Electrolytic Properties of This Alloy." The reading of the paper was accompanied by experiments.

The first portion of the paper describes an apparatus which was specially designed by the author for the purpose of the accurate and rapid determination of the copper content (which should lie between 60.5 and 61.5 per cent) of Muntz's metal. As about forty to sixty "heats" of metal are cast every day, and it being necessary to obtain the results within twelve hours of the time of casting, the apparatus had to be such as to enable 100 analyses to be made in twenty-four hours—with a mean probable error of not more than ± 0.1 per cent. The author decided that an electrolytic method would best fit in with these stringent requirements.

The electrodes employed consist of concentric cylinders of very fine platinum gauze, supported by stout frameworks in order to ensure even current distribution. The anode rests on a ring at the bottom of the containing-vessel, so that the cathode can easily be slipped away and removed, and both electrodes are held in modified Classen stands. The present installation consists of thirty such unit cells, and current is supplied to them from six pairs of accumulators, each of which supplies current to five pairs of electrodes, through suitable nickelin resistances.

One gramme of the alloy, dissolved in nitric acid, is used for analysis, and a current either of 0.5 ampere or else of two amperes is employed for the deposition. In the former case deposition is complete in twelve to fifteen hours, in the latter in three hours. Electrolysis proceeds in three phases: (1) copper deposition and ammoniacal reduction of nitric acid. (2) Ammoniacal reduction only. (3) Deposition of zinc. A perfect separation takes place if phase (2) occupies a long time and is unaccompanied by metal deposition. If certain impurities, such as arsenic or nickel, be present they must be removed chemically. The paper describes in detail the actual procedure at the works laboratory, and also includes a table showing the kind of accuracy obtained in cases where re-

Digitized by Google

analyses have been made. Since these analyses in bulk have been made it has been found that they act as an infallible guide to the casters, so that remelting has now become very rarely necessary.

In conclusion, the author discusses the electrochemical properties of Muntz's metal. The metal is largely used as a sheathing to protect ships' bottoms from certain mollusca and algæ, and to be successful it should dissolve in sea-water just to a sufficient extent as to render the surface poisonous, the best conditions being the equal dissolution of the copper and zinc. The author shows how these may be calculated approximately by supposing that the electrolytic dissolution rate is proportional to the heat of formation of the ultimate compounds (zinc and cuprous chlorides), and to the conductivities of the metals which dissolve. Assuming that both the chlorides of copper are formed, and taking the mean of the results in the two cases, the best values are found to be 60.811 per cent of copper, and 39.189 per cent of zinc, numbers which agree very closely with the results of practical experience. The author is now engaged in exhaustively investigating the absolute dissolution-velocity of pure Muntz's metal at a definite temperature, and he adds here a preliminary description of these experiments, describing in an appendix his most recent experiments on the subject. He finds that a binary alloy like Muntz's metal dissolves slowly at first, the velocity then quickly arrives at a maximum, then it falls suddenly—remaining almost constant for some time—and finally a more or less rapid fall again occurs. During the period of constant velocity the surface must alter as the resistance capacity, if the action is galvanic. The seat of electromotive force must be in the electrolyte, as the constancy of action indicates a steady electromotive force of considerable magnitude. It is probable that the result is influenced by the actual mass of metal present, relative to that of the solvent. The external pressure certainly exercises a very considerable effect on the reaction-velocity, by influencing the speed with which hydrogen can leave the surface of the metal.

Professor Huntington asked whether the author had considered the question of the best composition of Muntz's metal from the point of view of the constituents of the alloy, and of the critical points of the various combinations formed. He drew attention to the work of Mr. E. S. Shepherd on this subject, and showed the curves he had obtained in his study of the copper-zinc series. What determined whether the alloy would roll hot or not, appeared to be the presence of the compound Cu_2Zn.

Mr. W. R. Cooper thought there was some difficulty in the view that the dissolving action referred to by Mr. Rhodin was galvanic. If that were the case, he did not see how both metals could be affected.

Mr. A. Stevenson referred to the question of the deposition of bright copper in the presence of colloids.

Mr. Rhodin in reply dealt in detail with the point raised by Mr. Stevenson, which he himself had first investigated in conjunction with Sir Joseph Swan. Replying to Professor Huntington, he said that it was certain impurities which determined whether a Muntz alloy would roll hot. An alloy containing seventy per cent of copper could be rolled, if these impurities were not present.

Mr. R. Beckett Denison presented a paper entitled "The Equilibrium between Sodium Sulphate and Magnesium Sulphate."

Experiments conducted from the standpoint of the phase rule are described, the object of which was to determine whether the double salt of sodium and magnesium sulphates, $2MgSO_4 . Na_2SO_4$, which has been described as a naturally occurring mineral, is capable of existence in contact with solution, that is, whether it has been formed in nature by the evaporation of saline waters. The corresponding potassium compound is known to occur in Stassfurt as langbeinit, and it was thought that a detailed investigation might result in the isolation of the sodium langbeinit from solution.

A transition temperature of fifty-nine degrees centigrade was obtained for the system $MgSO_4 . 7H_2O + MgSO_4 . Na_2SO_4 . 4H_2O$, but it was found that only the double salt loeweit, $Na_4Mg_2(SO_4)_4 5H_2O$, was formed, the usual transition-point (seventy-one degrees) being depressed to fifty-nine degrees centigrade by saturation with $MgSO_4$.

Mr. E. Kilburn Scott gave a short abstract of his paper on "Refractory Materials for Furnace Linings," which dealt principally with carborundum, siloxicon, and electrically shrunk magnesite. As the paper had not yet appeared in type, the discussion was postponed.

The next ordinary meeting of the society will be held on Monday, March 6, 1905, at the Institution of Electrical Engineers, 92 Victoria street, London, S.W., England, when Mr. F. W. Harbord will read a paper on "Electric Steel Smelting."

The ordinary meeting will be preceded by the annual general meeting, at which the balance sheet and report of the council will be presented for adoption, and the officers and council for the ensuing year elected.

TWO-MOTOR VERSUS FOUR-MOTOR EQUIPMENTS.[1]

BY N. McD. CRAWFORD.

It is manifestly impossible to consider judiciously the relative commercial efficiency of two-motor *versus* four-motor equipments, or to reach any absolute conclusion unless certain conditions under which the equipments are to be operated have first been determined. For the purpose of this paper a line was selected having light grades and reasonably small line losses, a line passing through the business centre of a city and reaching the residential section, thus at all hours of the day calling for a fair average number of stops and therefore reasonably rapid acceleration, in order to make the time schedule.

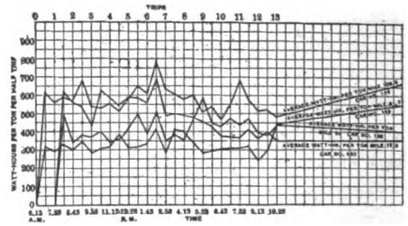


FIG. 1.—AVERAGE WATT-HOURS PER TON-MILE.

Four types of equipment were selected for this service, as follows: car 169 having a twenty-foot body, single trucks, two twenty-five-horse-power motors, and a gear ratio of 1 to 4.87; car 138, having a twenty-six-foot body, two trucks, two thirty-five-horse-power motors, and a gear ratio of 1 to 2.82; car 101, having the same length of body and number of trucks as car 138, but having four thirty-five-horse-power motors and a gear ratio

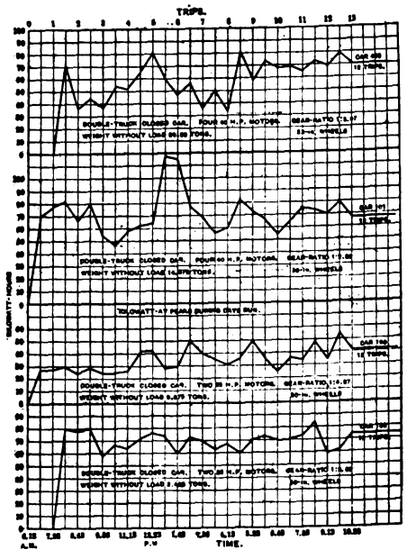


FIG. 2.—KILOWATTS AT PEAKS DURING DAY'S RUN.

[1] A paper presented at the 194th meeting of the American Institute of Electrical Engineers, New York, February 24, 1905.

Digitized by Google

of 1 to 2.82; car 480, having a twenty-nine-foot body, two trucks, four forty-horse-power motors, and a gear ratio of 1 to 3.67.

The service required of these four equipments was exactly the same, namely, 136.5 miles per day at an average schedule of 8.45 miles per hour. The runs were made on succeeding speed days and during the same relative hours. Each car

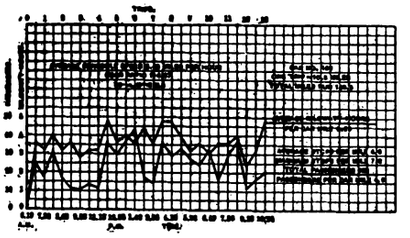


FIG. 3.—PASSENGERS AND KILOWATT-HOURS PER HALF TRIP.

was equipped with a wattmeter, an ammeter, and a voltmeter; the wattmeter readings at the end of each trip were recorded, and at the end of the run checked by the ammeter and voltmeter readings. The wattmeter was also carefully calibrated with a standard meter, using a water rheostat as a load. The peaks were noted at times of acceleration and on grades. These tests have been tabulated as follows:

Fig. 1, the average watt-hours per ton-mile.

Fig. 2, kilowatts at peaks during day's run.

Fig. 3, passengers and kilowatt-hours per half trip.

Fig. 4, passengers and kilowatt-hours per half trip.

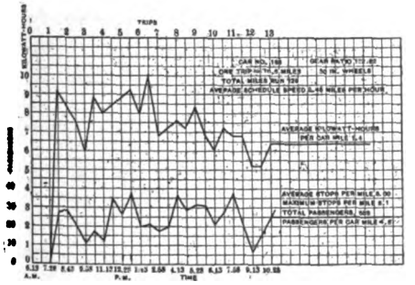


FIG. 4.—PASSENGERS AND KILOWATT-HOURS PER HALF TRIP.

Fig. 5, passengers and kilowatt-hours per half trip.

Fig. 6, passengers and kilowatt-hours per half trip.

Table i has been deduced from the sheets given.

The commercial efficiency E was obtained as follows: $A + B + C + D = E$, and $\frac{H}{E}$ = commercial efficiency.

The same formula, substituting B for H, will give greatest commercial efficiency. The letters used in the above formula represent the following:

A, cost of current per watt-hour at station switchboard.

B, value of seated load.

C, platform labor per mile run.

D, interest and depreciation per mile run, figured at eight per cent.

H, value of actual passengers carried per mile.

In obtaining the commercial efficiency, line losses and repairs of equipments and track have purposely been omitted, because it is almost impossible to determine what these values should be; the value of the standing load has been omitted for the same reason.

Applying the above formula and substituting values obtained during the test, the results are as follows:

An examination of table i, readily shows that car 169 is the most efficient for the service selected. This apparent efficiency must, however, be modified when the number of passengers carried, as shown in Fig. 3, is considered, because it will be seen that many times during

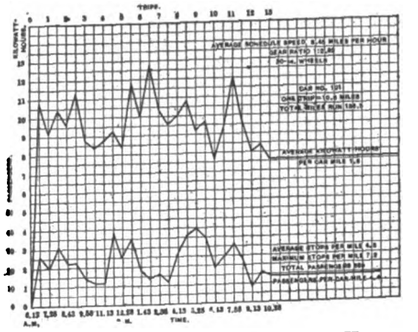


FIG. 5.—PASSENGERS AND KILOWATT-HOURS PER HALF TRIP.

the day's run the number of passengers was greater than twenty-six, the excess constituting a standing load.

Car 138, although showing a lower commercial efficiency, probably on account of its greater weight, yet accommodates the passengers much better throughout the entire day.

Car 480 was the least efficient of those tried, although there was only a short time when all the passengers could not be seated. This car was provided with thirty-three-inch wheels and could have

CAR NO. 169.

$$0.0006787+1.30+0.0475+0.0043 = 1.3525$$

$$\frac{0.23}{1.3525} = 0.1698\%$$

$$0.0006787+1.30+0.0475+0.0043 = 1.3525$$

$$\frac{1.30}{1.3525} = 0.96\%$$

CAR NO. 138.

$$0.001056+1.70+0.0475+0.0056 = 1.7542$$

$$\frac{0.23}{1.7542} = 0.1310\%$$

$$0.001056+1.70+0.0475+0.0056 = 1.7542$$

$$\frac{1.70}{1.7542} = 0.96\%$$

CAR NO. 101.

$$0.001174+1.70+0.0475+0.0070 = 1.7557$$

$$\frac{0.22}{1.7557} = 0.1253\%$$

$$0.001174+1.70+0.0475+0.0070 = 1.7557$$

$$\frac{1.70}{1.7557} = 0.97\%$$

CAR NO. 480.

$$0.000847+2.10+0.0475+0.0087 = 2.1570$$

$$\frac{0.23}{2.1570} = 0.1065\%$$

$$0.000847+2.10+0.0475+0.0087 = 2.1570$$

$$\frac{2.10}{2.1570} = 0.97\%$$

TABLE I.

Car No.	Capacity, Seats.	Horse-Power Motors.	Gear-Ratio.	Total Tons.	Total Cost.	Cost per Seat.	Cost per Ton.	Commercial Efficiency, Per Cent.
169	26	two 25	1:4.87	9.075	$2,710	$104.23	$298.62	17.0
138	34	two 35	1:2.82	12.425	3,275	96 38	263.59	13.11
101	34	four 35	1:2.82	14 675	4,360	128 23	297.10	12.53
480	42	four 40	1:3.67	20.680	5,040	120.00	243.71	10.66

Digitized by Google

made the time schedule easily with a lower gear ratio.

Temperatures were taken at the end of each day's run; these were not excessive except possibly in the case of car 138, due no doubt to the weight of the equipment and the greater number of stops to the mile as shown on Fig. 4. (See appendix for record of temperatures.)

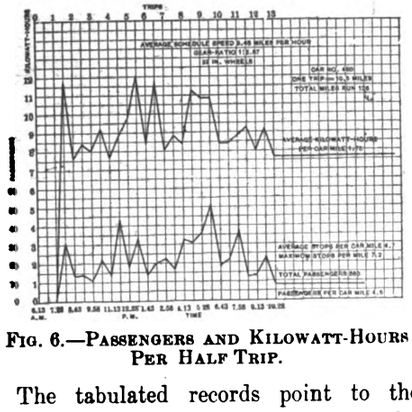


FIG. 6.—PASSENGERS AND KILOWATT-HOURS PER HALF TRIP.

The tabulated records point to the superiority of the light two-motor, single-truck equipments for service on the line and under the conditions selected. With longer trips, heavier grades, greater speed in miles per hour, and greater density of population, requiring more rapid acceleration, there is no doubt but that a car of the 480 type would show the greatest efficiency.

The operating manager is looking not only for an equipment that will fulfil all the requirements of any particular service with the least cost for repairs, and the minimum demand on the power station, but also for one that will combine these advantages at the greatest speed with safety to the public, and the distance to be traveled per trip will allow. If the distance is, say, six miles per half trip, or twelve miles per round trip, requiring four cars for fifteen-minute service at twelve miles per hour, and three cars for the same headway at sixteen miles per hour, the platform labor per mile in the first instance will be $0.0335 \times 4 = 0.1340$, and in the second instance $0.025 \times 3 = 0.075$, a saving in labor

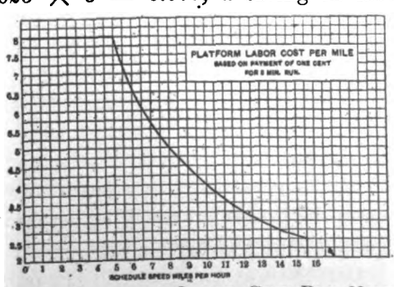


FIG. 7.—PLATFORM LABOR COST PER MILE.

of 0.059 per mile, and 0.0085 per car-mile. This great saving in cost of operation appeals to the operator, but not so greatly if the operating costs are increased by excessive demand on power-station equipment and by added interest charges due to increased line copper and rail bonds. In selecting motors and cars for a given run, it will be found necessary to consider the following:

Density of population, as governing the size and seating capacity of the car body; the number of stops per mile, and consequently the acceleration; the frequency of service; and the speed in miles per hour.

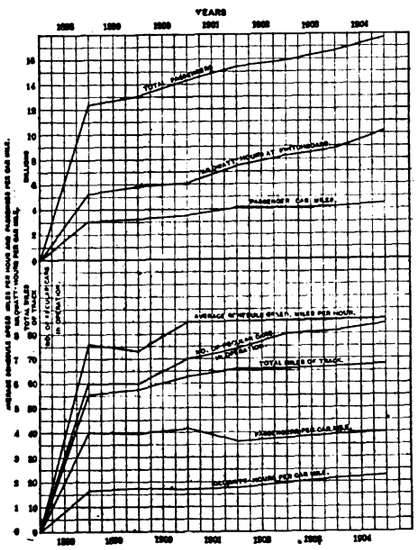


FIG. 8.—COMPARISON CURVES.

The number of trucks and motors, as determining the size and weight of cars selected; the tractive effort, and the acceleration.

The speed in miles per hour, as determining the number of cars in service; the platform labor; the demand upon power-plant equipment; the increased interest charge for line and power plant.

The gear ratio, as determining the size of motors; the acceleration; the number of stops per mile; the heating of motors, and consequent repairs; and additional power station and line requirements.

Too much care can not be exercised in determining the gear ratio for given service; for there can be no doubt that in many cases lack of power-station equipment and excessive motor repairs can be traced to the use of wrong gear ratio. In the first place, cars should be selected of ample capacity for the service requirements, and then motors should be selected with a rating only slightly greater than the service requires, and with a gear ratio so designed that the schedule may be made without resorting to rapid acceleration on starting, and, as a consequence, running the motors on low-efficiency points in order to kill time. The additional tables contained in this report show the various conditions existing in Hartford, and may be of general interest.

TABLE "I."

	1899	1900	1901	1902	1903	1904
Passenger-car miles, per cent increase	0.07	0.082	0.171	—0.0122	0.0247	0.051
Total passengers, per cent increase	0.06	0.021	0.0772	0.031	0.052	0.065
Passengers per car-mile, per cent increase	—0.009	0.058	0.112	0.0375	0.0154	0 035
Kilowatt-hours at switchboard, per cent inc.	0.012	0.051	0.222	0.094	0.061	0.146
Kilowatt-hours per car-mile, per cent inc.	0.038	0.028	0.0462	0.105	0.085	0.06
Total miles of track, per cent increase	0.016	0.006	0.0408	0.0	0.0142	0.0158
Number regular cars operated, per cent inc.	0.0	0.107	0.058	0.081	0.0125	0.037
Schedule speed, per cent increase	—0.021	0.142	0.0058	0.0	0.0116	0.0

TABLE "J."

	1904	1903	1902	1901	1900	1899	1898
Passenger-car miles	4,420,873	4,208,485	4,104,488	4,155,414	3,546,564	3,278,314	3,063,705
Total passengers	17,726,397	16,735,071	15,900,325	15,434,068	14,819,252	13 043,728	12,804,639
Passengers per car-mile	4.00	3.96	3.87	3.73	4.2	3.97	4.007
Kilowatt-hours, switchboard	10,204,480	8,896,924	8,226,905	7,520,852	6,148,588	5,849,584	5,295,010
Kilowatt-hours per car-mile	2.3	2.17	2.00	1.81	1.73	1.78	1.715
Total miles of track	67.573	66.546	65.614	65.614	63.045	57.533	56.638
Number regular cars operated	84	81	80	74	70	60	60

AVERAGE SCHEDULE SPEED MILES PER HOUR.

1898	7.6
1899	7.44
1900	8.5
1901	8.55
1902	8.55
1903	8.56
1904	8.56

APPENDIX.

CAR 138. JANUARY 16.

Temperatures are in degrees centigrade.

Motor 1:
Car in at 10.35 P. M.
Temperature of air, 0.
Temperature of armature iron, 60.
Temperature of field, 63.

CAR 101. JANUARY 17.

Motor 1:
Car in at 10.35 P. M.
Temperature of air, 1.
Temperature of armature iron, 70.
Temperature of field, 46.
Temperature of air in car barn at 6 A. M., 70.

CAR 480. JANUARY 18.

Motor 4:
Car in at 10.35 P. M.
Temperature of air, 1.5.
Temperature of armature iron, 29.
Temperature of field, 25.
Temperature in barn at 6 A. M., 23.

CAR 169. JANUARY 19.

Motor 1:
Car in at 10.35 P. M.
Temperature of air, 5.
Temperature of armature iron, 41.5.
Temperature of field, 27.5.
Temperature in barn at 6 A. M., 20.

In all the above temperature readings the temperature of the field coil was obtained by placing a thermometer on the top right-hand field coil at about the same point. The armature temperature was obtained by placing the thermometer on the iron core.

Digitized by Google

FUEL ECONOMY IN STEAM POWER PLANTS—II.[1]

BY WILLIAM H. BOOTH AND JOHN B. C. KERSHAW, F. I. C.

Radiation and Air Leakage—Loss of heat by radiation has long been recognized and it will suffice here merely to indicate its reduction to a minimum by careful covering.

Loss by infiltration of air has only lately been generally recognized as a serious matter. It was possibly first pointed out as serious by one of the authors over twenty years ago, and was ridiculed as hair-splitting. It is serious as a direct loss, as a reducer of temperature head in the external flues and in the economizer, and as a reducer of draught by cooling and choking the chimney. Glazed brickwork—recommended by the authors many years ago—might often be better employed to case in boilers than to decorate engine rooms. In the absence of glazed brick, all boiler-casing walls should be of hard pressed brick in cement, or the walls should be thickly painted until air-proof, or covered in thin sheet metal all the way to the chimney. Heat insulation of pipes depends for its effect upon the entrapping of films of air by some poor-conducting cellular or laminated material. Animal wool is probably the best heat insulator could it withstand modern temperatures. Of the many coverings sold, any maker can produce figures of test which prove his particular material to be the best, if gauged per unit of thickness, or by price, or upon some other basis. All of them are better than bare pipes. Pipe flanges must be afforded equal protection with pipe bodies, and heat insulation is of sufficient importance to warrant careful attention.

Stoking—Few men can properly stoke a furnace so long as six feet. The chief thing to aim at in stoking is even thickness, careful filling of hollow places, and complete covering of the bars, often so neglected at the front corners near the door. More steam can usually be made on the spreading than on the coking system; but in the spreading system either one side only should be fired at once, or one-half of the length, so that the excess of air through half the grate may mix hot with the gases from the other half. Bituminous coal does not burn, except as a gas, until about a third of its weight has been gasified. When stoked it chills the fire much more than would happen with so many cold stones, and the remarkable deadening of the fire is not due to this slight cause, for only about 11,000 heat units are employed in raising a charge of one-half a hundredweight to 1,000 degrees Fahrenheit of temperature, or say two-third pounds of coal. The cooling is due chiefly to absorption of latent heat by the production of gas. A piece of coal is obviously carbon plus some solid variety or varieties of hydrocarbon unknown to the chemist, with a mean proximate empirical formula C_7H_5. Chemists only know the various heat distillates, and, as in all operations involving change of state from solid to liquid, and liquid to gaseous, the change of solid coal into gaseous compounds demands heat. In burning bituminous coal on a grate, much of the calorific capacity of the fuel is absorbed as latent heat by the newly distilled gas, which renders it up again when burned later. Coke or anthracite, producing little or no gas, burns at or near the grate, and produces a clear bright fire. Bituminous coal can not be thus burned. It must have time, and space, and temperature, and the least time and space are demanded when the temperature is highest.

Mechanical stoking can not abolish these facts, nor can it possibly be a panacea for the smoke evil. Mechanical stoking does permit the use of inferior or rather smaller coal, and it tends to render more uniform the régime of the furnace. It does not render grate cleaning unnecessary, and it is not, therefore, a perfectly continuous process with the ordinary moving bars. In a coking stoker which feeds fuel to one end of a grate, the action as regards smoke production and burning is perfect, for the coked fuel tumbles into a pit behind the grate and burns out there as in a gas producer. The grate is short and the coal never burns very thin upon the bars in such a stoker as the Vicars which aims to keep down air excess by this means. In the chain grate without a back pit, the fuel burns out on the grate, and large volumes of excess air get in at the back end. This renders economy impossible, unless means are taken to regulate the admission of air to different sections of the grate in accordance with the demands of the fuel. Air admission above the fire is regulated by grids in the furnace door. The opening for air may be four square inches per square foot of grate. Such grids are regulated by hand, or by clockwork or similar devices. In mechanical stoking the air supply gets in more or less incidentally through the fuel hopper and through casual openings, and often in far too large amounts in the rear of the grate.

Mechanical stoking does not eliminate the need for correct furnace forms, or for sufficient temperature and proper mixture of air and gas. All inventors and purveyors of furnace accessories, such as grate bars, air-admission devices, stokers, etc., appear to become possessed of one idea, and this they push for every case, overlooking the fact that the combustion of bituminous coal is a complex chemical process which can only be conducted where the chemical equivalents are present to combine, and the further essentials of combustion are ensured. Theoretically, perhaps little air beyond the chemical equivalent would be required were the furnace continued to so great a length that ultimately every molecule of combustible came into contact with its molecule of oxygen. This assumes a heat-conserving furnace.

Practical considerations render it necessary to reduce the extent of the furnace, and to add an excess of air, so as to ensure oxygen coming into contact with all the combustible elements of the fuel within the zone of sufficient temperature. It should be possible to do this with twenty-five to thirty-three per cent of air in excess, and certainly with less than fifty per cent excess. The flame of bituminous coal will be longer, as the heat is kept low, so that a suitable furnace has a cumulative effect. By conserving temperature flame is shortened, and by shortening flame the necessity for long-protected furnace surfaces is reduced. So far as the authors are aware there is no ordinary chain grate that does not pass an unnecessary and grossly excessive volume of air. Until this furnace is tried with a less wasteful form of grate, no absolute opinion can be passed upon its proportions, though its principles are correct.

The manufacture of a maximum of carbonic acid gas per unit of fuel consumed, or rather per unit of air used, is what should be the aim of a stoker. High CO_2 means high furnace temperature, high heat transmission, small weight of waste gases, and general furnace economy. *Per se,* black smoke may not indicate serious waste of fuel; but it is evidence that the boiler surfaces are covered with non-conducting soot, and black smoke is an incentive to buy more costly coal of a less smoky order.

The Weir water-tube boiler is an example of the same principle, scarcely different in the way it is carried out. Coal is burned in a V-shaped furnace, the walls

[1] A paper read before the Institution of Electrical Engineers, London, England, January 12. The first part appeared in the ELECTRICAL REVIEW, February 25.

Digitized by Google

on all four sides of which are of firebrick, and combustion is continued in a similarly protected chamber, and is perfect with ordinary hand-firing before the heated gases pass among the tubes.

The chain grate stoker is perfect as a self-cleaning contrivance, but admits excessive air. Hence the need of choking boxes, as employed by Mr. E. B. Coxe. These difficulties with traveling grates are responsible for the sprinkling form of stoker, which, when in good order, keeps the grate evenly covered, as the coal tends to fill the hollow places. But the winnowing action of the draught carries off the dust to become a public nuisance. Such stokers require initially providing for, in the design of a chimney with a settling chamber to gather the dust. The economy of mechanical stokers lies in their ability to raise sufficient steam with cheaper coal than hand-firing demands, and in the reduction of the stoking staff. But mechanical stokers will not be an economy unless their hoppers are filled mechanically, and they ought to be in charge of a skilled mechanic to look to upkeep and maintenance, and not be expected to run with unskilled attention.

The ideal mechanical stoker is of the inclined grate type in which the inevitable thinning of the fire of the coking furnace is made good by the aid of a moving grate assisted by gravity. In this type, only possible in its full extent with external furnaces, the fuel is helped to fill gaps and close the lower end of the fire by gravity, and at the foot of the inclined grate is some arrangement which enables ash and dirt to be removed. Rocking grates which profess to cut out the ash and clinker from the underside of the fuel bed are of doubtful use, for clinker is tough and adhesive when hot. It becomes brittle only when chilled, and users of such bars should be prepared at least to have each half of the grate workable independently. The system may then be used to clean a grate quickly, after the clinker has been chilled by removal of the fire to the other half of the grate.

Smoke Prevention—This can often be managed by excessive air admission, for the reason, probably, that though air in excess has a chilling effect, its ample provision enables all the gases to burn before they have lost much temperature. But smoke can not be prevented with economy unless sound conditions are present, as already detailed, and the crux of the whole matter is summed up in saying that a maximum percentage of CO_2 must be present in the furnace gases.

Could the furnace products be rejected at atmospheric temperature, an excess of air would be of no account. But the heating surfaces commercially available render it impossible to cool rejected gases below, say, 400 degrees Fahrenheit whatever the supply of air, and obviously the loss of heat is greater where air is used in excess. This point is emphasized because there is frequently a serious confusion of thought in relation to heat and temperature, and the weight of the gases possessed of such heat or temperature. Cold flue gases, unless of small weight per unit of fuel, do not represent economy, but excess of air. Some people think otherwise.

STEAM.

The object of burning fuel under steam boilers is to produce steam. Steam at atmospheric pressure contains about 967 units of latent heat and 160 units of sensible heat above feed temperature. Only by means of the latent heat can work be done. These facts make it of prime importance that when steam is used it should contain all possible latent heat. It should be steam, in fact, and not hot water. Steam loses heat from the moment it leaves the boiler. The surfaces which contain it must, therefore, be of a minimum area. This involves pipes of minimum length and is one of the various reasons for avoiding ring mains, the fancied need for which is obviated by using good materials well put together for steam piping. Short pipes make it possible to carry a given weight of steam with less drop of pressure, or otherwise to carry the same steam at the same pressure fall through smaller pipes.

The loss of heat through pipes varies with the head of temperature. The weight of steam that will flow through a pipe varies with the pressure absolute very nearly. The pressure of steam rises faster than the temperature, and high-pressure steam (realized to be economical) will lose less heat than low-pressure steam, if the pipes are as much smaller as they should be for the high pressure. It is a mistake to employ steam pipes so large that there shall be no appreciable fall of pressure. Some fall, three pounds to five pounds, per square inch may be allowed in long pipes, for there is a point where the saving due to high pressure will be lost by the extra radiation from the larger pipes. Wet steam travels with more friction than dry steam. Superheated steam, despite its greater head of temperature, loses heat less rapidly by contact than does wet steam; it flows with less friction and loses less at joints. Less of it is also required, and pipes may be smaller.

There is no thermodynamic gain from superheat. Steam leaves the boiler at boiler temperature; it starts expanding at boiler temperature. The work done on the piston during admission comes directly from the fire, or is done by expansion of saturated steam in the boiler. The superheater is merely an incident in the steam pipe. The sole function of superheat is to ensure that steam, saturated with heat, and at maximum density per cubic foot for its pressure, shall be present in the cylinder to work expansively when steam is cut off from the boiler. Superheat is thus intended to heat the cylinder as hot as the boiler, and, by avoiding the presence of water in the cylinder, to minimize the exchanges of heat between the cylinder metal and the steam. Superheated steam supplies heat directly to the cooled surfaces which require it. The jacket, on the other hand, endeavors to maintain the outside of the working liner of the cylinder as hot as the boiler, and, while it may do some good in certain cases, it is always liable to do little else than evaporate water of condensation during the exhaust period.

The steam engine, being a heat engine, it is obvious that the best working fluid is that which contains a maximum of heat in a unit of volume. This is what saturated steam does contain, and the object of superheat is to supply saturated steam to fill the cylinder at the time of cut-off. Superheated steam is still often erroneously claimed to owe its superiority to the fact that less of it will fill a given space at a given pressure than is the case with saturated steam. This argument ignores the rapid drop of pressure which occurs when superheated steam expands. It ignores the fact that in a given bulk there is less heat and therefore less capacity for doing work. Therefore, while superheat is essential to economy, it is so only because it is the one means we possess of filling a cylinder with dry saturated steam.

(To be continued.)

Technical Education in France.

United States Consul Hilary S. Brunot, at St. Etienne, France, in a recent report, described what is being done along the lines of technical education in France. The work of the National Institute of Arts and Trades, Paris; the Central School of Arts and Manufactures, the High School of Commerce, the High Commercial School, the School of Arts and Trades, the National School of Workmen and Foremen, Cluny; National School of Watchmaking, at Cluses, and professional schools, is described.

Digitized by Google

THE MUNICIPAL ELECTRIC PLANT IN NEW YORK CITY.

AN ANALYSIS OF THE REPORT OF THE MAYOR'S COMMITTEE.

On February 10, the commission appointed by George B. McClellan, mayor of New York city, made public its preliminary report on a municipal electric plant. The salient features of the report are as follows:

A power station having a capacity of 10,000 kilowatts, to cost exclusive of real estate, $1,250,000. Cost of building plants for providing 6,000 arcs and 250,000 sixteen-candle-power incandescent lamps is $4,100,000, exclusive of the cost of real estate. Cost of high-pressure cables, substations and other details is $2,850,000. Cost per year of arc lights, including interest on bonds and depreciation of plant, is $75.40. Cost per year of sixteen-candle-power incandescent lamps is $5.15. Total annual cost of operating the proposed plant is $906,000.

To these figures Mr. Ernest H. Davis, president of the National Electric Light Association, takes exception. His ideas are embodied in the following open letter:

"In the report upon the proposed municipal lighting plant submitted to the mayor by the engineering committee, a number of items are omitted, some intentionally, others apparently not. And there is at least one error of a very glaring nature in the principal figures upon which the conclusions are based.

"The report admits the omission of lost taxes, of the principal real estate costs and of all subway charges. The result, quoted generally as comprehensive, is therefore only a partial statement of the cost of operating the municipal plant. It is not stated, however, that the large expenditures required to replace the electric motors and other apparatus, and to equip the buildings now using gas for electric light, are omitted. Every motor now used for an elevator, pump, for ventilation or for any other power purpose, in any school or other public building must be changed to utilize the new system, which differs radically from the present system of the private companies.

"In the various public buildings now supplied by the private companies there are 75,000 incandescent lamps. For the new conditions the engineers have estimated upon 250,000, leaving a balance of 175,000 to be wired for and provided with fixtures. The cost of this equipment and of changing the motors will be not less than $1,000,000, to which must be added the fees of the engineers, which their report places at ten per cent of the amount expended. The inclusion of this one item, of a number, for which the report makes no provision, will increase the estimated expenditure for this proposed municipal undertaking by not less than twenty-five per cent.

"There is another error greater in magnitude and more inexcusable in nature. The original report of the chairman of the present committee stated that 4,000,000 kilowatt-hours annually at the lamps would be required to supply 160,000 incandescent lamps of sixteen candles. The present committee have increased the incandescent installation to 250,000 lamps which on the same basis of consumption will require 6,250,000 kilowatt-hours. At 5.15 cents a kilowatt-hour, the estimated cost given by the committee, the annual expenditure for operating this portion of the plant will be $321,875. The total expenditure is $906,000. A balance is therefore left of $584,125—chargeable to arc lighting—which is $97.35 per arc lamp, and not $75.40 as stated in the report.

"Another error has crept into the report figures, arising possibly through some lack of familiarity with the question, though the necessary data were available to the expert committee. In all the public buildings, the armories, schools and various departments, the city is now using 75,640 incandescent lamps of the equivalent of sixteen candles, which use annually an average of 13.75 kilowatt-hours. On the same basis the annual consumption by 250,000 incandescent lamps would be 3,437,500 kilowatt-hours, which at 5.15 cents a kilowatt-hour would cost only $177,031.25. This change would make very slight difference in the total cost of operating the plant, and therefore if the contention of the engineers that they can make current for 5.15 cents a kilowatt-hour is correct, we must increase the charge against the arc lighting to $728,968.75, which is an average of $121.49 per lamp, again not including lost taxes, real estate and subway costs.

"It would probably not be entirely fair, however, to charge the entire difference against the arc lighting, but rather the estimated cost of producing the incandescent service must be largely increased. Where reduction is made merely in the amount of current generated by a plant of fixed size the costs of generation do not decrease in like proportion. The fixed charges, including interest, depreciation, taxes and other general expenses, remain as before and labor remains. The difference in such an instance as this would be but a slight change in coal and water. Any diminished wear and repairs upon the machinery are negligible. And therefore instead of charging the difference against the arc lighting it would be more nearly accurate to divide the cost of generation by the correct consumption of current; the partial costs thereupon become instead of 5.15 cents, 9.36 cents a kilowatt-hour. Loss of taxes and the principal real estate and the subway costs still are not included.

"This figure also fails to include the large expenditures which must be made to utilize the proposed service, and they are of such a nature that they must be charged exclusively to the incandescent lighting—the estimates for which include power. Upon interest and depreciation, taking the figures of the report together eleven per cent, a total of $121,000 annually must be added to this account. There would be an additional expenditure for the maintenance of these installations, but I have purposely omitted this item. This additional sum alone represents an increase of 37.5 per cent, bringing the cost of this service to 12.88 cents a kilowatt-hour, still excluding the subway, tax, and real estate items.

"A further word upon the arc lighting. It is a matter of simple arithmetic in your own hands to find from the report itself that the partial cost of the arc lighting is $97.35 annually. Adding the omitted items of lost taxes, the principal real estate costs and subways, the final cost becomes in no sense competitive with the prices that may now be obtained from the private companies. The largest item omitted relates to the subways, under the assumption that they must be provided at the expense of the subway companies —but this, I presume, is a legal question. Ex-Mayor Matthews, of Boston, after an exhaustive examination upon the subject reported to the authorities of his city that underground service, such as that of New York, added thirty-nine dollars annually to the cost of an arc lamp. If anything, these figures err on the low side. The experts have omitted lost taxes from their estimates on the ground that with the installation of this plant 'taxation of the existing companies would not be affected.' It is not supposable that the private companies would continue to pay taxes upon a service they do not render, or from which they receive no revenue.

"Recapitulating we have the following: (1) that the partial cost of the incandescent lighting service if supplied from a municipal plant would be not less than 12.88 cents a kilowatt-hour; still excluding subway, tax and real estate items. The private companies now quote the city twelve cents a kilowatt-hour and in some buildings six cents, in each instance the price being inclusive of incandescent lamps, the supply of carbons and the care and maintenance of arc lamps. (2) That from the report the partial cost of an arc lamp is shown to be $97.35 annually, and that the entire cost, inclusive of subway, real estate and lost taxes, would be in excess of $140—the present maximum price of the private companies.

"Without speaking for the companies, for whom I have no authority to speak, I am convinced that were they offered, to even a limited extent, the advantages enjoyed by this proposed plant, either in a fairly long-term contract for the present service or a year-to-year contract for a service as large as that proposed, reductions from their present prices would be made. For, permit me to point out the private companies are now serving less than half the aggregated installation of the proposed enterprise.

"To a communication that has already gone beyond reasonable limits, may I add that the method proposed by the expert

Digitized by Google

committee is inferior to the system by which the city is now lighting. One feature of inferiority is the absence of the reserve found in the storage batteries of the private companies. These batteries alone, which at all times stand behind the public lighting, have cost fully half the entire proposed expenditure on the part of the municipality. One result would be that were an accident to occur either at the main or any substation a large section of the city would be placed in absolute darkness. In fact, in the system planned it is proposed to give up all the advantages of the present low-tension direct-current system which has been brought to an almost perfect state technically through years of study, development and the expenditure of millions of money.

"It is to be hoped that this entire question will be passed upon by more adequate and competent authority and from a standpoint entirely disinterested, unprejudiced and impersonal before the city is committed to an enterprise from which once launched there would be no turning back."

Peculiar Photographic Action.

A peculiar photographic action has been discovered by Mr. G. W. A. Kahlbaum, of Bâle, Switzerland, which is described in *Engineering* (London), February 10. While studying the effect of density on gravitation, and the transparency of metals to Rœntgen rays, he noticed that the metals themselves had photographic action under the following circumstances: placing a sensitized plate, film upward, in a box of cardboard lined with black paper, and placing over the film a strip of paraffin paper, pieces of cardboard and pieces of sheet metal, in the order named, and then in the reverse order, with a second photographic plate on top, and allowing the combination to stand for several days, a distinct photographic action was seen on the lower film. The metals used were aluminum, iron, zinc and lead, but the impression was found only upon the film below the pile of metal sheets—not on that above. The action was strongest in the case of zinc. These pieces of metal had previously been exposed to Rœntgen rays and other experiments; a special set of metals which had not been used in any way was obtained. Photographic action again took place, and, as before, only upon the lower photographic plate. This seemed to indicate that the effect was due to gravitation. When several photographic plates are piled one upon the other, underneath the metal, all are affected, the one nearest the metal being most strongly impressed. When the plates are placed vertically, instead of horizontally, there is no difference between the images produced on the right and left sides.

RAILWAY SIGNAL SYSTEMS.

BY AZEL AMES, JR.

The impression which the large number of train accidents during the last year has made upon the public mind is very strongly evidenced by the rather drastic legislation that is being introduced in some states and by the interest that is being taken all over the country in the further adoption of safety appliances by the railroad companies, particularly along the lines of block signaling.

While the most that will be done immediately by many of the roads will be the adoption of a simple form of telegraphic block system, a number of the larger roads will go very heavily into automatic block signaling the coming season. The Lake Shore and Michigan Southern are spending considerable money along these lines and a number of other roads are going quite heavily into the automatic field; even the extreme western roads are going in for a lot of automatic blocking on their single-track lines, not, of course, with the intention of entirely doing away with train despatching, but as a valuable adjunct for increased safety and for expediting the movement of trains.

While undoubtedly there will be a great deal of stimulation given to invention and designing of signaling apparatus, it is doubtful if there will be much variation in the next few seasons in the types of signals now being put upon the market. There is a strongly growing tendency toward the use of storage batteries for automatic motor signals where the blocks are of such lengths, the traffic of such volume and the number of tracks to signal of such a number as to warrant the cost of a transmission line. The coming season will perhaps see a decrease in the number of semaphores operated by primary battery and a fair increase in the number of electro-gas signals put in use and quite a heavy increase in the number of motor semaphores operated by storage batteries. A number of roads are at present operating their motor signals by storage battery, taking the battery to some point of advantage for the purpose of charging it. This is being done on the Southern Pacific and Mr. Slater claims an economy over the cost of operation by primary battery. It would appear that where automatic block signals are to be operated by a self-contained source of energy, that the electro-gas signal will increase in favor, those at present in use having given a high degree of satisfaction to the roads using them.

There is a strong tendency toward the use of all-electric interlocking even at points where the cost of installation of mechanical interlocking would be somewhat cheaper. There is hardly any doubt but what electric interlocking will be shown to be slightly more expensive to maintain than the mechanical, but there is no doubt of its greatly increasing use on account of its great advantages and very satisfactory performance under proper maintenance.

The General Railway Signal Company has until recently had practical control of all the all-electric interlocking in the country, but the Union Switch and Signal Company is developing what will undoubtedly turn out a very efficient apparatus and system. Of course the various roads are daily besieged by inventors and others with all sorts of schemes and all sorts of safety appliances. Quite a number of these are along the lines of some form of cab signal or automatic train-stop. While there is bound to be advance along these lines of signaling, and while under certain conditions of low speed on structures or in tunnels the automatic train-stop is giving satisfactory service, it is not likely that extensive applications of either the train-stop or cab signal will be made on steam roads in the immediate future. Signal engineers are all looking anxiously for the development of an alternating-current apparatus for railway signaling, the chief trouble with all automatic work at present being the use of direct current for the track circuit and the consequent interference therewith of foreign current. While it is true that very satisfactory alternating-current relays have been devised and are in service, there has not yet been developed a form of alternating-current magnet suitable for signal clutches or slots. Until such have been perfected we probably shall not see the introduction of much alternating-current signal apparatus.

Amusement Telephones.

The Orpheum Theatre, Brooklyn, N. Y., is engaged in an experimental test of connecting its patrons by telephone, and enabling them to enjoy the vaudeville performance without leaving their homes. Quite recently a demonstration was made, a number of prominent Brooklynites being connected up to the telephone system, and enjoying the entire performance.

Almost directly in front of the stage there is a receiving apparatus which is fitted with a specially constructed diaphragm. This sends impulses over a trunk line which is tapped by any number of individual line circuits. The tests are being conducted over the system of the New York & New Jersey Telephone Company. It is possible that, if the experiments are satisfactory, the service may be installed, not only in private homes, but at hotels and restaurants throughout the city.

Digitized by Google

Report of the Directors of the New York & New Jersey Telephone Company.

The twenty-second annual report of the directors of the New York & New Jersey Telephone Company, for the year ending December 31, 1904, shows substantial gains in both the Long Island and New Jersey territory covered by the system.

The gross earnings were $5,393,708.76. The expenses of operation were $3,729,335.35. Earnings over operation were $1,664,373.41.

FIXED CHARGES AND TAXES.

Interest	$66,422.04	
Taxes	121,000.00	
		$187,422.04
Net earnings applicable to dividends		$1,476,951.37
Dividends paid		962,088.50
Surplus earnings, 1904		$514,862.87
Surplus, January 1, 1904		3,071,099.06
Surplus, December 31, 1904		$3,585,961.93

COMPARISON.

	1904	1903	Changes
Gross earnings	$5,393,708.76	$4,741,343.90	$652,364.86 inc.
Expenses of operation and maintenance	3,729,335.35	3,269,996.38	459,338.97 inc.
Earnings over expenses	$1,664,373.41	$1,471,347.52	$193,025.89 inc.
Fixed charges, taxes and dividends	1,149,510.54	1,033,429.77	116,080.77 inc.
Surplus	$514,862.87	$437,917.75	$76,935.12 inc.

The results of the year's operations show increase in both gross and net earnings. The company has been particularly fortunate in having escaped severe storms.

Under date of January 26, 1904, the directors offered to the stockholders at par $1,252,000 of treasury stock, which was duly subscribed and paid for during the year.

Under the operation of the sinking fund, the amount of the company's general mortgage bonds outstanding was reduced $18,000, leaving the amount of outstanding bonds at the close of the year $1,268,000. There have been purchased for the sinking fund and cancelled since the issuance of the general mortgage in 1900, $232,000 of the bonds secured by it.

The expenditures for extension of plant and new construction during the year were as follows:

Real estate	$82,717.90
Equipment	478,394.46
Telephone lines	783,444.20
Making a total amount charged to construction of	$1,844,556.56

The large outlays for construction and maintenance during the past few years, with the general extension of the company's underground system, both in the important cities and towns of its territory and on the main trunk lines running out of the city of New York, have placed the plant in a sound and permanent condition. The extended use of the Pupin coil, together with the improved common battery switchboards, which have now been widely installed in the important exchanges, have resulted in a substantial improvement in the quality of service which the company is able to render.

Five new buildings of fireproof construction, for the use of important exchanges, have been completed and occupied during the year. Chief among these is the large six-story building known as the Prospect Central Office in Brooklyn, in which have been placed the equipment for the Prospect district, the Long Island trunk switchboard and the general force of the Long Island division. Sites have been secured also and work commenced on four other buildings, to be located at West Brighton, S. I., and at Montclair, Newark and Morristown, N. J. These buildings will be completed during the year, and work will be commenced upon several additional properties.

From time to time, the directors have authorized modifications and reductions of rates to meet the constantly changing conditions. On October 1, 1904, a general revision of toll rates, involving substantial reductions, was put in effect throughout the territory.

On September 1, 1904, under an agreement effected with the Delaware & Atlantic Telegraph and Telephone Company, the company assumed control of a portion of the territory formerly operated by that company in Ocean County, N. J., but which was naturally tributary to the New York & New Jersey Telephone Company lines. At the same time the company transferred to the Delaware & Atlantic company a small portion of territory theretofore operated by the New York & New Jersey company in Middlesex County, N. J., where the business was naturally appurtenant to the lines of the Delaware & Atlantic company.

During the year the office of chairman of the board of directors was created, and some other changes were made in the plan of organization of the company, looking to a more efficient arrangement of its force, in order to properly care for its complex and rapidly growing business.

In the month of September occurred the death of Mr. David B. Powell, for many years a member of the board of directors. At a meeting of the board, held shortly thereafter, the following resolutions were unanimously adopted:

Resolved, That in the death of Mr. David B. Powell this board has lost a member whose high character and sterling qualities of heart and mind his associates have always held in the highest esteem.

For more than fourteen years Mr. Powell has been an active member of this board, ever showing a keen interest in the affairs of the company, and on all occasions giving counsel and advice of the highest value.

Resolved, That we tender our deep sympathy to Mr. Powell's family in their bereavement, and that, in common with his other friends and associates, we bear tribute to his genial nature and his capacity for large affairs, which was so signally marked by integrity and worthy purpose.

Resolved, That these resolutions be spread upon the minutes of this board, and that the secretary transmit a copy thereof to the family of Mr. Powell.

The directors express their appreciation of the loyal cooperation of the employés of the company, the intelligent discharge of whose duties has contributed very greatly to the successful result of the year's operations.

The total number of stations are shown in the following summary:

	L. I. Div.	N. J. Div.	Total
Stations, Jan. 1, 1905	39,544	40,780	80,324
Stations, Jan 1, 1904	32,471	34,093	66,564
Gain	7,073	6,687	13,760

The officers and directors of the New York & New Jersey Telephone Company are as follows:

Chairman, Charles F. Cutler.

President, U. N. Bethell.

Vice-president, William D. Sargent.

Secretary, Waldron Hoppins.

Treasurer, Henry Sanger Snow.

General manager, J. C. Reilly.

Executive committee, Charles F. Cutler, William D. Sargent, Jos. P. Davis, Frederick P. Fish, U. N. Bethell.

Directors, Charles F. Cutler, New York, N. Y.; Alexander Cameron, Brooklyn, N. Y.; Jos. P. Davis, New York, N. Y.; Charles A. Nichols, Springfield, Mass.; Hugh Kinnard, Newark, N. J; William D. Sargent, Brooklyn, N. Y.; George H. Prentiss, New York, N. Y.; Edward J. Hall, New York, N. Y.; Henry Sanger Snow, Brooklyn, N. Y.; Zenas Crane, Dalton, Mass.; U. N. Bethell, New York, N. Y.; Frederick P. Fish, Boston, Mass.; John W. Griggs, Paterson, N. J.; Theodore F. Miller, Brooklyn, N. Y.; James Jourdan, Brooklyn, N. Y.; Wm. C. Courtney, Brooklyn, N. Y.; Waldron Hoppins, Brooklyn, N. Y.; William Berri, Brooklyn, N. Y.

Digitized by Google

American Institute of Electrical Engineers.

The 194th meeting of the American Institute of Electrical Engineers was held in the chapter room of Carnegie Hall, New York city, on Friday evening, February 24, 1905. President Lieb was in the chair. The secretary announced the death of Mr. Eugene F. Phillips, of Providence, R. I.

The first paper of the evening was then presented, namely: "Two-Motor *versus* Four-Motor Equipments," by N. McD. Crawford. This paper appears in full on another page of this issue. Mr. Crawford himself was not present, and the paper was read by Dr. Samuel Sheldon. At the conclusion of the paper Dr. Sheldon read a letter from Mr. Crawford, in which he explained the term "A" in the efficiency formula in the paper. He stated that the value of A is obtained by multiplying the average watt-hours per ton-mile by ton weight of car, and this result by the cost of power per watt-hour at the switchboard. Mr. Crawford stated that it seemed important also to use the cost of current per ton-mile at the switchboard, the value of the seated load, platform labor per mile run, and the interest and depreciation per mile run, considering these terms as input, and the returns per mile as output in determining the efficiency. He stated that it would be extravagant practice to run a heavy, high-speed, expensive car of large seating capacity over a line from which a small earning capacity would be returned—due to density of population and other causes—when a lighter, slower-speed, less expensive car of smaller seating capacity would fully accommodate the travel and produce an efficiency nearer 100 per cent. Mr. Crawford stated that he had endeavored to name the efficiency obtained "commercial efficiency," but that possibly this was erroneous, and that it might be better to name the figure obtained "load-factor" or "earning efficiency." He said, however, that he was looking at the matter from the standpoint of a street railway manager, and not from an engineering standpoint.

President Lieb then called on Mr. A. H. Armstrong, Schenectady, N. Y., to open the discussion. Mr. Armstrong stated that the contest between two and four-motor equipments seems to have been settled in favor of the four-motor equipment. He held, however, that each case must be settled for itself, according to local conditions. The fundamental reason for four-motor equipments is the need of increased traction, the increase being due to hilly routes and rapid acceleration. City roads particularly need the rapid acceleration on account of the many stops, and on a surface line four motors are necessary in order to obtain this rapid acceleration. On a road having good rail surface, such as an elevated or subway road, the two-motor equipment is sufficient to give the train rapid acceleration without discomfort to passengers. Suburban work is different, one-car trains being run, and hills which would not be tolerated on a steam road being encountered. The climatic conditions also affect the operation of trains. With a high-speed road, with cars running at from fifty to sixty miles per hour, the proper schedule can only be maintained by means of four motors—one on each axle. The two-motor equipment is perfectly satisfactory for light city traffic, where the road has a low profile and many stops. Mr. Armstrong criticised the efficiency formula, and said that it did not, in all cases, give true results. He called attention to the fact that if a two-mile run had been taken as a basis, instead of a one-mile run, the efficiency of car No. 169 would have been about doubled. He stated that there was no reason why a car should demand more energy with four motors than with two, if the weight on the wheels is the same. He also thought that a car equipped with two thirty-five-horse-power motors should not be compared with a car equipped with four thirty-five-horse-power motors, but that a car equipped with four thirty-five-horse-power motors should be compared with one equipped with two seventy-horse-power motors. He thought that the only fair basis of comparison of two and four-motor equipments is due to local conditions, and that the trend of public opinion seems to favor four motors.

Mr. S. T. Dodd was then called upon to continue the discussion. He criticised the efficiency formula, and stated that it does not, as it stands, mean efficiency in the sense that an engineer would state it. He criticised the introduction of the term "seat value," and thought that Mr. Crawford should have given two formulas, and used the carrying capacity of the car in one. He thought that the cost of repairs should have been added to the table of operating expenses, as the vital question is, do two motors cost less than four for repairs? He pointed out that if the cost per seat-mile had been obtained, instead of the cost per car-mile, car No. 480 would have been the most economical. He stated that more data on repairs were necessary, and that these data should be cost of repairs per motor, instead of per car-mile. In regard to the question of heating, he said that it was often stated that a two-motor equipment on the same load and service as a four-motor equipment will heat quicker on account of the smaller motors having a greater proportional radiating surface. He questioned the truth of this, however, and cited some tests made by himself on a number of different motors, in which he found no practical difference. He stated that the difference in the heating of motors on the cars mentioned in the paper was not due to difference in motors, but difference in gearing. He said that Mr. Crawford's curves showed that two of the cars were geared too high for their service.

Mr. Calvert Townley, New Haven, Ct., stated that in the comparison of two and four-motor equipments, two motors and four motors are not strictly compared; that the comparison is one of local conditions. In any given city, the comparison should first determine what type of car is best suited to the service, and then whether two motors or four motors were the best equipment for that car. The question of gear ratio should not be brought in when the equipments are under comparison. Another difficulty encountered is that four-motor equipments are usually compared with two-motor equipments of lower aggregate capacity. If we assume exactly the same capacity of motors, the corresponding four-motor equipment is heavier and must be made larger to account for the difference in weight; therefore the cost will be greater. The difference is not great if the motor capacity is the same, but it will be considerably greater if the motor capacity per ton weight is considered. The cost of maintenance is greater with four motors, on account of the greater number of parts. All the foregoing points are against the four-motor equipment. Four motors, however, give increased traction, which is needed with high speeds, and four-motor equipments must be used when the needed motor capacity can not be obtained with two. The conditions in winter are very different from those obtaining in summer. In winter frequently one truck has no adhesion whatever, and the motor or motors on that truck are not available to start the car. With a two-motor equipment this might result in stalling the car. In summer, however, there were few conditions where a two-motor equipment would not give perfectly satisfactory service. Regarding the efficiency formula, he

Digitized by Google

stated that the question of efficiency is considered a question of interest and depreciation on car equipment, and that the interest on track and overhead work should also be considered, as they increase with a heavier equipment.

A paper entitled "On Track Bonding" was presented by Mr. C. W. Ricker. In this paper the history of rail bonding was first taken up, and the different types of rail bonds classified as follows: first, compressed terminals, in which a hole is drilled or punched in the rail, and the cylindrical terminal of the bond is upset in it by great pressure; second, expanded terminals, in which a terminal of cylindrical form is expanded in the hole in the rail by means of a drift driven through a hole in the terminal; third, soldered terminals, which is a flat terminal soldered to the surface of the rail either with soft or brazier's solder; fourth, amalgamated terminals, the terminal of a copper bond, and the surface or a hole in the rail being amalgamated and held in contact with slight pressure, depending upon a layer of tin amalgam maintained in metallic contact; fifth, bolted terminals, in which copper strips or sheets are pressed against the surface of the rail by bolts designed for the purpose; sixth, makeshift terminals, which are of many forms, and are used mostly where there is no money with which to get those of better design.

A good bond should be so formed that it may be applied with the types of rails in ordinary use, in such position as to be protected from accidental damage and from theft. The bonds should be readily accessible for inspection and repair. The cost of application must be kept low, and to this end it is very important that the process shall be so simple and easy that no high-skilled labor or extraordinary care is required to install them with certain and uniform results. The bond that satisfies all these conditions has not yet been devised. No standard has so far been adopted for the ratio of contact area to cross-section of bond. The practice seems to be to get as large contact area as is possible. The failure of a bond is usually due to one of three causes, namely: breakage of bonds, disintegration of bonds, and the impairment of contacts. The breakage may occur because of defects in manufacture or fatigue from long-continued jar and repeated flexures. The bond may become disintegrated at the surface of imperfect welds. In an amalgamated bond the amalgam may harden and shrink, losing flexibility and contact with the bonded surface. The most important cause of impaired contact is oxidation, which is greatly facilitated by the presence of moisture. Soft soldered contacts under ground are not to be trusted, especially on track laid in streets which are sure to be wet. Brazed bonds seem to give no trouble.

Attention is called in the paper to the importance of good contact, and instances are cited to show the efficiency and durability of the different forms of bonds.

The discussion was opened by Mr. Henry A. Lardner, of New York. He regretted that the perfect bond described by Mr. Ricker had not been devised, and stated that the difficulty of obtaining a perfect bond seems to be due to the difficulty of obtaining a good contact between the rail and the bond. He thought that an entirely new method of bonding must be devised. He believes that a proper method of welding can be worked out—one that can be readily inspected and successfully applied. The quality of a bond depends so much on the quality of labor employed that it is impossible to tell, at any time, whether a good bond is obtained. Holes in the rail should be reamed, and it is possible that the bond terminals should be machined so as to obtain a better fit than is possible with any bond now on the market. He believes that, with heavy traction, the plug bond now in use must be replaced by some other which will ensure better contact. The question of maintenance is very severe. On roads operating under steam road conditions bond gangs have been able to replace only three or four bonds per day. He believes that it may be possible to use the splice bars as a bond with some form of outside connection, so that the rail may be bonded without removing the splice bar.

Mr. A. A. Knudson, New York city, called attention to the method of bonding which was not mentioned in the paper, namely, that in which an iron bar is welded to the joint, the bar being heated electrically and hydraulic pressure applied. He quoted a sentence from the paper, which stated that "in the bonding of elevated railways using steel structures, the metal of the structure has been used to excellent advantage. However, this presents some peculiar problems in bonding, and a serious risk of electrolysis of anchor bolts." Regarding this, Mr. Knudson stated that when the elevated structure was compared with that of the pipes underground, but little current would go from the structure to the pipe. He related the result of poor bonding on a railroad near New York city, where a large water main was entirely destroyed by electrolysis.

Mr. William Pestell, New York city, stated that he had had occasion to note the various types of bond. The exposed type of bond deteriorates more rapidly when in a street and accessible to moisture than when it is installed on a private right of way. With steel terminal bonds he has found that, after ten years' service, the steel terminal was as good as on the day it was put in. The only corrosion found was at the joint of the steel and copper.

Mr. R. D. Mershon, New York city, stated that the author had not taken into account the effect of increased conductivity in the bond, and electrolysis; that if the current-carrying capacity of the bond was increased, there would be less tendency of the current to leave the track. He stated that electrolysis was becoming a more serious question all the time, and that more account should be taken of it.

Dinner of the Electrical Contractors of New York City.

The banquet of the Electrical Contractors' Association of New York city was held at the Hotel Astor, Monday evening, February 27, about two hundred well-known electrical men and their guests being in attendance. The dinner was one of the best that Landlord Muschenheim has yet served, and was appreciated by every one. A very entertaining vaudeville performance followed the dinner and continued until a late hour.

At each plate was a small bag labeled "An Electrical Contract," which on being opened was found to contain a Sterling incandescent lamp in the form of a plump young pig. This souvenir, it was said, represented an electrical contract in the sense that such contracts are often a "pig in a poke." A hand-painted card bearing a motto and the diner's name was at each plate, many of the mottoes being particularly appropriate to the individual.

The officers of the Electrical Contractors' Association are: president, J. C. Hatzel; secretary, G. W. Russell, Jr., and treasurer, J. P. Hall. The very competent dinner committee consisted of Messrs. S. Davis, Fred Pearce and E. S. Keefer, and in addition to these among the others present were H. B. Kirkland, J. B. Olsen, P. H. Klein, Jr., Charles L. Eidlitz, Albert S. DeVeau, P. M. Scribner, F. W. Wilkins, Martin A. Oberlander, Cyrus O. Baker, Charles W. Price, C. J. Purdy, E. W. Rothschild, F. W. Harrington, R. B. Corey, E. R. Knowles, W. H. Morton, secretary of the National Electrical Contractors' Association, J. E. Way, Albert Taylor, John H. Dale, George L. Patterson, F. M. Hawkins, A. P. Eckert, M. Loewenthal and E. B. Latham.

Digitized by Google

ECONOMICS OF TRANSMISSION PROBLEMS.[1]

ELECTRIC TRANSMISSION AS A PROBLEM OF ECONOMICS RATHER THAN OF ENGINEERING.

BY F. A. C. PERRINE.

The electrical transmission of energy is but a special case of transmission and transportation; of transmission when the distance is short, or transportation when it is long. For transmission it is analogous to the belt; for transportation to the coal train or pipe line.

While the electrical problems may be identical whether the transmission be long or short, the economical problems are totally different and the elements of greatest importance in short-distance transmission are only incidental advantages in long-distance problems.

In electrical transmission at short distances, we concern ourselves only with a comparison to mechanisms. Shafts, gears, belts, chains or wire ropes accomplish the same purpose and the decision is based upon the relative efficiency, with due consideration of the applicability of electricity to the machinery in question to which it is capable of applying a more uniform torque and in the operation of which it can affect economies, particularly when there is any question of intermittent operation.

These questions, while of importance to the proper solution of the long-distance problem, are nevertheless of relatively secondary interest, the fundamental question not being of the applicability but of the development and cost of transport.

The analogue and competition of long-distance transmission of energy are, therefore, the coal train and the pipe line, and the problem set squarely before us is whether it be cheaper to transform the energy of coal or water at the point of production and transmit it to the favorable factory site, or either by moving the factory to the power site make use of a water power or again locate the factory at a point advantageously located as regards a market and transport the fuel unconverted to be transferred at the factory into some useful form of energy.

Markets may be said to be in existence when, in the region to be served, sufficient factories or other plants are to be found capable of making full use of the energy to be developed. That such plants are in existence proves the availability of the territory for users of power, at the same time it points equally strongly to the fact that the region is one in which the source of energy already in use can be readily utilized in competition with other regions similarly situated as regards market for their produce and available workmen. In other words, a market already established is an indication that some competitive form of energy is strongly established and such territories may at the best be examined only with a view to competition and the possible revenue can only be estimated on a competitive standpoint. In such a region, the cost of the installation of a new form of drive to supersede that already in operation is a disadvantage to be overcome, and the advantage to the customer must be assured. Every advantage to be derived from the electrical drive is then important to consider as well as the price of energy per unit if a market is to be wrested from the competitor.

While it is important to secure a market which is thus ideal, it is not always true that such a market is readily accessible from the operating plant. It is true that electrical energy may be transported to considerable distances, but at the same time we must never lose sight of the fact that transmission to a distance greater than that equivalent to 100 kilowatts per mile is a transmission in which it is not easy to predict success and, in consequence, the nearer competitive market is often preferable to the market with a better possible price where the transmission is for a considerably greater distance.

The character of the market determines the possible revenue, and this in turn determines the limits of possible transmission or accessibility. Great distances of market has no terrors for the electrician perhaps, as he can plan the system at high voltage and with economical construction to permit delivery and satisfactory regulation, but, to the operating engineer, an entirely different problem is presented by distance. As distance increases, not only must new questions of voltage, inductance, capacity, switching and lighting protection be introduced, but every additional mile of separation between points of generation and distribution increases the difficulty of supervision and every mile of line increases the number of supports for the line, which not only vastly increases the difficulty of inspection but also increases the probability of accidental interruption.

At the present time each kilowatt of energy developed may be estimated conservatively as being equal to the use of twelve tons of coal per annum, and on this basis the water power compared with the coal mine. In making any such comparison it must, however, be remembered that while the value of the coal mine is constantly decreasing, as the coal is mined, the value of the water power is constantly increasing with the rising price of coal, and that, when the coal supply of the country is entirely exhausted, the water power will still be in operation with but slightly diminished volume.

The simple presence of an apparently invincible source of competition does not necessarily render the development of transmission plants, whether operated by water or coal, unprofitable ventures; though it does necessitate more than usually careful study of the character of the market and the adaptability of electricity as a form of energy to its needs. For certain industries and in certain localities the isolated plant, whether for the direct application of steam power or for the production of electricity for use on the premises, is an anomaly.

So far, we have considered the competitors of power transmission as arising solely from the character of supply and have not considered other means of the transmission or transportation of energy or its source. This brings us directly to the question as to whether it is not more advantageous to develop power at the coal mine or oil well for transmission electrically than it is to transport the coal or oil by means of a railroad or pipe line to the point of use to be used there as a means of generation. This is a new problem in electrical engineering. Much has been written against the feasibility of generating electricity at the location of the source of fuel and transmitting it to the market. The arguments so far have been almost invariably based upon the relative efficiency of the electrical transmission and the coal train. If we assume that a railroad is already built and that it is already being maintained by its present freight traffic, there is no question but what it would be difficult to figure out any increased economy or decreased cost of transportation of energy from coal by means of the transmission line. Furthermore, the alluring problem of the use of the waste from coal mine in the development of electrical power for transmission has been thoroughly condemned by those who have investigated it on account of the fact that in the present day the untransportable waste of coal mine is too small to be considered as a fuel for a transmission plant of any importance. There are, however, many locations in the country where fuel is obtainable which are not readily connected with a manu-

[1] Abstract of a lecture delivered recently before the Brooklyn Polytechnic Institute, Brooklyn, N. Y.

Digitized by Google

facturing market by satisfactory transportation routes.

In these locations are included not only the undeveloped mines in remote mountainous locations, but more particularly the mines which are surrounded or those owned or operated by coal-carrying roads themselves or by companies allied to these roads. The present condition of the independent miner, particularly in the anthracite coal field, is a non-competitive position. He is only capable of mining for a market in excess of that for which the companies controlling the territory wish to mine from their own properties and his only customer possible to him is the coal road or the coal company with which he is supposed to be in competition. In consequence, he must either take the price they offer him or leave his coal unmined and unsold.

Electrical generation and transmission is a means, under such circumstances, of finding an independent market for the product of the mine, and when such a plan is carried out, it is the equivalent for a miner of an independent road of his own. It may be objected that such a miner is not, even at his delivery point, free from the same competition that he finds about the mine itself, and while this is apparently axiomatic, it is at the same time true that at the delivery point the possible price of coal is determined by other circumstances than those which surround the mine, and in dealing directly with the customer for power the owner of the mine will find many conditions in his favor which are absent in the location from which the coal has been originally obtained. This problem is one for the immediate future. No such undertakings have as yet been attempted, but with the increasing use and advantage of electrical application, the probability of such a plan being carried out and the strong possibility of its commercial success is every day approaching nearer and nearer.

Automobile Freight Line between Lima and Callao.

A report from United States Consul A. L. M. Gottschalk, Callao, Peru, states that an automobile line has just been put into service between Lima and Callao, for the purpose of hauling freight between the two towns. The company has been formed by substantial business men, and has a capital of over $200,000. There are five automobiles in use at the present time, each having a carrying capacity of five metric tons. They carry the freight directly from the Callao docks to the warehouses in the city of Lima.

AUSTRALIAN TRAMWAY SYSTEMS.

BY JOHN PLUMMER.

In no part of the world, in proportion to the density of population, are street tramways more extensively used as a means of passenger transit than in the leading Australian state capitals. Although their introduction is of comparatively recent date, their development has been marvelous, and, as in many European and American cities, they have assisted in making riding cheaper than walking, and are causing the omnibuses and other conveyances of a past generation to become forgotten.

In Sydney the tramways were originally worker by steam power, the cars being double-decked, like the railway carriages on several of the Paris suburban lines, but subsequently the cable system was introduced, and later on electricity became utilized as the motive power, and with such success that it is only a question of time when the locomotive and cable will be found dispensed with.

The various tram-lines, which, like the railways, are the property of the state, form a complete network of communication between nearly every part of Sydney and its suburbs, thus assisting in counteracting the tendency to overcrowding which forms one of the evils associated with large centres of population.

The total length of tram-lines open on June 30, 1903, was 124.5 miles, representing an expenditure of £3,371,587 for construction and equipment, the number of passengers carried during 1903 being 130,405,402.

The Melbourne system, embracing a length of forty-eight miles, forty-three and one-half miles of which are worked by cable, and four and one-half miles by horses, was constructed by a municipal trust at a cost of £1,705,794, and is leased to a company. It is said to be the largest and best cable system in existence. The number of passengers carried during the year was 47,564,942.

There are also several suburban lines worked by limited liability companies as follows—horse eight and one-half miles, electricity four miles, and cable two and one-quarter miles. In Brisbane the tram-lines were originally worked by horses, but in 1897 they were replaced by electricity, the tramways being the property of an English company, and covering a total length of twenty-eight miles. As the traffic increases, extensions are effected.

At the close of 1902 there were in the state sixty-five miles of tramways, including those in Brisbane, the number of passengers carried during 1903 being 18,125,302. In Adelaide there are several tramway lines worked by horses, but an attempt is being made to secure the introduction of the electric system. The lines are owned by private companies.

In Western Australia, Perth has a well-organized system of electric tramways, which, like that in the Kalgoorlie municipalities, is the property of a private company. Fremantle and Boulder City also will shortly be in possession of electric tramway systems, constructed by private enterprise under municipal supervision. The only state-owned tramway is that running between the port of Roebourne and the town of Cossack, a distance of eight and one-half miles, in the northwestern portion of the state.

In Tasmania the Hobart tramways are worked by electricity, and extend a distance of about nine mines. They are owned by a private company, and were opened in 1901, in which year they carried 1,432,176 passengers. There is also a steam tramway in the northwest portion of the state, connecting Zeehan with Williamsford, a distance of eleven miles, its summit being 1,500 feet above sea level.

Compared with other Australian tramway systems, that of Sydney is considerably the most efficient, there being a continuous succession of trams from early morning until midnight, an all-night service being established on several lines. During the earlier hours of the day and in the evening the tram traffic is enormous, the cars, running almost every minute, being densely crowded. It is the same at holiday time, and the greater the amount of accommodation provided by the state railway commissioners the denser becomes the crowding. It is as if the whole population desired the use of the tram-cars. Yet, with all this heavy traffic, accidents are comparatively few, being in most instances due to the disregard of ordinary precautions on the part of the sufferers.

All the Australian electric systems are on the overhead wire principle, which is not found to interfere with the work of fire-brigades to anything like the extent originally anticipated. The cost of the New South Wales tramways was defrayed out of loan revenue, and they constitute one of the most valuable assets of the state.

The Schenectady (N. Y.) Home Telephone Company has installed two street telephones in that city. In addition to being public pay stations they are for police and fire service.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Cadmium Amalgam Lamp.

An attempt to improve the color of the light emitted by the mercury vapor lamp is here described by M. A. Bainville, who quotes from a German contemporary. The lamp consists of a H-shaped bulb with the horizontal member somewhat elongated. The lower parts of the two end members are filled with an amalgam of mercury and cadmium. To these terminals are attached two glass tubes, which are turned through two right angles. In the horizontal portion of each of these tubes a glass plug is fused, through which an iridium wire is passed. These plugs form the first seals of the lamp. Beyond them, in the vertical portion of the tubes, mercury is placed, and into this two iron wires are inserted, which are then sealed in by means of shellac. The tube is thoroughly exhausted, and is started as is the ordinary mercury vapor lamp. The amalgam is soft at ordinary temperatures, but becomes liquid when heated. It consists of fourteen parts of cadmium to 100 parts of mercury. The light contains, in addition to the mercury rays, those of cadmium. It burns quietly, but there is a tendency for it to lose its vacuum. This gives it a short life. When this condition has been reached, the lamp can only be started after having been heated. The lamp can be restored to its original condition by reexhausting.—*Translated and abstracted from L'Électricien (Paris), February* 11.

A Universal Projection Lantern.

A conveniently arranged projection lantern, designed by Dr. M. T. Edelmann, is here described. The lantern proper is mounted on a tilting shelf, attached by short legs and hinges to a table. The table itself is carried on a triangular pedestal, made large so as to be rigid, and enclosing the regulating resistance. This pedestal is, in turn, carried on a tripod, two of the legs of which are mounted on casters, and the third has rollers which do not swivel. These rollers and a bolt attached to one of the other legs hold the lantern firmly in a fixed position. The lantern may be supplied either with a hand-regulated or automatic arc lamp. It has the usual complement of lenses, a water cell, and a system of mirrors which enables the horizontal ray to be thrown vertically and then again horizontally in any direction. The lantern has a convenient arrangement of rods attached to the upper part, which is swung back when not in use, and which may be used as a support for certain attachments. For lecture purposes, a set of skeleton instruments is supplied. One of these is a vertical conductor, to which is attached a skeleton hand and a magnet for demonstrating the relation between the direction of current flow and magnetic flux. The essential parts of an electric bell, mounted on a sheet of glass, demonstrate the operation of the device, while ammeters and voltmeters of different types, and mounted in a similar way, may be placed directly in the beam of light and an image thrown on the screen, enabling readings to be observed by the entire audience.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), February* 1.

Some Tests Conducted with an Electrolytic Rectifier and Motor-Generator.

Having occasion recently to specify apparatus for charging an electric automobile, Mr. Horace Boot tested two types of apparatus for this purpose. The first was a motor-generator set, the dynamo having an output of fifty amperes at 120 volts. It was driven by a twelve-horsepower motor. The efficiency of the set was found to be only 49.1 per cent. The cost of the equipment was $775. The low efficiency seems to have been due to poor electrical design, for the mechanical losses were small. Thinking that an electrolytic rectifier would be cheaper and, at the same time, more efficient than the motor-generator set, a Nodon rectifier with a similar direct-current output was tested. This device consists of four lead cells filled with a saturated solution of ammonium phosphate. The cells are arranged according to the Gratz method, so as to rectify both halves of the current wave. Tests of this device showed an efficiency of sixty-five per cent. The cost of the complete installation was $340. The electrodes are twelve inches long, six inches deep, and one-eighth of an inch thick, and consist of an alloy of zinc and aluminum. This device gave no trouble whatever as long as the temperature did not exceed 120 degrees Fahrenheit. To prevent this occurring, a small fan is mounted at the side of the case, so as to force a draught of air through the device. The efficiency is well maintained up to this temperature, but beyond that begins to fall rapidly. As the device is constructed there is said to be no danger of an excessive temperature rise. The size overall, of the case, is three feet nine inches by two feet four inches by four feet ten inches high.—*Abstracted from the Electrical Review (London), February* 10.

Measurement of High Temperatures in the Electric Laboratory.

An easily constructed pyrometer is here described by M. Georges Rosset. The author first discusses the usefulness of the ordinary forms of pyrometer, and lays stress upon the necessity of determining accurately high temperatures which are so frequently used in research and in industrial laboratories. Those who can not afford the commercial instruments may construct a simple and cheap, but reliable, pyrometer, in the following way: the couple is made of a platinum wire and a ten per cent platinum-rhodium wire. The two wires are soldered together and enclosed in any convenient form of protecting tube. For measuring temperatures, a sensitive galvanometer is desirable, but, when this is not available, a millivoltmeter may be employed with sufficient accuracy. To calibrate the instrument, the following temperatures are useful:

	Degrees C.
Water boils	100
Naphthaline boils	218
Zinc melts	420
Sulphur melts	445
Aluminum melts	655
Sodium chloride melts	800
Zinc boils	930
Gold melts	1,065
Copper melts	1,085
Platinum melts	1,780

The reading for the latter temperature is obtained when soldering the couple together. Plotting the galvanometer deflections and temperatures on rectangular coordinates, practically a straight line is obtained, which allows the temperature for any deflection to be interpolated readily. It should be noted that every individual couple must be calibrated, and the process must be repeated every time the solder of the couple is melted or broken. If the platinum and platinum-rhodium wires are not available, other

Digitized by Google

materials which are to be found in every laboratory may be employed. Iron, German silver, nickel, or nickel-steel wires, which are commonly used for constructing resistances, give fairly high thermoelectric forces, and may be used in constructing fairly satisfactory pyrometers.—*Translated and abstracted from Centralblatt für Accumulatoren (Gross-Lichterfelde-West), February* 1.

The Arc in a Magnetic Field.

An investigation of the effect of a magnetic field upon the Voltaic arc has been carried out by Mr. C. D. Child, who here gives the results of his study. The first experiment consisted in placing two carbon pencils at diametrically opposite points of the arc, so that the effect of the magnet is to blow the arc out toward one pencil. To measure the effect, a millivoltmeter was used, and readings indicating a difference of potential of approximately three volts were obtained. Measurements with an electrometer gave approximately the same results. To test whether the effect was due to unsuspected causes, measurements were made between the carbons of the arc and the carbon pencils. The results agreed with those previously obtained. It should be said that that pencil toward which the arc is deflected becomes positively charged. To eliminate effects due to the varying voltage of the arc itself, a commutator was arranged, which rapidly reversed the direction of current through the arc and the voltmeter. A deflection of the millivoltmeter was obtained, agreeing with the first readings. To test whether the effect was due to the magnetic action or to the mechanical displacement of the arc, the latter was blown to one side by means of a current of air. In this case readings were obtained on the voltmeter or the electrometer, but they were uncertain both in direction and in amount. The effect in this case seems to be due to the difference in temperature of the two carbon pencils. In another arrangement an oscillating fan was placed so as to blow the arc alternately in two directions. The voltmeter connections were changed at the same time. No deflection of the voltmeter was observed. Varying the rapidity with which the current through the arc was reversed produced but little effect on the deflection of the voltmeter, and this may be attributed to the inductance of the electromagnet and the voltmeter. Exploring the field around the arc by means of the pencils gave uncertain results. In this case the carbons were unequally heated. The current through the arc was varied from five to twenty-five amperes without obtaining any change in the difference of potential between the two supporting pencils. Changing the length of arc, however, did change the results, for with a length of arc of three millimetres, the current being twelve amperes, the potential difference between the pencils was 1.7 volts. When the length of the arc was nine millimetres, the difference of potential between the pencils had risen to three volts. When the strength of the magnetic field was varied by varying the distance of the solenoid from the arc, the difference of potential between the pencils varied with the field. The effect depends largely upon the kind of carbon used: when salts are added to the carbon it is greatly reduced, and may even disappear entirely. The effect took place with the arc in a vacuum. The difference of potential between the pencils decreased with decreasing pressure of the gas. The common equation for the Hall effect does not apply to this phenomenon, since there is here a motion of the ions traverse to the direction of the impressed electromotive force. The effect may be explained by assuming that the positive ions move more rapidly than the negative ions.—*Abstracted from the Physical Review (Lancaster), February.*

The Mercury Arc.

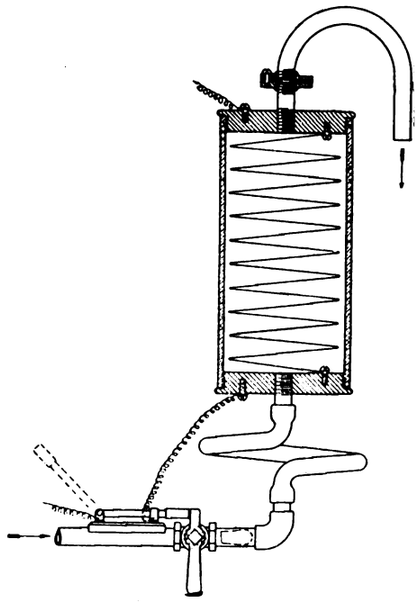
A brief summary is here given by M. D. de Valbreuze of the principal results obtained from the application of the electric arc in mercury vapor. The most important application is that of lighting, and the different types of lamps are described and criticised. The most satisfactory method of starting is held to be that in which a short-circuit is produced by means of a thin column of mercury which flows from one electrode to the other. When this breaks, the arc is started. When this method is used, precaution must be taken to prevent the breaking of the tube, due to the shock of the mercury. This is done by inserting in the bulbs bundles of iron wires, which break up the mercury and prevent a shock. The author thinks that the life of these lamps will be less than that which is usually given, for it is impossible to drive off all the occluded gases from either the iron electrode or the mercury. The purest mercury obtainable should be used. The condensing chamber of the lamps should be large, so as to maintain the current steady. The objection to the color has not been overcome, as no satisfactory method of adding the needed red rays has been found. Attempts to add other metals to the mercury have failed; nor have endeavors to make use of fluorescence had any better result. Neglecting the objection to the color, the light is held to be very satisfactory and very easy on the eyes. The lamp has high actinic value, and thus can be employed in therapeutics. In this case it is desirable to make the enclosing-vessel of quartz. The high-frequency mercury-vapor interrupter has not yet been applied in practice, but the use of the mercury-vapor arc as a simple interrupter for alternating currents promises well, though its application will be limited to small currents. No actual instance of such use is known to the author. The operation of the mercury-vapor rectifier is explained. It is usual to attribute this action to the dissymmetry of the electrode, but M. de Valbreuze holds that this is not correct, for a rectifier may be made in which all the electrodes are formed of mercury. It is held that when an arc is once started through mercury vapor, it tends to persist in the same direction, and current can not pass through in the opposite direction unless a fresh start is made. With an alternating current between electrodes of carbon, the current may flow in either direction after its passage through zero, because the electrodes are maintained at a temperature high enough for the emission of negative electrons from the cathode. On the contrary, with electrodes of mercury the temperature is uniformly in the neighborhood of 150 degrees after the passage of the current through zero, although the temperature at the base of the arc must have been sufficient to raise the mercury to yellow or white incandescence. In order that the current may flow in the opposite direction after having changed sign, the electrode must be in such a state that the arc can pass without a fresh starting. While the dissymmetry of the electrodes contributes some, the other effect is the principal one. The great difficulty in the general use of this apparatus is that of preventing an increase in the temperature of the rectifier, and a consequent increase in pressure in the interior of the globe.—*Translated and abstracted from L'Eclairage Électrique (Paris), January* 28.

The production of Lake Copper in January is returned at 18,483,880 pounds. Of this amount the Calumet & Hecla has to its credit 6,800,000 pounds, and the balance came from seventeen other mines. —*Copper Gossip.*

Digitized by Google

Electrical Patents.

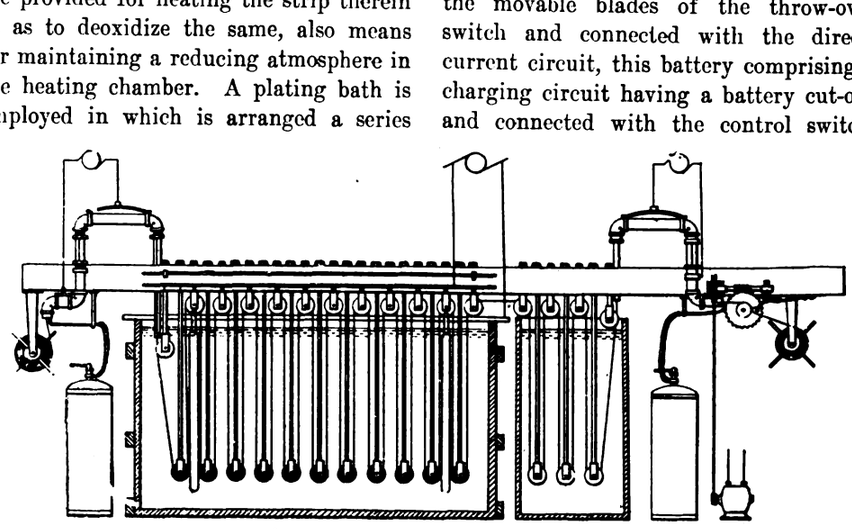
An electrical water heater has been recently patented by Milton H. Shoenberg, of San Francisco, Cal., and assigned to the Shoenberg Electric Appliance Company, of the same place (782,525, February 14, 1905). The invention consists of an insulating heating chamber



ELECTRICAL WATER HEATER.

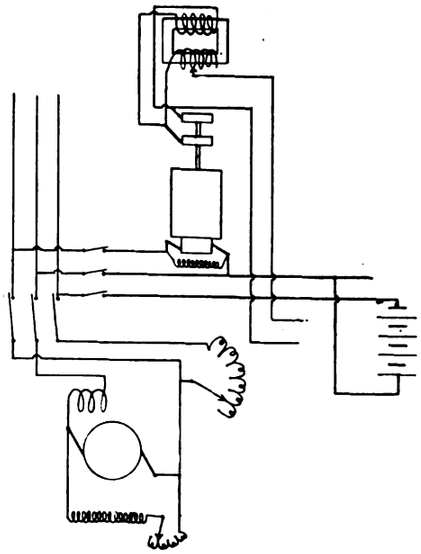
having supply and discharge passages at opposite ends, and an electrical conductor located within the chamber and immersed in the liquid to be heated. In carrying out the invention, an electrical water heater is provided and an insulated chamber through which an electrical resistance coil extends. Conducting wires are employed by which an electric circuit may be established through the coil. A controlling switch is provided for the circuit. Connecting with opposite ends of the chamber are insulated water supply and discharge pipes, the water supply being controlled by a cock or faucet. A switch member is in the electric circuit and is movable into and out of the range of action of the faucet, whereby the faucet is prevented from closing while the electrical switch is closed.

An apparatus for nickel-plating has been recently devised and patented by Jonas W. Aylsworth, of East Orange, N. J., and assigned to the Edison Storage Battery Company, of Orange, N. J. (781,867, February 7, 1905). The invention relates to improved apparatus for nickel-plating after the manner of the process described in the patent to Thomas A. Edison, No. 734,522, of July 28, 1903, wherein the nickel film electrolytically deposited on the iron or steel surface is welded thereto by heat in a non-oxidizing atmosphere, whereby the plated coating is relieved of any condition of tension and is practically homogeneously united to the sheet, plate, or other article. The object of the invention is to provide an apparatus which will permit such a process to be carried on continuously, the article or articles being electroplated and the deposited coating being subsequently welded by successive automatic operations, whereby previously nickel-plated articles will be subjected to the welding operation simultaneously with the plating of successive portions of the same article or successive articles. Improved facilities are also provided for automatically washing the plated articles subsequently to the plating and previous to the heating thereof, and it also provides improved means for treating the articles previous to the plating so as to remove any film of oxide or grease, which would interfere with or reduce the character of the deposited coating. Means are also employed for electrically heating the articles for the purpose of welding the deposited coating thereon, although the heat may be applied in other ways. The deoxidizing or cleaning of the articles can also be effected by electrically heating them in a reduced atmosphere. The apparatus comprises a heating chamber containing a reducing atmosphere through which the strip passes. Means are provided for heating the strip therein so as to deoxidize the same, also means for maintaining a reducing atmosphere in the heating chamber. A plating bath is employed in which is arranged a series of pulleys over which the strip runs. A second heating chamber welds the plated coating on the strip and pulleys are located in this second heating chamber, over which the strip runs. Means are provided for heating the strip in the second heating chamber and also means are employed for maintaining a non-oxidizing atmosphere therein.



APPARATUS FOR NICKEL-PLATING.

An electric system having particular relation to alternating and direct-current systems which may be used for train lighting or other purposes has been devised and patented by Horace Dowie, of Brooklyn, N. Y. (203,828, February 14, 1905). In this system there are employed



ELECTRIC SYSTEM.

an alternating-current circuit and a direct-current circuit of normally higher potential. A solenoid is connected to the alternating-current circuit. An automatic throw-over switch comprises movable contacts permanently connected with fixed contacts. A storage battery is connected to the contacts cooperating with the movable blades of the throw-over switch and connected with the direct-current circuit, this battery comprising a charging circuit having a battery cut-out and connected with the control switch. The throw-over switch comprises a solenoid energized through the control switch and throwing the load into connection with the alternating-current circuit when the circuit is properly energized. The control switch is normally drawn into contact to throw the load into connection with the direct-current circuit and the storage battery when the alternating-current circuit is not properly energized.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Best Manufacturing Company's Valves.

The Best Manufacturing Company, Pittsburg, Pa., makes a number of steam specialties which are shown in the accompanying illustrations. In Fig. 1 is shown the Best patented, adjustable, wedge gate valve.

The adjustable wedge is of the same form as the solid taper wedge, except that it is in two parts, there being a ball joint on the inner surfaces around the entire circumferences of the wedges, thus ensuring a positive seating and being at all

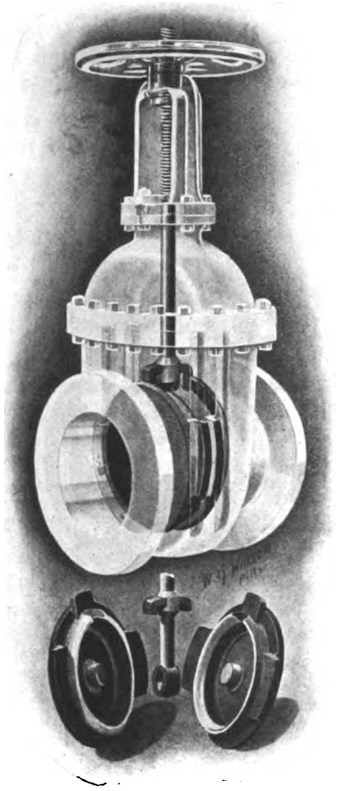


FIG. 1.—BEST ADJUSTABLE WEDGE GATE VALVE.

times absolutely adjustable. This also ensures the taking up of the wear, the renewable feature making the valve very durable. There are rails or guides cast in the body on either side, and wings cast on either side of the wedges which fit inside of the guides or rails in the body; this absolutely prevents any possibility of the valve becoming disarranged. It will also be noted that there are wings cast on the top edge of the wedges, and also a collar with guides, cast on the spindle. The Best adjustable wedge gate valves are so constructed that they have no more parts than a solid taper wedge gate. The wedges have bronze facings and the bronze seats are screwed up in such a manner as to leave no pockets in the rear for the

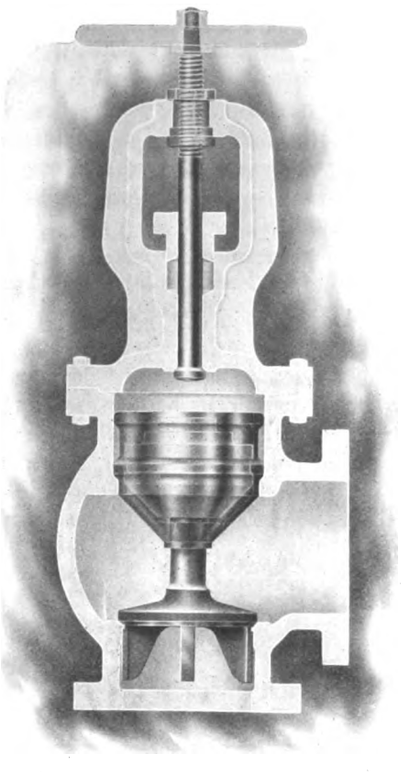


FIG. 2.—ANDERSON CUSHIONED NON-RETURN VALVE.

water and steam to attack the threads. The method of seat construction avoids some of the alleged bad features of gate valves. The correct mechanical construction of these valves makes them especially fitted for all classes of service, and particularly high pressure and superheated steam service.

The Anderson cushioned non-return

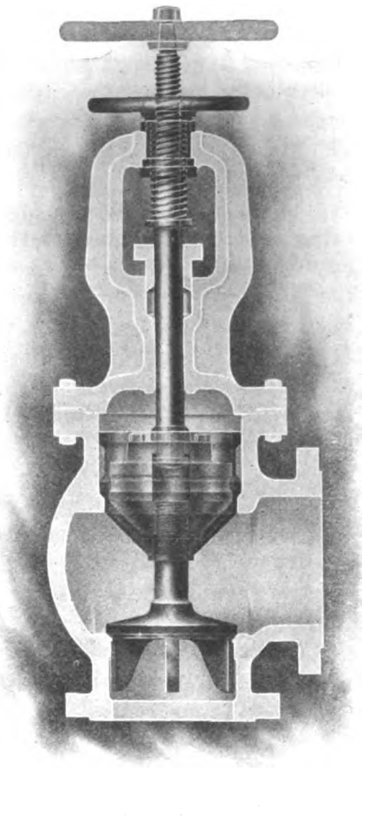


FIG. 3.—ANDERSON COMBINATION CUSHIONED NON-RETURN VALVE.

valve is shown in Fig. 2. This valve, when placed between the boiler and header, will equalize the pressure between the different units of a battery of boilers. They remain closed as long as the boiler pressure is lower than that of the header. When

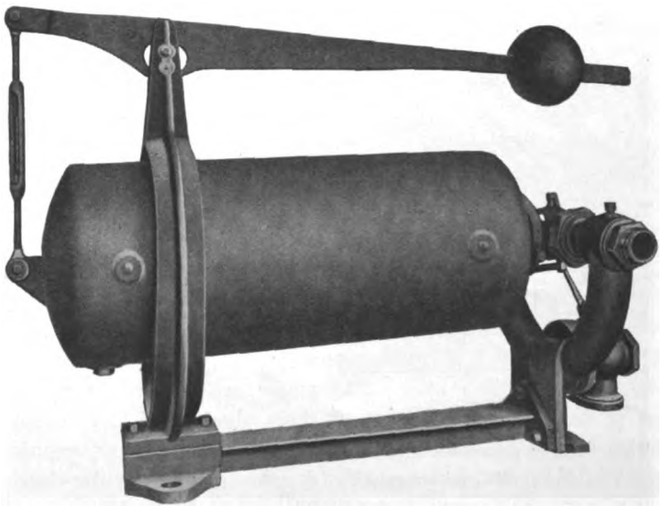


FIG. 4.—BEST HIGH AND LOW PRESSURE TILTING STEAM TRAP.

Digitized by Google

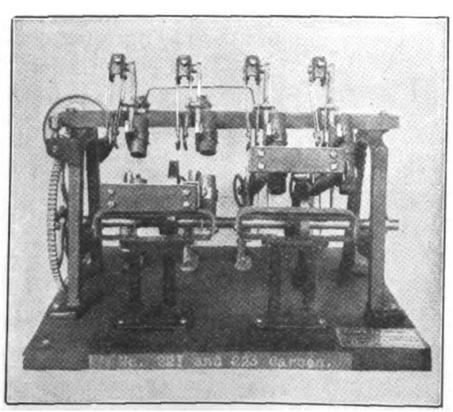
the boiler pressure equals the header pressure, they open and will remain in that position without chattering or hammering. They will automatically cut off a boiler in case of accident to the boiler, such as the bursting of a tube, and will also act as a safety stop to prevent steam being turned into a cold boiler while men are working inside. The cut shows plainly the perfect dash-pot arrangement for cushioning these valves, which is so essential in order to avoid the chattering and hammering existing in this class of valves. The Anderson combination cushioned non-return valve, shown in Fig. 3, is the same as the Anderson cushioned non-return valve, with the additional mechanism to open the valve and hold it in that position if desired by simply operating the small auxiliary hand-wheel.

The Best high and low-pressure, tilting, steam trap is illustrated in Fig. 4. The trap is positive in action at all times and can not get out of order. The discharge is prompt, speedy and practically noiseless. All working parts are bronze and easily removed when necessary. The traps are thoroughly tested under varying conditions for high and low pressures.

Dull's Carbon Type Flasher.

The Reynolds-Dull Flasher Company, 177 Adams street, Chicago, is placing on the market a new type of sign flasher for making and breaking the circuits of electric displays and signs. The illustration herewith shows a machine of the two-circuit size, but the flashers can be furnished in sizes from one to six circuits for either two or three-wire systems.

For handling heavy currents it is



DULL'S CARBON TYPE FLASHER.

claimed that this flasher possesses marked advantages as the "make" and "break" of the circuits fall on carbon points which are less susceptible to injury by the arc than is the case with metal contacts.

Standard five-eighths-inch light carbons are used, which by the action of the flashers are subsequently relieved by metallic contacts. These contacts receive the load without arching and on the break are first released. The carbon finally breaks the circuit and all burning incidental to the arc falls on the carbon contacts. The use of auxiliary metallic contacts prevents heating of the carbons and reduces their deterioration.

This improvement is of value as the natural properties of both sides of contacts are employed to prolong the useful life of the machine.

It is claimed that these machines are practically noiseless and require only a very small amount of power for their operation.

Portable Electrically Driven Grinders and Drills.

The accompanying illustrations show a few of the specialties in portable electrically driven grinders and drills manufactured by the Hisey-Wolf Machine Company, Cincinnati, Ohio. This company

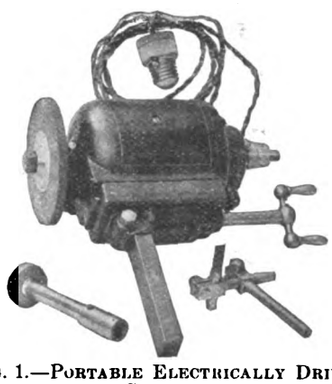


FIG. 1.—PORTABLE ELECTRICALLY DRIVEN GRINDER.

devotes its entire attention to the building and perfecting of this form of apparatus. The company makes its own motors, and also all parts pertaining to the apparatus. Each machine is thoroughly tested by actual use before leaving the shops, and the company feels that it can guarantee the apparatus in every way.

Fig. 1 shows a portable electrically driven grinder. The standard motor grinders are wound for 110 and 220 volts, direct current. When required, however, they may be wound for from 70 to 250 volts. All the parts pertaining to the motor are encased in the shell, making them dust-proof. The spindle carries taper cone bushings running in three-degree and forty-five-degree bearings. They are adjustable to wear by means of a nut on the rear end of the spindle, and are provided with dust-proof caps.

The V-slide has a three-inch travel by means of a worm through the handle and is fitted with a gib to take up the wear. The shank is of steel, and is fitted to the hole in the V-cap. It is held in position with a screw so that different sizes of shanks may be used. An extension mandrel is used for internal

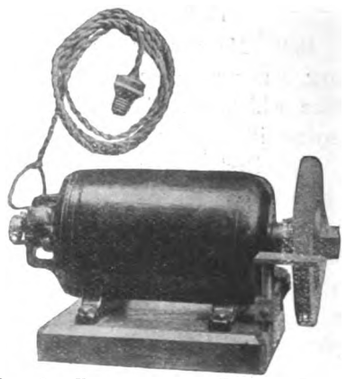


FIG. 2.—ELECTRICALLY DRIVEN BENCH GRINDER.

grinding by removing the regular wheel and attaching the mandrel in its place. The tooth rest is a valuable attachment, serving as an index for cutter and reamer grinding. Power is secured for this grinder from any incandescent light socket.

Fig. 2 shows a portable electrically driven bench grinder. This may be utilized for grinding, buffing and polishing, as the emery wheel can be removed, and any other wheel substituted. This apparatus is made in three sizes—styles E, F and M. One wheel and detachable wheel rest are included with each machine.

Fig. 3 shows a portable electrically driven hand or breast drill. The motor is provided with a switch to start and stop the drill, located near the vertical handle, as may be seen from the illustration. In operation, the switch is easily reached by the index finger. The chuck spindle is so arranged as to allow drilling on the line with the base of the motor, by this means permitting angle and corner drilling.

The motor is enclosed, and suitably

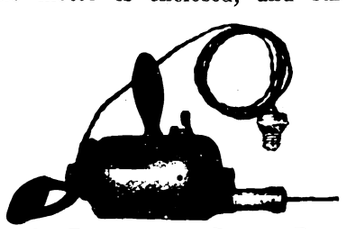


FIG. 3.—ELECTRICALLY DRIVEN BREAST DRILL.

geared to develop the necessary power up to the capacity of the drill. Being light in weight, the apparatus may be carried anywhere, and the operation is only limited by the length of cord which may be employed.

Archibald B. Rush, 120 Liberty street, New York city, is eastern representative of the manufacturer.

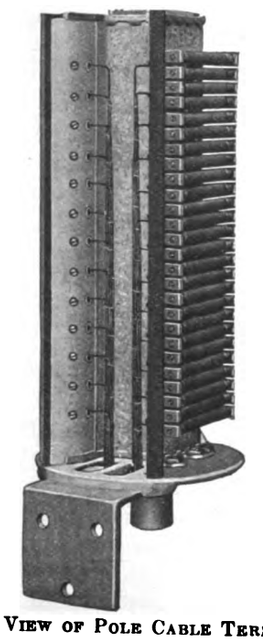
Digitized by Google

Pole Cable Terminals.

Frank B. Cook, 249 West Lake street, Chicago, Ill., has made a number of radical improvements in his pole cable terminals. His type S. A. terminal is a

POLE CABLE TERMINAL WITH COVER.

combination of the tubular line fuse and carbon lightning arrester, mounted upon a galvanized sheet cable box. This is provided with a bracket so that the terminal



REAR VIEW OF POLE CABLE TERMINAL.

can either be attached to the cable pole or cross-arm. A sliding galvanized cover thoroughly protects all parts from the weather. A heavy cast-iron box was originally used for these terminals, but the sheet metal box now used reduces the weight considerably and makes connections easier of access.

The type T. A. terminal is for use exclusively with potheads. It is of the same size and exterior appearance as the type S. A. There is a difference in mounting, however, as hard maple strips are employed in place of the sheet-metal cable box, the tubular fuses and carbon lightning arresters being mounted on these strips. The strips are rigidly attached to the bracket.

With either of these terminals it is not necessary to use a pole house or balcony. The galvanized metal cover stays up when it is raised, and when it is pulled down it locks automatically. The manufacturer states that these terminals are absolutely weatherproof and combine ease of access with efficiency and simplicity. Being constructed of metal, they will not burn. The springs which hold the tubular fuses are so arranged that it is impossible for a man to leave a loose connection. The terminals will go between the wires if desired, and it is unnecessary to move the wires or the guys.

Los Angeles-Pacific Railroad.

Owing to the greatly increased traffic on the interurban railway system of the Los Angeles-Pacific Railroad Company, the officers of that company have decided to increase the capacity of their central power-house at Vineyard and to install an additional substation in Los Angeles. The new electrical equipment has recently been contracted for with the Crocker-Wheeler Company, Ampere, N. J., through its Pacific coast managers, the Abner Doble Company, of San Francisco. The contract comprises one 1,200-kilowatt, three-phase, fifty-cycle, 2,300-volt, engine-type generator with a speed of 125 revolutions per minute; one 300-kilowatt motor-generator set; one 400-kilowatt motor-generator set; three 400-kilowatt transformers; three 160-kilowatt transformers; three 120-kilowatt transformers, and a sixty-kilowatt engine-type exciter. The 1,200-kilowatt alternator will be of the Crocker-Wheeler Company's new revolving-field type, similar in construction to the three 4,000-kilowatt alternators recently ordered by the California Gas and Electric Corporation. The Los Angeles generator will be driven by a 2,000-horse-power compound, condensing McIntosh & Seymour engine. The motor-generator sets will consist of 2,300-volt synchronous motors driving 600-volt direct-current railway generators. The transformers will be built for 15,000 volts on the primary and 2,300 volts on the secondary and will be of the new water-cooled and oil-insulated type recently brought out by the Crocker-Wheeler Company.

The interurban railway system of the Los Angeles-Pacific Railroad Company is one of the most extensive in the country, embracing nearly 200 miles of up-to-date lines. The company owes its growth largely to the energetic and untiring work of the president and manager, Mr. E. P. Clark, who was one of the pioneer railway men of Southern California and who has seen his system develop from a very small beginning to its present commanding position in the traction field. The system extends from Los Angeles in a fan-shape to Santa Monica, Ocean Park, Playa del Rey, Hermosa, Manhattan Beach, and Rodondo on the ocean, and passes through the intermediate towns of Hollywood, Colegrove, Sawtelle, Sherman and Palms. In other words, the lines cover thoroughly the territory lying south of the Santa Monica mountains and between Los Angeles and the ocean. Most of the lines have been double-tracked and are constructed in conformity with the best steam railroad practice. About a year ago a new central steam plant was installed at Vineyard about five miles west of Los Angeles and from this station transmission lines at 15,000 volts carry the power to several substations located at intervals over the system.

An Automatic System of Refrigeration.

The Federal Automatic Refrigerating Company, 22 Thames street, New York city, manufactures and installs complete automatic refrigerating plants from one horse-power to ten horse-power capacity, or the equivalent of 800 to 1,200 pounds of ice refrigeration per day. The automatic system developed by this company is mechanical and purely automatic. Any desired low temperature, even to zero Fahrenheit, may be uniformly maintained in a properly constructed refrigerator or compartment. The machine and all automatic devices are controlled or regulated solely by the temperature required in the refrigerator. A special thermostat absolutely controls the operation of the motor-driven compressor. All other automatic devices are, in turn, dependent upon and regulated by the compressor in operation.

The compressor can be operated either by an electric motor, a steam, gas or oil engine, or may be belted to a countershaft. Any existing plant can be made automatic in its operation by introducing the several automatic devices and regulators manufactured by this company.

The officers of the Federal Automatic Refrigerating Company are A. M. Young, president; A. C. Dunham, vice-president; F. M. Kimball, secretary and treasurer, and J. C. Chamberlain, general manager.

Digitized by Google

Closing Bulkhead Doors by Electricity.

The Long Arm System Company, Cleveland, Ohio, has developed a system for electrically closing the doors in the water-tight bulkheads in naval vessels.

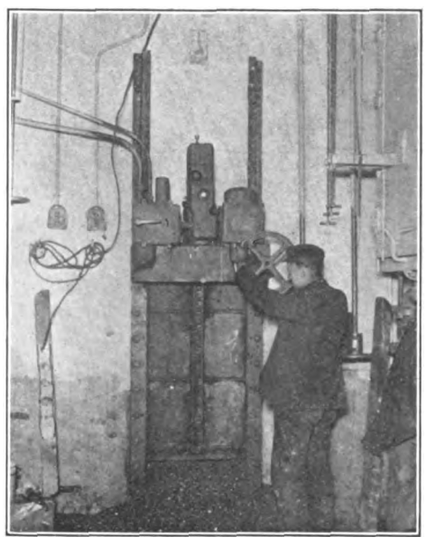
After several years of costly experimentation with pneumatic and hydraulic systems for operating bulkhead doors and armored hatches aboard warships, both systems have been abandoned by the American navy in favor of an electrical system. The first electrical installations are now in working order on the new 13,500-ton armored cruisers Colorado and Pennsylvania. Thirteen other cruisers and battleships now building will be similarly equipped.

The defects developed in the hydraulic and pneumatic systems—due mainly to the practical impossibility of keeping their valves and packings in working order—have been overcome in the electric system, and naval authorities, including many who have heretofore opposed, as necessarily ineffective, all power doors for bulkheads, have given the new "Long Arm" electrical system unqualified approval. The bad repute into which distantly controlled bulkhead doors fell at one time was brought about by the members of the crew who were likely to suffer from the operation of the power system. The first idea was to drop the heavy doors like so many guillotines; then followed the idea of closing doors slowly by air or water pressure. But in both cases it was found that the doors could not be depended upon to shut at the right moment, nor to stay open when so required, because the pneumatic and hydraulic pressure could not be perfectly maintained.

The electrical system, however, is not subject to these defects. It complies in every way with the specifications of the navy department providing that power doors or armor hatches "must be capable of permitting operation on the spot by power or by hand from either side of the bulkhead or deck," and "be capable of being closed by power simultaneously from an emergency station." It is further provided that when the doors are closed and the emergency is on, any door may be opened by a man at the door to allow him to pass through in performing his duties, but after he has passed through and released the controller handle the door will again close by the emergency action.

The mechanism of the "Long Arm" system may be outlined as follows:

1. An emergency station, located usually in the pilot house or some convenient place above the deck. 2. The power doors or hatch-gears, supplied with three independent mechanisms, namely, *a*, the switch by which a man at any door can open and close it at will from either side; *b*, the switch, operated from the emergency station, by which the door is closed upon the approach of danger. This emergency switch, although permitting absolute control, may have its operation suspended temporarily by the hand switch just mentioned. In such a case the emergency station switch will close the door as soon as the hand controller is released; *c*, the limit switch, by means of which the current supplying the motor which provides the power for closing and opening the doors, is cut off when the door has closed and locked, or has encountered an obstacle to full closure. This switch has mechanical connection with the door or hatch-plate and is so arranged that it will



TYPE OF VERTICAL DOOR OPERATED BY THE "LONG ARM" SYSTEM OF ELECTRICAL CONTROL, SHUTTING OFF COAL BUNKERS FROM THE ENGINE ROOM, U. S. ARMORED CRUISER COLORADO.

cut off the current from the motor, and thus prevent blowing out of the fuses. An interesting improvement of this part of the mechanism is one by which the switch is made to again close the circuit to the motor and thus start the door toward its grooves after an obstruction is removed, *e. g.*, when an inflow of water washes away coal obstructing a bunker opening.

The door and hatch-gear motors are direct current, reversible, ironclad, bipolar, of light and compact construction for intermittent service. They are entirely enclosed in water-tight cases, and are capable of carrying large overloads without heating or injury.

The emergency station consists of two parts, one a water-tight case containing the mechanism for controlling the circuit running to each door or hatch-gear for closing the same, and the lamps to indicate the closure; the other, a case containing the fuse box, in which each wire is supplied with the proper fuse.

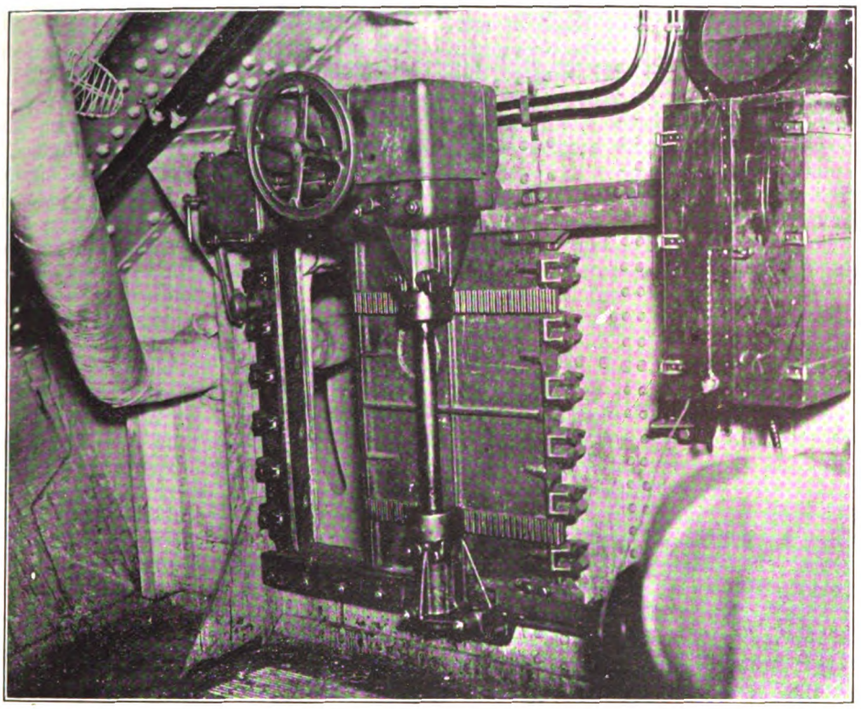
The wiring required for a complete installation of the system is very simple. It comprises one twin conductor by which the emergency station is connected with the ship's mains; one twin conductor by which the controller on each door and hatch-gear is connected with the emergency station, and one twin conductor connecting the controller on each hatch-gear or door with the ship's mains. Here, as in other parts of the system, great simplification has been worked by replacing pneumatic and hydraulic power by electricity. The latter added another set of complicated machinery to the ship's equipment, while the electric system calls for nothing more complicated than connection with the electrical mains necessary for other purposes.

The operation of the "Long Arm" system is as follows: suppose that a vessel is in danger of being rammed, or that her hull has been punctured in some way. The officer of the deck or the one first aware of the danger will close the switch at the emergency station, immediately releasing the gearing driven by a spring and controlled by an adequate escapement. This gearing then closes the circuit for operating the emergency switch in the controller of each door or hatch-gear. It does not start all the motors at the same time, thus avoiding the necessity for a large supply of current. It starts the doors one after the other at intervals of about three seconds, so that twenty-five doors and hatch-gears can be closed in seventy-five seconds from each emergency station without more than six motors being in operation at any one time.

As each door makes a complete closure it automatically completes the circuit running to the emergency station and is there connected with a small incandescent lamp, located back of each of the discs around the edge of the emergency station. Each disc is numbered to correspond to a door, so that the officer in charge can tell by a glance at the station whether or not all the doors have closed. If any one door or hatch-plate has not closed the fact is immediately observed, and the location of the trouble is known by reference to a diagram at hand showing the location of all the power doors and hatchways.

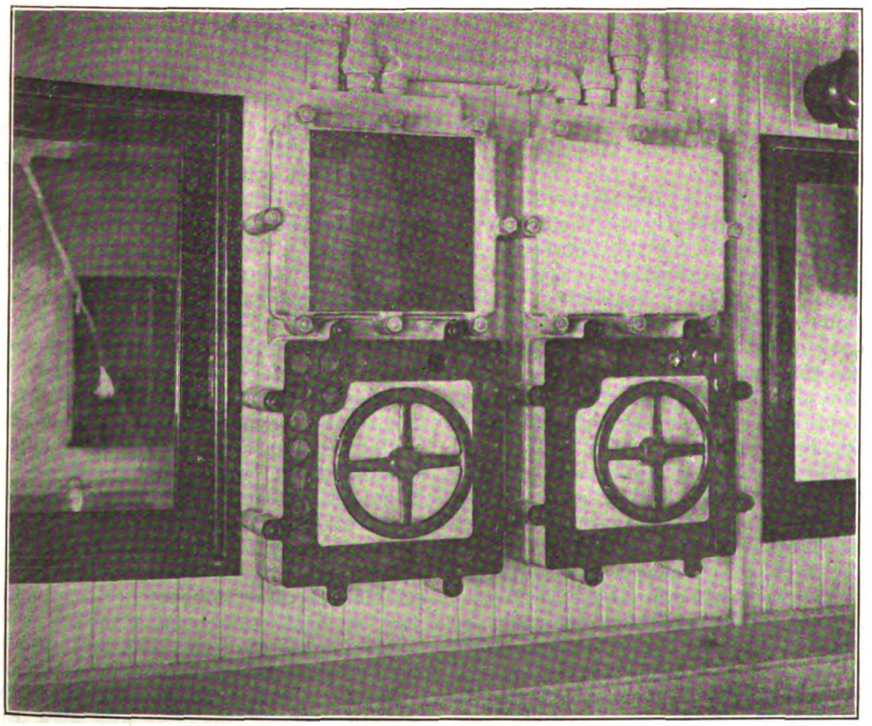
Digitized by Google

Whether the emergency is "on" or "off" is indicated by a red light shining through one of the lower discs of the station.



HORIZONTAL BULKHEAD DOORS WITH ELECTRICAL CLOSING DEVICE, U. S. ARMORED CRUISER COLORADO.

The navy department has subjected this system to the severest possible tests before approving it. The results of these tests are shown in the fact that similar equipment is called for in the specifications for the last three of the men-of-war authorized by the United States government. The principal feature which has excited the approval of practical naval officers is that this device secures the confidence of the members of the crew stationed in the immediate vicinity of the power doors, the same men who had so little confidence in the hydraulic and pneumatic systems that they invariably tampered with the mechanism in such a way as to defeat its purpose completely. The combination of perfect local control with the certainty which the electrical system gives that the doors will not suddenly drop, mainly accounts for this confidence.

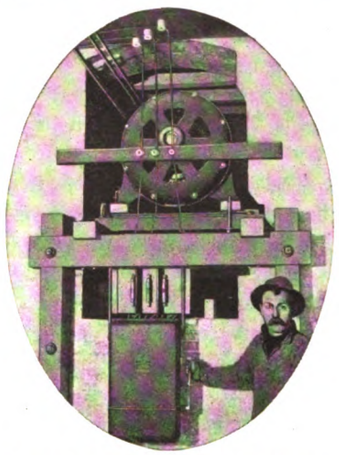


EMERGENCY STATION, "LONG ARM" SYSTEM, U. S. ARMORED CRUISER COLORADO.

The question of power doors is receiving attention by the admiralty departments of almost every important government in the world. The fact that H. M. S. Victoria might have been saved if her bulkhead doors had been closed has been ever in the minds of progressive naval constructors. Owing to the fact that nothing has been devised abroad better than clumsy imitations of the old hydraulic and pneumatic installations on American warships, now discarded by the American navy itself, accounts for the fact that foreign navies have not yet seen fit to call for power doors in the equipment of their new ships. It is likely, however, that several European battleships will be equipped with the "Long Arm" apparatus within a short time.

Induction Motor in a Tannery.

It is well known that the electric motor requires so little space, care and maintenance that it may be installed in very crowded and inaccessible quarters. These characteristics in which the electric motor compares so favorably with other forms of motive power are often important considerations leading to the selection of electric drive.



INDUCTION MOTOR IN A TANNERY.

Available space is seldom as scarce, however, as in the case of the Zeller tannery, at Buffalo, N. Y. In this installation, also, the spattering and slopping of the tanning liquor require that the motor be placed well out of the way of the tanning processes. The problem was solved by taking out a window in a brick partition and installing a forty-horse-power, twenty-five-cycle, 750 revolutions per minute, three-phase General Electric induction motor on a wood framework set in the space thus provided, as shown in the accompanying illustration.

Digitized by Google

An Important Decision Sustaining the Tesla Patents.

On February 20 Judge Seaman, in the United States Circuit Court for the Eastern District of Wisconsin, handed down a decision sustaining the Tesla patents owned by the Westinghouse Electric and Manufacturing Company. The defendant was the National Electric Company, and infringement was claimed of the broad rights covered in Tesla patents Nos. 381,968, 381,969, 382,280 and 382,281. Judge Seaman, in Milwaukee, on February 24 enjoined the defendant company from the further sale of synchronous motors. The decision in the suit is the first that has been obtained in the litigation begun some time ago by the Westinghouse company to prevent the sale of synchronous motors and rotary converters by American manufacturers not enjoying a license under the Tesla polyphase motor patents. A decision is pending in the United States Circuit Court for the Southern District of Ohio in the suit brought by the Westinghouse company against the Bullock Electric Manufacturing Company, alleging infringement of the same patent rights. The final hearing in the latter suit was conducted before Judge Thompson, in Cincinnati, on February 7 and 8.

The Tesla patents involved in these suits have been the subject of considerable litigation in the past few years. The action instituted by the Westinghouse company a number of years ago against the Thomson-Houston Company, for alleged infringement of the Tesla patents, was discontinued upon the execution of a patent agreement under which the General Electric Company has for several years manufactured and sold induction and synchronous motors and rotary converters. A number of manufacturers have been enjoined from manufacturing induction motors, but the decision by the Wisconsin court is the first court ruling that the synchronous motor is within the generic Tesla invention. Judge Seaman's decision, covering the main points, is as follows:

"With the excellent and thorough review of the earlier patents and prior art, and the well considered concurrent view of the novelty and scope of the Tesla invention covered by the patents (thus appearing in several of these opinions) I am relieved of any need to attempt an analysis of the general showing in the present case, which departs from the prior cases only in respect of the application of the invention of the synchronous-motor type. Although the enquiry thus presented is not free from difficulty—involving abstruse discussion and distinctions in the electrical art which are perplexing to the non-expert understanding, and are not clarified by the many pages of conflicting expert testimony—the arguments at the bar were clear and well directed, and I am convinced that the issue as now presented is within narrow compass and governed by tests for its solution which are not complicated.

"The defendant's contentions are, in substance, that the Tesla invention, embodied in each of the patents, is the rotating field mode of operation, which is 'the production of the conjoint effect of out-of-phase currents of a progressive shifting by the polarity,' and thus 'identical in its effect with that of a rotating physical magnet;' that it is limited to a self-starting motor so operated and both by the terms of the patents and the state of the art, the defendant's synchronous motor with direct-current excitation is not within the invention; that the defendant's synchronous motor is simply a reversed 'two-phase alternating-current dynamo of the prior art used as a generator,' adapted to alternating use; and that the claims of patents 381,969 and 382,281, which bring in 'direct-current excitation producing synchronous operation,' must be limited to such use 'after the motor is started by the Tesla means and method and brought up to speed.' If the invention is so limited by the prior art it is plain that the defendant escapes infringement. On the other hand, if not so restricted, it is equally clear that the patents are broad enough to reach the defendant's means and methods of operation.

"The Tesla discovery for which these patents were granted revolutionized the art of electrical power transmission, as well demonstrated in the record from both judicial and scientific standpoints. Judge Townsend's definition in reference to the generic patents in the New England Granite case, repeatedly approved by other courts, is adopted for this consideration, namely, 'Tesla's invention, considered in its essence, was the production of a continuously rotating or whirling field of magnetic forces for power purposes by generating two or more displaced or different phases of the alternating current, transmitting such phases, with their independence preserved, to the motor, and utilizing the displaced phases as such in the motor.' So viewed the patent monopoly was rightly granted for its brief term to the use of the means and methods thus discovered. While it could not exclude the known uses of the prior art, it is surely entitled to be protected against like motor structure and mode of operation, not clearly disclosed in the prior art, and the patent claims to that end must be fairly construed in conformity with the rule applicable to such inventions. I am of the opinion, therefore, that the several contentions for the defendant are either without force or untenable for the following reasons:

"Whether the effect of the Tesla invention in its production of the 'whirling field of magnetic force' is identical with that of a rotating physical magnet, as argued by experts and counsel, does not impress me as material to this issue. Nor does it seem material that in the one form of motor 'the rotation is produced by the unaided effect of alternating out-of-phase currents,' as described by counsel, and that so applied a self-starting motor is obtained. The discovery was of means and method in the polyphase rotating field motor to produce the whirling field of force, and employment thereof was patentable with or without direct-current excitation of the armature or secondary element. So the fact that its use produced a self-starting motor without the aid of such excitation can not alone serve to limit the invention to that effect, and I find no such limitation in the terms of the patent. The quotations from the arguments of counsel and experts for the complainant in prior cases, urging the distinction of this self-starting effect in reference to the application of the generic patents to non-synchronous motors, are without force in the present controversy, and it is unnecessary to ascertain their consistency or inconsistency with the interpretation sought on this hearing. Unless limitation to self-starting motors arises out of the prior art none can be imposed upon the claims in suit.

"The further propositions urged by way of defence—aside from the defence founded upon prior inventions of the synchronous type to be considered—are these (1) that the synchronous motor of the defendant is the old generator of the art, simply reversed; and (2) that the Tesla invention is not present therein, because (as asserted) 'the prepondering magnetization of the' direct current displaced and obliterates the 'shifting alternating-current magnetization,' or Tesla 'whirling field of force.' However specious both propositions appear on their face and in the argument, neither of them impresses me as controlling.

"I believe that no proposition in the able and extended arguments on the part of the defence have been overlooked in my consideration of this case, although it has not seemed needful to discuss all of them for the purposes of this opinion. My conclusions are that the defendant's synchronous motor structure and operation are within the generic invention as patented, and expressly covered by the claims of Nos. 381,969 and 382,281; that the invention is utilized in the defendant's motor operation, notwithstanding the introduction of direct-current excitation to make it synchronous, in lieu of the full realization of the revolving field effect for self-starting; that such supplemental aid does not escape infringement, with or without advantage in such associations; and that, in any view the combination patents referred to are not limited to after-effect of the direct-current excitation, but apply to the defendant's combination. Decree will be entered accordingly as prayed in the bill."

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

APPROPRIATION FOR CITY LIGHTING PLANT IN NEW YORK—The board of estimate of the city of New York, on Friday, February 24, appropriated $600,000 to buy a site and begin construction of a municipal electric lighting plant. Sites are recommended either on Blackwell's Island or on the bank of the East river, near the island.

BUFFALO TRACTION DEAL—Henry J. Pierce, of Buffalo, N. Y., and Nelson Robinson, a New York capitalist, and others have bought control of the International Traction Company, of Buffalo, N. Y., which is the holding company of the International Railway Company. The International Railway Company was organized February 20, 1902, when it took over the property of the old local company and also the Buffalo & Niagara Falls and other suburban lines. W. Caryl Ely, formerly of Niagara Falls, was elected president, and has continued in that office down to the present. Mr. Pierce is the president of the Chamber of Commerce of Buffalo.

STATION CHANGES IN THE INTERBOROUGH RAPID TRANSIT COMPANY'S SYSTEM—Because of the great pressure of traffic at the local subway stations between Brooklyn bridge and Ninety-sixth street and the limits of the combination express-local service the Interborough company, through August Belmont, its president, has requested the Rapid Transit Board to consider the lengthening of local platforms so as to permit the use of eight or ten-car trains, instead of the five or six-car trains that have been run thus far on the local tracks. It is expected that the board will take the matter up in the near future, so as to allow work to be begun as soon as the weather makes excavation practicable. It is expected that the work will involve the expenditure of about a million dollars.

TENNESSEE POWER PLANT—It has been announced that a lock and dam power plant, which will produce 30,000 horse-power, will be erected at a point in the Tennessee river, near Kelly's Ferry, Chattanooga, Tenn. For some time government dredging boats have been busily engaged in dredging the river at Kelly's Ferry to determine the kind of foundation which may be secured for the dam. It has been found that a stone foundation is located in the bottom of the river, near Kelly's Ferry, and there the lock and dam power plant is to be erected by C. E. James, of Chattanooga, and eastern capitalists. The Iona Cement Works, of Kansas, has purchased valuable lands near the site of the proposed lock and dam power plant, and a cement plant will be erected there with a capacity of 100 barrels per day, as soon as sufficient power can be secured to run the plant. It is given out that work will actually begin on the lock and dam power plant as soon as the spring freshets are over.

KANSAS CITY-ST. LOUIS TROLLEY—The construction of an electric railroad between St. Louis and Kansas City is promised in about two years. The Missouri Central Railroad Company, incorporated under the laws of Missouri two years ago, with a capital of $4,000,000, and which is to be shortly increased to $12,000,000, will operate this line. The Missouri Central Construction Company, incorporated under the laws of Delaware, with a capital of $1,000,000, will construct the line. Daniel F. Lewis, formerly connected with the Brooklyn Rapid Transit Company, is president of the latter company. The officers of the Missouri Central Railroad are: George B. Harrison, of Glasgow, Mo., president; Edwin W. Price, of Keytesville, vice-president; Howard Ellis, of New Florence, secretary, and Charles A. Lewis, of Kansas City, general counsel. The board of directors includes the officers named, with Daniel F. Lewis, of New York; Foster M. Voorhees, former governor of New Jersey; Edward Johnson, president of the People's Trust Company, Brooklyn; Walter Brownly, of Brooklyn; E. W. Grant, of Fulton, Mo.; the Rev. Dr. S. F. Taylor, of St. Louis, and Colonel W. H. Chase, of Toledo.

THE PLANS OF THE NEW YORK, WESTCHESTER & BOSTON RAILWAY COMPANY—Announcement has been made that the New York, Westchester & Boston Railway Company has reached an understanding with Mr. August Belmont, president of the Interborough Rapid Transit Company, whereby a terminal station for the interchange of traffic between the subway and the Westchester lines will be erected at some point between 149th and 170th streets. This arrangement will make the Westchester railroad practically an extension of the subway on the east side of the borough of the Bronx. The company is to furnish rapid transit to the upper section of New York city and Westchester County. The general supervision of the construction of the road will be under the direction of Mr. Samuel Hunt, vice-president of the company. The railroad will consist of four tracks on both the main line and branches, and will be built over right of way fenced in, and with no grade crossings on streets, highways, private roads or railroads. Ninety-pound rails will be used, laid upon tie-plates on oak ties, ballasted throughout with broken stone. The cars will be built of steel and fireproof material, vestibuled at each end. The full board of directors is as follows: William Lanman Bull, president; Samuel Hunt, vice-president; H. Carroll Winchester, secretary; Evans R. Dick, Charles E. Lewis, John B. Jackson, John R. McAllister, William Barclay Parsons, Robert C. Pruyn, Robert E. Robinson, Frederick E. Whitridge, Andrew Freedman and William H. Buckley.

SIMPLON TUNNEL PIERCED—The piercing of the Simplon tunnel through the Alps was completed at 7.20 o'clock on the morning of February 24. The work was commenced in 1898. The meeting of the two boring parties (Swiss and Italian) was signaled throughout Switzerland by the ringing of church bells and the salutes by cannon. President Ruchet sent congratulatory messages by telegraph to King Victor Emmanuel and Premier Giolitti, expressing the hope that the great work would further strengthen the friendship between Italy and Switzerland and add to their prosperity. The work of preparing the tunnel for a permanent way will be pushed as rapidly as possible, and it is hoped to inaugurate the tunnel about March 20. The length of the Simplon tunnel from Briga, in Switzerland, to Iselle, on the Italian side of the mountain, is about twelve miles. A very hard formation of rock was encountered at the outset on the Iselle side, which rendered necessary the construction of special machinery. After the boring had been pushed about two miles powerful cold springs were met, from which poured more than 500 gallons of water a minute, and for a time caused a suspension of all work on the Italian side. Hardly had this difficulty been overcome when about 200 feet further on a stratum of shifting material was encountered, and the further tunneling of about 150 feet required six months' time, and an expenditure of over $100,000. As the work proceeded it was found that the brickwork arch erected for the support of the finished portions of the tunnel was threatened with ruin, because of a slippery substance contained in the mountain's formation, and most of the work on the archway had to be gone over again. But the greatest difficulty encountered was last September, when hot water began to pour into the tunnel and caused a further suspension of work for several months, the temperature rising to 131 degrees Fahrenheit. On the Swiss or northern side there exists an accumulation of water which has been a constant menace to the workmen. Now that the borers have met this water can be drawn off. The Swiss and Italian governments jointly financed the tunnel undertaking, share and share alike, at the cost of $15,000,000.

Digitized by Google

TELEPHONE AND TELEGRAPH.

LYONS, N. Y.—The Wayne & Monroe Telephone Company is arranging to extend its lines further south.

FARGO, N. D.—The Tri-State Telephone Company's line between Grand Forks and Minneapolis is in operation.

GREENE, N. Y.—The Chenango Valley Telephone Company has completed a new line between Greene and Brisbin.

LONGMONT, COL.—The Colorado Telephone Company has completed a new toll line from Longmont direct to Platteville.

DAYKIN, NEB.—Money has been subscribed for the establishment of a telephone system, and work is to begin in the spring.

LISTOWEL, ONTARIO—The town council has decided to grant the Bell Telephone Company a five-year renewal of its exclusive franchise.

SHERBOURNE, N. Y.—The Sherbourne Telephone Company has extended its lines to Earlville, and will have an exchange at that place.

LEE, MASS.—Arrangements have been made to extend the farmers' telephone lines in East Lee, Tyrington, Otis, Becket and Washington.

OSWEGO, N. Y.—The Ontario Telephone Company will erect a large building in Oswego, and also purposes putting its wires underground.

LORAIN, OHIO—The Black River Telephone Company has authorized the expenditure of $15,000 for the improvement of its service in the vicinity of Lorain.

WILKESBARRE, PA.—The stockholders of the Consolidated Telephone Company have authorized a bond issue of $500,000, the intention being to use the money for improvements.

HUNTSVILLE, ALA.—A telephone exchange is being installed at Albertville, Marshall County, by the Southern Bell company. The town will be connected with Huntsville and Gadsden by long-distance telephone.

MOUNT MORRIS, N. Y.—The Mount Morris village board of trustees has granted a new franchise to the Inter-Ocean Telephone and Telegraph Company for the erection of a local telephone exchange in that town.

MANITOWOC, WIS.—The organization of a new independent telephone company has been effected. The line will traverse the Neshota road. The promoters are Charles Kiel, Henry Rohn, Fred Kiel and August Eberhardt, residents on the route.

CLINTON, N. Y.—The Independent Telephone Securities Company has purchased the plant and lines of the Clinton Telephone Company. The company operates exchanges in Clinton, Westmoreland, Paris Hill, Clark's Mills and adjacent villages.

PROVIDENCE, R. I.—The officers of the Providence Telephone Company have been reelected as follows: president, Dexter B. Potter; vice-president, Fenner H. Peckham; secretary and treasurer, Charles T. Howard; general manager, Joseph F. Beck.

DOYLESTOWN, PA.—The receivers of the Standard Telephone and Telegraph Company are having a new switchboard installed in the Yardley exchange. When this work is finished attention will be turned to the Langhorne exchange, which is also to be supplied with a new switchboard.

BOWLING GREEN, KY.—The stockholders of the Home Telephone Company elected the following officers at their annual meeting: I. F. Beard, of Huntington, Ind., president; E. B. Stout, first vice-president; W. B. Mayes, second vice-president; J. Whit Potter, treasurer; Hubert Myers, secretary; W. I. Allison, general manager.

SMITHVILLE, TEX.—At the annual meeting of the Smithville Independent Telephone Company the following directors were elected: H. C. Schumacher, J. W. Moore, W. D. Jones, Yerger Hill. The directors then elected the following officers: H. C. Schumacher, president; W. D. Jones, vice-president; J. W. Moore, secretary and treasurer; W. F. Lowen, manager.

KINGSTON, N. Y.—H. K. Rose, of South Kortright, who owns and operates nearly 500 miles of telephone lines in Delaware and Otsego counties, has bought a controlling interest in the Stamford village telephone exchange. New instruments will be installed, and it is also planned to build a supplementary circuit from Grand Gorge to Delhi, to be used principally for through business to New York, Kingston and Albany.

FINDLAY, OHIO—At the annual election of the Home Telephone Company the following officers were elected: president, E. C. Taylor, Findlay; vice-president, F. S. Dickson, Cleveland; treasurer, R. W. Judd, Cleveland; secretary and manager, George W. Vernor, Findlay; directors, E. C. Taylor, John C. Firmin and John D. Snyder, of Findlay, and J. B. Hoge, F. S. Dickson, W. T. Cary, Jr., and C. Y. McVey, all of Cleveland.

LIMA, OHIO—At the annual meeting of the Lima Telephone and Telegraph Company, D. J. Cable was reelected president and George L. Metheany secretary and treasurer. A detailed statement of the company's affairs shows over 400 new telephones placed. The directors voted to issue $10,000 additional preferred stock to bear five per cent interest, which will be placed on the market at once.

MISSOURI VALLEY, IOWA—At the annual meeting of the Interstate Telephone Company, of Harrison County, the following officers were elected for the ensuing year: W. A. Smith, president; A. Spooner, vice-president; C. J. Cutler, secretary; John Young, manager; H. M. Silsby, treasurer; W. J. Burke, of Missouri Valley; John Young and C. J. Cutler, of Modale; A. Spooner, of Mondamin, and F. M. Terry, of Little Sioux, directors.

NASHVILLE, TENN.—The annual meeting of the stockholders of the Cumberland Telephone and Telegraph Company was held recently. The report showed that thirty new exchanges were equipped and opened during the year. The net gain in subscribers was 17,569, making the total at the close of business, December 31, 1904, 121,313 subscribers. On February 1 the company made an increase of fifteen per cent in its capital stock, the increase amounting to $1,754,300.

ALBANY, N. Y.—The Frankfort, East & West Schuyler Mutual Telephone Company has been incorporated with the secretary of state to build a line from the village of Frankfort to East and West Schuyler, then to Utica, where Bell telephone connections will be made. The capital is $1,000. Directors are: Aaron Eaton, E. J. Ladd, Walter Klock, H. Robinson, H. L. Burch, S. P. Johnson, R. H. Smith, H. S. Cristman, J. H. J. Watkins, H. L. Johnson, Newell Miller, C. M. Rose and W. M. Wilbur.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company has announced that the long-distance lines connecting Pittsburg with Northern Central and Western Pennsylvania, and also Ohio and West Virginia, which have been in process of construction, are now completed. Direct lines to Wheeling, W. Va., and to Butler have also been completed. Additional lines to Johnstown and Uniontown, Pa., connecting with lines to Baltimore and Philadelphia, are now in process of construction.

LEXINGTON, KY.—At the annual meeting of the Fayette Home Telephone Company the president made an itemized statement of the finances for each quarter, and also for the entire year ending December 31, 1904. These reports showed that the net income for last year was $59,599.73 as against $55,766.80 for the year preceding. The reports also showed that after charging off operating expenses and salaries there was a net earning for last year of $29,211.31, which sum was divided as follows: interest on bonds, $14,300; charged off for reconstruction and maintenance, $11,430.17, leaving a net surplus of $3,381.14. The following officers were elected for the ensuing year: George S. Shanklin, president; A. Smith Bowman, vice-president; Charles Kerr, secretary, and J. W. Stoll, treasurer.

WASHINGTON, D. C.—The report of the Chesapeake & Potomac Telephone Company shows that the receipts from telephone earnings in the calendar year 1904 were $604,193.66, and from real estate earnings $38,989.95, a total of $643,183.61. The expenditures were as follows: general administrative expenses and taxes, $89,328.30; traffic expenses, $177,864.36; maintenance, $204,309.43; rentals and sundries, $32,751.65; real estate expenses, $38,757.65; interest charges, $83,539.21; miscellaneous expenses, $59.21, a total of $626,806.30. The net earnings from all sources were $16,377.31. The report shows that the receipts and expenditures on account of property in the District of Columbia were as follows: proceeds of company's notes, $453,600.86; construction of conduits and cables, $137,671.86; construction of poles, etc., $42,113.80; central office equipment, $273,815.20; total expenses, $453,600.86.

Digitized by Google

The value of the company's property, not including real estate, is given as $2,439,745.61.

CHARLTON, N. Y.—The Galway Telephone Company will extend its line from West Charleton to Birchton.

ELM GROVE, W. VA.—Poles have been set for a new telephone line to Fulmers, about four miles up Wheeling creek.

LYONS, N. Y.—The Wayne & Monroe Telephone Company is preparing to extend its lines through to Wolcott, to connect with the independent exchanges at that place.

CAPE MAY, N. J.—The Citizens' Local Telephone Company has been organized at Cold Spring, to connect that town and adjoining villages with the lines of the South Jersey Telephone Company at Cape May.

SALEM, ILL.—The Seven-Mile Prairie Telephone Company has been organized, with Charles Gehrig as president; Charles McDonald, vice-president; William Parkerson, secretary; Charles Davis, treasurer, and Charles Sanders, John Gregg and Boyd Henry, directors.

GADSDEN, ALA.—A telephone line is to be constructed between Ohatchie, on the Seaboard Air Line, and Ingram Wells, the Calhoun County summer resort. Work is to be commenced on the line as soon as the weather will permit, in order that the line may be ready by early spring.

BENZONIA, MICH.—At the annual meeting of the Benzie County Telephone Company it was shown that the company was in a prosperous condition. The capital will be increased to $100,000. W. A. Young was chosen president for the ensuing year, and H. B. Woodward, secretary and treasurer.

LIVINGSTON, TEX.—At a meeting of stockholders of the Livingston Telephone exchange the secretary's report showed that the receipts paid all expenses, with a small margin of profit. S. H. Smith, J. E. Hill, Jr., L. F. Gerloch, G. F. Sawyer and B. C. Marsh were elected directors for the ensuing year, with the first two as president and secretary, respectively.

JEFFERSON CITY, TENN.—An independent telephone company has been organized, with headquarters at Piedmont, known as the Piedmont Telephone Company. The following are the officers: William R. West, general manager; W. M. Brooks, secretary; J. Randle French, Thomas Hudson, John Milligan, Alfred Caldwell, J. Underwood, directors. This line will run from Piedmont to Knoxville, Kodak, Strawberry Plains, New Market, Jefferson City and Dandridge.

GAINESVILLE, FLA.—The East Florida Telephone Company, a line owned and operated by Gainesville parties, will be extended to Ocala. The system connects Gainesville with Archer, Micanopy, Evinston, McIntosh, Rocky Point, Tacoma, Palmer, Arredondo, Kanapaha, Rochelle, Windsor, Fairbanks and intermediate points. It is proposed to begin the extension to Ocala from McIntosh as soon as arrangements can be made, after which the line will be extended to Waldo, Melrose and other points.

WHITEHOUSE, N. J.—The annual meeting of the Lebanon Telephone Company was held recently at the offices of the organization at Lebanon. The following officers were chosen: president, S. J. Shurts; vice-president, George Clark; secretary, G. W. B. Tiffany; treasurer and general manager, E. W. Sutton; board of directors, the foregoing and O. A. Farley, J. C. Farley and Dr. H. H. Miller. At a meeting of the stockholders of the company it was voted to increase the capital from $5,000 to $25,000, and to have the state charter of the concern amended so that the company can build its lines anywhere in New Jersey. At present the Lebanon line is operating only in Hunterdon, Somerset, Warren and Morris counties. It was also decided to extend the service to several new points as soon as the weather will permit.

ELECTRICAL SECURITIES.

Last week recorded a further advance in the general average of security values. On the last day of the week a new high record of transactions was made, with sales of 1,309,300 shares. This compares with the previous record for a Saturday, of April 20, 1901, with 1,113,900 shares. As an evidence that considerable interest is being manifested by the buying public there has been a decided increase in commission business. It is now certain that no legislation will be enacted at this session of Congress, looking to any radical interstate rate regulation. This removes an uncertain factor, and gives an added impetus to speculation in many lines. The leading part now being taken by electric railroad securities, and the splendid showing that the Interborough Rapid Transit Company, in New York city, is making in the way of a dividend-earning proposition, will exert a powerful influence in the direction of hastening the electrification of present steam roads, and the construction of new electrical lines, both for passenger and freight service. This will mean greatly increased manufacturing, and will, of course, divert considerable money into purely electrical channels. The strong financial support which is being accorded to almost every security offering of value indicates that there will be no lack of money to finance new construction when plans are consummated for the inauguration of the work.

ELECTRICAL SECURITIES FOR THE WEEK ENDING FEBRUARY 25.

New York:	*Closing.*
Brooklyn Rapid Transit	63¾
Consolidated Gas	204
General Electric	187
Interborough Rapid Transit	205
Kings County Electric	200
Manhattan Elevated	172¼
Metropolitan Street Railway	120½
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	190

At the annual stockholders' meeting of the New York & New Jersey Telephone Company the old board of directors was reelected. Other business was routine.

Boston:	*Closing.*
American Telephone and Telegraph	146
Edison Electric Illuminating	252
Massachusetts Electric	58
New England Telephone	136
Western Telephone and Telegraph preferred	103

It has been decided to finance the requirements of the American Telephone and Telegraph Company for 1905 by an issue of $25,000,000 bonds. The bonds will carry 4 per cent interest. Bids were scheduled to be received March 1, and payments to the American company will be at the rate of $2,000,000 a month.

Philadelphia:	*Closing.*
Electrical Company of America	12⅛
Electric Storage Battery common	89¼
Electric Storage Battery preferred	89¼
Philadelphia Electric	11¼
Philadelphia Rapid Transit	31¼
United Gas Improvement	115⅞

A special meeting of the Philadelphia Rapid Transit stockholders will be held April 25 to authorize the company to join as guarantor to the $10,000,000 bonds of the Market street elevated passenger railway. The balance sheet of the company as of June 30, 1904, shows assets of $12,002,543, and liabilities of $11,379,869, leaving a surplus of $622,674.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	170
Metropolitan Elevated preferred	62
National Carbon common	42
National Carbon preferred	114¼
Union Traction common	11
Union Traction preferred	48

South Side Elevated directors have declared the regular 1 per cent quarterly dividend, payable March 31. Books close March 21, and reopen April 1.

The Illinois Supreme Court has affirmed the ruling of the Appellate Court, that the Chicago Union Traction Company must lower the Van Buren street tunnel under the Chicago river at its own expense.

Digitized by Google

NEW INCORPORATIONS.

YOE, PA.—Yoe Electric Light Company. $5,000.

MONROE, MICH.—Stoddard-Osgood Telephone Company. $10,000.

CHANDLER, OKLA.—Stroud Light and Power Company. $15,000.

TORONTO, ONTARIO—Markham & Pickering Telephone Company. $40,000.

WASHINGTON, PA.—West End Electric Light, Heat and Power Company. $25,000.

DAYTON, OHIO—Richwood Telephone Company. Increased from $20,000 to $50,000.

MARIETTA, OHIO—Marietta Telephone Company. Increased from $50,000 to $100,000.

STONY POINT, IND.—Home Mutual Telephone Company. Increased from $10,000 to $30,000.

COLUMBUS, OHIO—Barlow & Watertown Telephone Company. Increased from $10,000 to $16,000.

NEWARK, N. J.—Butte Electric and Power Company. Increased from $2,500,000 to $3,000,000.

AURORA, ILL.—Hayes Electric Company. $3,000. Incorporators: T. J. Hayes, E. R. Price and Frank La Sauer.

BETHEL, ME.—Middle Intervale Telephone Company. $1,000. President, O. A. Buck; treasurer, C. C. Bryant, both of Bethel.

ALBION, ILL.—Edwards County Mutual Telephone Company. $4,048. Incorporators: Philip King, William H. Reid, T. B. Mitchell.

LAFAYETTE, WIS.—Wilcox Valley Telephone Company. $2,500. Incorporators: Albert E. Harris, Charles J. Fox and Thomas Grady.

TIPTON, IND.—Fairview Cooperative Telephone Company. $1,025. Incorporators: W. H. Achenbach, L. J. Boull, John McCrory.

DOWNSVILLE, WIS.—Downsville Telephone Company. $3,500. Incorporators: J. F. Dennhan, George McCarty, Uriah Anderson and others.

FIELDON, ILL.—Western Telephone Company. $960. Incorporators: Frank F. Loelike, Francis A. Marks, and A. W. Pinkelmann.

TURTLE CREEK, PA.—The Rose Electric Light and Power Company. $20,000. President, William L. Ledger; secretary, C. R. Trevaskis.

CLEVELAND, OHIO—Gillen Electric Company. $10,000. Incorporators: S. H. Gillen, E. J. Gillen, D. F. Streb, W. S. Rowell, A. L. Vermilye.

AMHERST, ME.—Union River Telephone Company. $8,000. Incorporators: A. E. Mace, H. T. Silsby, both of Aurora; J. H. Patten, of Amherst.

RETREAT, WIS.—Vernon County Telephone Company. $5,000. Incorporators: A. J. Broadhead, J. L. Davis, F. P. Bean, W. P. Morand, Anna Esch.

BATTLE GROUND, IND.—Battle Ground Telephone Company. $1,500. Incorporators: Edward Towers, William J. Walters and Thomas D. Chenoweth.

MAPLEHURST, WIS.—Withee & Maplehurst Telephone Company. $1,000. Incorporators: Wallace D. Clemons, John Christensen and John Laneville.

YELLVILLE, ARK.—Yellville Telephone Company. $150,000. Incorporators: V. H. Weart, L. M. Weart, S. L. Brooksher, R. R. Brooksher and G. A. Ward.

RICHMOND, VA.—Southern Bell Telephone and Telegraph Company of Virginia. $200,000. Incorporators: W. T. Gentry, F. E. Montague, William H. Sands.

PORTERSVILLE, OHIO—Triadelphia-Sayre Telephone Company. $5,000. Incorporators: B. H. Petit, M. R. Hearing, H. C. Hearing, M. C. Smith and J. C. Masterton.

COSHOCTON, OHIO—Coshocton County Telephone Company. $30,000. Incorporators: Joseph A. Finlay, James L. Beck, J. H. Elder, W. D. Kissner and S. C. Kissner.

PEKIN, ILL.—Petersburg Telephone Company. $20,000. President, George H. Glass, Pekin; secretary, George N. Kelly, Petersburg; treasurer, B. G. Henion, Petersburg.

NORTH ADAMS, MASS.—Bennington & North Adams Street Railway Company. $150,000. President, A. H. Rice, of Pittsfield; O. M. Barber, of Bennington, Vt., treasurer.

ELLSWORTH, IND.—Otter Creek Telephone Company. $1,200. Incorporators: George L. Stevenson, William F. Carty, S. D. Humphrey, all of Edwards P. O., Vigo County, Ind.

ROCHESTER, N. Y.—Eastern Monroe Electric Light and Gas Company. $250,000. Directors, Henry C. Brewster, Rochester; Andrew H. Brown, Penfield, and Walter A. Parce, Fairport.

LEBANON, OHIO—The Miami Transit, Light and Power Company. $600,000. Incorporators: F. O. Richards, M. D. Burke, Joseph S. Storr, C. A. Culbertson and Charles A. Hough.

COLUMBUS, OHIO—Dillonvale Heat, Light and Water Company. $50,000. Incorporators: William M. Dages, Frank Alexander, David I. Sennecker, W. L. Cole and Ralph E. Bartlett.

NORRISTOWN, PA.—Linfield Electric Light Company. $5,000. Incorporators: Horace Ashenfelter, Royersford; William S. Emlig, Philadelphia; G. E. Brownback, Linfield; A. H. Fry, Jr., Philadelphia.

HOULTON, ME.—Houlton Electric Light and Power Company. $10,000. President, H. T. Frisbee, Houlton; W. P. Manser, Houlton; directors, as above named and C. H. Pierce and J. A. Tenney, Houlton.

MOUNT HOLLY, N. J.—Lumberton Light, Water and Sewage Company. $50,000. Incorporators: George F. Ried, J. M. Harrison, Walter M. Voorhees, Henry Conrow and Moses S. Watson, of Lumberton.

TORONTO, ONTARIO—Scarboro Telephone Company, Limited. $40,000. Directors: Alexander Neilson and John Neilson, of Scarboro; Thomas Albert Young, of Markham, and William Mulock, Jr., of Toronto.

COLUMBUS, OHIO—Bucyrus Springs & New Washington Traction Company, of Bucyrus. $10,000. Incorporators: Ellis Bartholomew, William E. Moser, Samuel S. Thorn, Fred W. Armbruster and Elmer Luke.

PATERSON, N. J.—Beaver Lake Company; to supply electrical power, build and operate waterworks, etc. $50,000. Incorporators: Wayne Dumont, John A. Kane, Frank Wilson, of Paterson, and Denton W. Clark, of Green Pond.

ZANESVILLE, OHIO—Zanesville, Coshocton & New Philadelphia Traction Company. $10,000. Incorporators: John W. Cassingham, Arthur F. Stanley, G. A. Hay, H. C. Ferguson, J. L. Barnett, John U. Kissner and John A. Hanlon.

BERKELEY SPRINGS, W. VA.—Berkeley Springs Light and Water Company. $25,000. Incorporators: Henry N. Hanna, Eugene L. Morton, of Baltimore, Md.; J. Frank Fields, of Hancock, Md.; T. H. B. Dawson, Silas J. Honermall and Rumanus Hunter, of Berkeley Springs, W. Va.

HARRISBURG, PA.—Harmony Light and Power Company, of Harmony, $5,000; Jackson Light and Power Company, of Jackson Township, $5,000; Zelienople Light and Power Company, of Zelienople, $5,000. Incorporators: J. A. Frauenlein, W. H. Lose, Edwin Meeder, all of Zelienople.

SWEETWATER, ILL.—Springfield, Sweetwater & Peoria Electric Railway Company; to be constructed from Springfield, Ill., to Peoria, *via* Sweetwater. $2,500. Incorporators and first board of directors: George H. Hatch, Greenview, Ill.; Thomas H. Alkire, John W. Terhune, James E. Culver and Augustus K. Jones, of Sweetwater, Ill.

SAVANNAH, GA.—Savannah Lighting Company. $50,000, with the privilege of increasing to $500,000. Incorporators: John J. Cummings, Lawrence McNeil, J. H. Estill, Joseph D. Weed, Henry Blun, Samuel Meinhard, Willis A. Burney, Jr., John Flannery, Samuel B. Adams, Pleasant A. Stovall, J. H. H. Entelman, B. H. Levy, George W. Tiedeman and Leopold Adler.

Digitized by Google

AUTOMOBILE NOTES.

CLUB-HOUSE AND GARAGE FOR AUTOMOBILE CLUB OF AMERICA—The building committee of the Automobile Club of America, composed of Albert R. Shattuck, Colgate Hoyt and Dr. Schuyler Skaats Wheeler, announces the purchase of a plot of land in New York city, on the northerly side of Fifty-fourth street, about two hundred and fifty feet west of Broadway, having a frontage of one hundred and thirty-one feet, and a depth of one hundred feet and five inches. The property is at present covered by private dwellings. On this site the club will at once erect its new club-house and garage. The land and building will cost something over half a million of dollars. The building will be of the most modern fireproof construction, and it is designed to be a model structure of the kind both from the standpoint of architecture and utility. The location is accessible, and in a part of the city where the automobile interests are rapidly concentrating. The architect is Ernest Flagg.

RELIEF FROM FERRY RESTRICTIONS—The Automobile Club of America announces that the Platt-Gouden bill was signed by President Roosevelt on February 20, amending section 4472 of the revised statutes, so as to remove certain restrictions upon the transportation by steam vessels of gasoline and other products of petroleum when carried by automobiles using them as a source of power. The amended section reads as follows: "Nothing in the foregoing or following sections of this act shall prohibit the transportation by steam vessels of gasoline or any of the products of petroleum when carried by motor vehicles (commonly known as automobiles) using the same as a source of motive power. Provided, however, that all fire, if any, in such vehicles or automobiles be extinguished immediately after entering the said vessel, and that the same be not relighted until immediately before such vehicle shall leave the vessel. Provided, further, that any owner, master, agent or other person having charge of passenger steam vessels shall have the right to refuse to transport automobile vehicles the tanks of which contain gasoline, naphtha or other dangerous burning fluids."

OBITUARY NOTICES.

MR. CALVIN DETRICK, an early promoter of electrical enterprises, died on Saturday, February 18. He was president of the Staten Island, N. Y., Light, Heat and Power Company, and erected the first electric lighting plant in the borough of Richmond. He also constructed the system of water supply for the borough of Richmond, and was the builder of the first underground electric light supply system in Philadelphia, Pa. He was born in Monroe County, Pa., May 4, 1838, and although his office was in Stapleton, S. I., his home was in Brooklyn, N. Y.

MR. A. P. GODDARD, president of the Freeport Railway, Light and Power Company, a member of the National Electric Light Association, died at his home in Freeport, Ill., on Tuesday, February 12, at the age of seventy-two. He was born in Franklin County, N. Y., but his family removed to Freeport when he was two years old. Mr. Goddard was prominently identified with the development of Freeport, having served as alderman, mayor and member of the board of supervisors. He also served in the Civil War as first lieutenant in the Illinois Volunteer Infantry, and was brevetted a captain for honorable service. Mr. Goddard was a prominent freemason.

MR. EDWARD COOPER, ex-mayor of the city of New York, and the only son of Peter Cooper who lived to manhood, died on Saturday afternoon, February 25, at his home, 12 Washington square, New York city, of apoplexy. Mr. Cooper was in his eighty-first year. For the last few years he had not been active in business, though he was still a member of the firm of Cooper Hewitt & Company. He was born in New York city on October 26, 1824. He went to the public schools, and was in Columbia University in the class of 1845. He was in delicate health, and did not graduate, and in 1842 his father engaged Mr. Abram Hewitt to take him abroad as tutor. Mr. Cooper was a strong Democrat, and had been in public life from 1857 until 1896. In 1857 he was made street cleaning commissioner, and in 1878 was elected mayor of the city of New York. In the meantime he had served as delegate to the Charleston convention of 1860. He was president of Cooper Union for the Advancement of Science and Art, his father's gifts to which he very much increased. He was president of the Trenton Iron Company, and a member of the Union Club, Metropolitan, University and Knickerbocker clubs, and of the Century Association. The funeral was held at Grace Church, New York city, at ten o'clock Tuesday morning, February 28.

PERSONAL MENTION.

MR. H. M. HOBART has been appointed lecturer in electrical engineering design at the Northampton Institute, London. He succeeds Mr. E. K. Scott.

DR. WILLIAM R. HARPER, president of the University of Chicago, is suffering from an acute cancerous affliction. It has been decided to make a very complete test of the efficacy of the X-ray treatment as a cure for cancer and the destruction of cancerous growth in the tissues.

MR. F. D. PHILLIPS has been appointed general manager of the American Electrical Supply Company, 83-87 Fifth avenue, Chicago, Ill. Mr. Phillips's five years' experience with the Electric Appliance Company, and later as treasurer and sales manager of the Crescent Company, eminently fit him for the duties of his new position.

MR. CHARLES W. CROSS, M. E., E. E., formerly of the Roberts & Abbott Company, consulting engineers, of Cleveland, Ohio, and later electrical engineer for the Eastern Ohio Traction Company, has entered the employ of the Crocker-Wheeler Company, of Ampere, N. J., and is attached to the Cleveland office of the company at 816 New England Building.

MR. J. D. HOUSEMAN has resigned as general manager of the Suburban Telephone Company, St. Louis, Mo. He will engage in electric railway work. Mr. Houseman promoted the first street car line in St. Louis County, the branch of the Suburban system from Forrest Park to Kirkwood, and later completed an electric line to St. Charles.

MR. HENRY L. MANNING announces his retirement from the firm of Manning, Maxwell & Moore, he having sold his entire interest to his partner, Mr. Charles A. Moore. Mr. Manning requests that the many friends will continue their pleasant relations with the firm. The business will be conducted under the firm name of Manning, Maxwell & Moore, at 85-89 Liberty street, New York city.

MR. ARTHUR B. LISLE, assistant manager of the Narragansett Electric Lighting Company, Providence, R. I., has resigned to engage in a brokerage business. Mr. Lisle has been with Mr. Marsden J. Perry, president of the company, as confidential clerk, for about six years. He was also treasurer of the East Providence Water Company, and is interested in the Putnam, Ct., Water and Lighting Company.

MR. CHARLES R. UNDERHILL, formerly chief electrical engineer of the Varley Duplex Magnet Company, has engaged in consulting engineering, with headquarters at 55 Liberty street, New York city. He will make a specialty of the design of electromagnets and solenoids in general, but particularly for heavy power work. He will also take contracts for the complete construction of magnets and solenoids to perform a given duty. Mr. Underhill is the author of a book entitled "The Electromagnet," which treats the subject from the standpoint of design.

MR. B. T. BURT, one of the pioneers in electrical work, is the efficient general manager of the Chattanooga Electric Company, Chattanooga, Tenn. This plant was described in last week's issue of the ELECTRICAL REVIEW. Under Mr. Burt's management the plant of the company has been greatly enlarged, and, in addition to supplying light and power for the city of Chattanooga, Tenn., the company has taken over the entire load of the street railway company. Mr. Burt was an early associate of Thomas A. Edison, in much of the great electrician's early work, in New York city.

Digitized by Google

ELECTRIC RAILWAYS.

INDIANAPOLIS, IND.—The Winona Interurban Railroad Company will erect a $600,000 power plant at Warsaw.

DENVER, COL.—The Denver & Intermountain railway is to be extended to Idaho Springs, a distance of between twenty and thirty miles.

BIG STONE GAP, VA.—It is announced that an electric line will be built from Big Stone Gap, *via* Stone, Apalachia and Norton, to Wise, a distance of thirty miles. This will open up valuable mining property.

MOBILE, ALA.—It is stated on good authority that a syndicate of Indianapolis capitalists is planning an electric road between Mobile and New Orleans. The work of surveying the route will begin at an early date.

CLEVELAND, OHIO—The Northern Ohio Traction and Light Company has decided to spend $100,000 in improvements on its lines during the present year, and the engineering department is now at work on the plans.

ARDMORE, I. T.—A franchise has been granted by the Ardmore city council for the construction of an electric line. Right of way was given through the principal streets, and work is to be commenced by September 1.

OTTAWA, OHIO—The Cincinnati Northern Traction Company, which has recently been chartered to operate electric lines, with Cincinnati and Toledo as the termini, will pass through the western part of Putnam County.

WASHINGTON, PA.—Representatives of a Philadelphia company are taking up rights of way for a trolley line from a point near Bridgeville in Allegheny County up Miller's Run in the central section of Washington County.

NORTH ROSE, N. Y.—Steps have been taken to build an electric railway from Clyde to Sodus bay, with the probable terminal at the north end of Resort, which is at the head of Sodus bay. The railway will be called the Clyde & Sodus Bay Railway.

PITTSBURG, PA.—The Shenango Traction Company, which will build a line from Meadville to New Castle at a cost of $1,500,000, has been granted a franchise by the council of West Middlesex borough. Wheatland, Clarksburg and Greenville have also granted franchises.

LOUISVILLE, KY.—The fiscal court has passed a resolution granting the Kentucky Traction Company an extension of time in which to complete the electric line on the Eighteenth street road. The company is allowed two years more for the completion of the line to Valley Station, and four years for the building of the line to Riverview.

ST. PAUL, MINN.—The city council of Excelsior has granted E. J. Phelps and F. A. Kenaston a franchise for an electric railway between Hopkins and Excelsior, with permission to establish branch lines around lake Minnetonka. The applicants agreed to execute a bond in the sum of $5,000 that the line would be in operation within two years.

GREENSBURG, PA.—A company of coke region capitalists, headed by O. W. Kennedy, of Uniontown, has secured the right of way for a trolley line from Mt. Pleasant to Latrobe. The line will run through an undeveloped region of the coke country, the following towns being touched: Trauger, Calumet, Mammoth, Hecla and Baggaley. At the latter town the line will connect with the Latrobe Railway Company. Construction will begin in the spring.

ST. JOSEPH, MO.—The county court has granted a franchise to the Maryville & St. Joseph Electric Railway Company to cross with its line of railway all public highways between the city of St. Joseph and the north line of Buchanan County. It is specified in the order granting the franchise that if the road is not completed within two years of the date on which the franchise is granted the company must then put up a $5,000 bond to ensure its completion in a time specified by the court.

SPOKANE, WASH.—A corporation has been formed at Everett, Wash., with a capital stock of $2,000,000, to build an electric railway from Everett to Bellingham. The incorporators are Charles W. Taylor and R. W. Jacobus, eastern capitalists, and J. E. Stauffer and William M. Ross, of Everett. The company proposes to purchase the right of way the entire distance, and to build an independent line. It is claimed the funds for the construction of the road have all been provided for. The articles of incorporation have been filed in Snohomish, Skagit and Whatcom counties.

MARION, IND.—The commissioners of Grant County have granted a franchise to the Geneva Traction Company, which proposes to build an electric road east from Marion to Celina, Ohio, passing through Montpelier, Dundee and other Indiana cities. The road will connect the oil regions of Ohio and Indiana. The company has obtained a franchise in each county and city through which it will pass, and has bought a private right of way almost the entire distance between Marion and Celina. The company will begin construction as soon as the weather will permit.

NEW PUBLICATIONS.

DIE ABSTIMMUNG FUNKENTELEGRAPHISCHER SENDER—Dr. A. Slaby has issued, in pamphlet form, his recent series of articles in the *Elektrotechnischer Zeitschrift*, which treats of the classification of wireless telegraph systems.

ANNUAL REPORT OF THE UNITED STATES LIGHTHOUSE BOARD—The annual report of the United States Lighthouse Board for the year ending June 30, 1904, has been issued by the department of commerce and labor, Washington, D. C.

THE SOUTHWESTERN ELECTRICIAN—The first issue of the *Southwestern Electrician* has been distributed. This journal is published by the Southwest Publishing Company, Southwest Building, 910 Texas avenue, Houston, Tex. Mr. Charles A. Newning is manager.

REVIEW OF NAVAL PUBLICATIONS—The United States Navy Department has printed a report prepared by Commander L. A. Lan, of the Argentine navy, on the submarine boats of the Lake and Holland types. This report has been translated by Mr. M. E. Beall, of the United States War Department.

THE INDIAN TEXTILE JOURNAL DIARY AND REFERENCE BOOK—The *Indian Textile Journal*, Bombay, India, has issued its diary and reference book for 1905. This contains a great deal of information valuable to the textile engineer or manager, lists of Indian and British patents of interest to textile operators, and rules relating to certificates and examinations for mechanical engineers in India. There are also very complete lists of cotton mills in India, Japan and China, and a diary.

THE AMERICAN UNDERWRITER—The tenth anniversary special vellum number of the *American Underwriter* is indeed a handsome publication. Inclusive of advertising, the work represents forty-four pages of carefully selected material, fine typography and good presswork. The supplement to this tenth anniversary number is a photogravure of John A. McCall, president of the New York Life Insurance Company. The work has been compiled by, and is issued with the compliments of, Edward Bunnell Phelps, editor of the *American Underwriter*.

INDUSTRIAL EDUCATION AND INDUSTRIAL CONDITIONS IN GERMANY—The Department of Commerce and Labor, Washington, D. C., has compiled the consular reports on industrial conditions and industrial education in Germany, and has issued these in pamphlet form. The report is fairly complete, discussing the German system of education and the evolution of the German industrial schools, the engineering schools and schools of technology. Industrial and commercial schools are described, and the methods of administration explained. The reports upon the industrial conditions in Germany cover practically all districts. An appendix contains reports of technical schools at Roubaix and Lisle, France; commercial schools in Japan, and technical education in London. Illustrations of a number of well-known technical schools in Germany are given.

Digitized by Google

ELECTRIC LIGHTING.

HOPE, IND.—George S. Cook has secured a franchise to establish an electric light plant at Hope.

INDIANAPOLIS, IND.—The Brazil Electric Company has secured a site upon which to build a power plant in the spring.

LUTHERVILLE, MD.—Lutherville is now lighted by electricity furnished by the Mount Washington Electric Light and Power Company.

COOKVILLE, TENN.—The contract for the electric light plant has been awarded to McDonald, McCoy & Company, of Chicago, their bid being $25,159.

FAYETTEVILLE, ARK.—New machinery has been added to the electric light plant at Fayetteville, which gives the plant a capacity of 5,500 incandescent lights.

ANADARKO, OKLA.—The city council has let a contract for the construction of an electric lighting plant to the Union Light and Power Company, of El Reno, Okla. The cost will be $10,455.

LEAD, S. D.—The Homestake Mining Company has purchased the Spearfish Electric Light and Power Company's property, which furnishes light and power for Spearfish, the consideration being $18,000.

SEMINARY, MISS.—The Mason Lumber Company, whose plant is located at Pratt station, will put in a large electric lighting plant at an early date. The company will also furnish lights for Seminary.

SAN FRANCISCO, CAL.—The Bay Counties' Power Company will transfer its power line from the north to the south side of the Yuba river. A new electric railroad connecting Marysville and Yuba City will be constructed, following the river west from a point four miles below Marysville.

MILLIS, MASS.—The new electric lighting system installed by the Medfield Electric Light and Power Company has been completed. Over 125 incandescent lights of twenty-five candle-power have been placed in position. The selectmen have entered into a three years' contract with the company.

ROCHESTER, N. Y.—At a meeting of the directors of the Eastern Monroe Electric Light and Gas Company the following officers were elected: president, Andrew H. Bown, Penfield; vice-president, Walter A. Parce, Fairport; treasurer, Henry C. Brewster, Rochester; secretary, Clarence E. Shuster, Penfield.

LITTLE FALLS, N. Y.—T. N. Lovenheim, owner of the Consumers' Electric Light Company, has sold a half interest in his company to William LaDue. Mr. Lovenheim announces that the capacity of the plant will be doubled, a new dynamo having been ordered, which will increase the service by 1,500 lamps. The company is also rebuilding the structure which was recently burned.

PHILADELPHIA, PA.—At the annual meeting of the United Power and Transportation Company held in Camden the old board of directors was reelected. The annual report of the company for the fiscal year ended December 31 compares as follows: income from securities and loans, $708,512; expenses, taxes, fixed charges, etc., $364,056; balance for dividends, $344,456; dividends, $343,562; surplus, $894; total surplus, $267,078.

SHREVEPORT, LA.—H. N. Morris, president of the Shreveport Gas, Electric Light and Power Company, has closed a deal whereby the Dawes syndicate, owning the Shreveport gas and light plants, acquires the plants at that place, the transaction involving in the neighborhood of $200,000. It is the intention of the purchaser to spend considerable money in the improvement of the property. The officers of the new Texarkana company will be: president, H. N. Morris, Shreveport; vice-president, R. C. Dawes; secretary, J. B. Sherman.

MARTINSBURG, W. VA.—Capitalists of Washington and Baltimore are organizing a stock company for the purpose of purchasing the old pulp mills and water power at Harper's Ferry, where it is intended to erect a large electric light plant. It is said that $150,000 has been subscribed, and that the venture is already assured. It is expected to make this plant a central point for supplying electric light to several cities and towns in the valley, and negotiations are under way with Winchester, Brunswick, Harper's Ferry, Charlestown, Hagerstown, Williamsport and other places.

NOBLESVILLE, IND.—At a special meeting of the Noblesville city council a ten-year contract for lighting the city was awarded to George W. Heinzmann & Company. The company is required to furnish eighty arc lights at $70 a light per year, and ten cents a thousand watts will be charged for incandescent lights. The old electric light company, which now has the contract, and the Noblesville Hydraulic Company are consolidated with the new company. The large dam across White river, north of Noblesville, which the Hydraulic Company began two years ago, but which was not completed on account of an injunction, will be finished. The old company's present steam plant will be remodeled and held in reserve in the event of the dam power not being available at all times. The two plants, when in operation, will represent an investment of $150,000.

ENGINEERING SOCIETIES.

ENGINEERS' CLUB OF ST. LOUIS—The regular meeting of the Engineers' Club of St. Louis was held at the club rooms, 3817 Olive street, St. Louis, Mo., Wednesday evening, March 1. Mr. Carl Gayler presented a paper entitled "Our Grade-Crossing Problems."

TORONTO BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The sixteenth regular meeting of the Toronto branch of the American Institute of Electrical Engineers was held at the School of Practical Science, February 24. Mr. B. G. Lamme's Institute paper, entitled "Synchronous Motors for Regulation of Power-Factor and Line Pressure," was read and discussed.

LEGAL NOTE.

ELECTRIC FUSE LITIGATION—Concerning a note appearing recently in this department, the following has been received: "I notice under the head of 'Legal Notes' in your issue of February 18, 1905, on page 311, the following: 'Electric Fuse Litigation—In the suit of the American Electric Fuse Company against the Rolfe Electric Company and Charles A. Rolfe, in circuit court for the county of Lenawee, Mich., involving the ownership of the Rolfe pioneer self-soldering protector patents, a decision was handed down on February 4, in favor of the American Electric Fuse Company.' . . . . The facts of the matter are as follows: the American Electric Fuse Company claimed to have a royalty contract covering the Rolfe pioneer self-soldering protector patents. The contention of the Rolfe Electric Company and myself was that the American Electric Fuse Company had violated its contract with us, and the same was no longer valid. The action was brought by the Rolfe Electric Company and myself for the purpose of determining the validity of the contract. The court sustained the contention of the American Electric Fuse Company, holding that the contract was still in force. Should the contention of the American Electric Fuse Company finally be sustained, nevertheless, the ownership of the patents remains in the Rolfe Electric Company and myself, and the American Electric Fuse Company will be required to pay the royalties as provided by the contract, which they have repeatedly offered to do heretofore. I trust that in your next issue you will correct the impression given by the legal item to which I have referred, as the statement coming from your paper is very damaging to the Rolfe Electric Company and myself. One of the reasons why it is damaging is that, as you know, I have patents or applications for patents upon many forms of protectors, other than the self-soldering and those who are not informed in respect to the matter may think these were involved in the litigation. All the patents involved in the litigation constitute but a very small part of the patents owned by me, and the only right which I ever gave in respect to the patents involved in the litigation were the right to manufacture on payment of royalties from year to year. Signed, Charles A. Rolfe." This is the information that the item in question was intended to convey. The American Electric Fuse Company entered into a contract with the Rolfe Electric Company and Charles A. Rolfe to manufacture under exclusive rights. The Rolfe company contended that this contract had been violated, but the court held that this was not the case.

Digitized by Google

INDUSTRIAL ITEMS.

THE NERNST LAMP COMPANY, Pittsburg, Pa., is distributing a series of monthly bulletins calling attention to its product.

THE NATIONAL CABLE AND WIRE COMPANY announces that on March 1, 1905, it removed its general offices from Pittsburg, Pa., to the manufacturing plant at Shousetown, Allegheny County, Pa.

PARTRICK, CARTER & WILKINS, Philadelphia, Pa., have moved to a new factory at Twenty-second and Wood streets, where they have doubled their floor space and facilities, and are prepared to meet the constantly increasing demand for a full line of their exclusive specialties.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, is distributing folder No. 1, vol. ii, of its series of leaflets, calling attention to the application of Peerless motors to the individual driving of printing-presses. In addition to the leaflet there is a mailing card, which renders easy an application for further information.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., is now established in new and commodious New York city offices, at 203 Fulton street. This move was made to enable the company to serve its customers with greater promptness, and also to secure more room and added facilities. Telephone call, 6056 Cortlandt.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., in pamphlets Nos. 051 and 052 describes and illustrates the Hunt industrial railways and the general line of machinery manufactured by the company. The company is also distributing a paster designed for convenient insertion in the handbook, consisting of a conversion table.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., announces that it is completing one of the finest tollboards that it has ever turned out for the United States Telephone Company, for use at Toledo, Ohio. The board consists of five sections of three operators' positions each, and is equipped throughout with the most modern apparatus.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., will be pleased to send to those interested a handsome catalogue descriptive and illustrative of its unit accumulator. This accumulator has been built especially for high-charge and discharge rates, with long life and high efficiencies. These results are obtained with a positive Planté plate, and a negative of the Faure type.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, Ill., is distributing an attractive booklet calling attention to the Kaisling protector. This booklet is profusely illustrated, and the different forms of Kaisling apparatus are described in detail. This company is very enterprising, and is a persistent seeker for business. During 1905 it expects to increase very largely its protector business.

THE BARRIETT ELECTRIC COMPANY, Cincinnati, Ohio, announces the decease of Mr. S. L. Barriett, president of the company. The announcement is made that the death of Mr. Barriett will in no way interfere with the carrying on of the business of the company. The factory is in active operation, having a full volume of business. Orders are being received daily, and filled promptly.

THE STANDARD VARNISH WORKS, 29 Broadway, New York city, is mailing a folder calling attention to the three varnishes which it makes especially for electrical repair work. These are, respectively, "Voltalac," an all-around repair work varnish, black in color and especially made for insulating and repair work; "Gutta-Percha" black finishing varnish for repair work, and "Gutta-Percha" light finishing varnish for repair work.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 Market street, St. Louis, Mo., is calling attention to the Colonial direct-current ceiling and desk fans for the season of 1905. The company will be pleased to send descriptive matter upon request. Another specialty to which the company is calling attention is the Monarch improved incandescent lamp, made by the Monarch Electric Manufacturing Company, of Warren, Ohio.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, has recently opened a new office in Chicago, at 1107 Fisher Building, and has arranged with Mr. C. H. Norwood to represent it in the Chicago territory in its line of "Standard" motors and generators. The company will carry a complete stock of these goods in Chicago. Mr. Norwood is a man of wide experience and recognized ability, and will make a good representative.

THE ARNOLD ELECTRIC POWER STATION COMPANY, Marquette Building, Chicago, Ill., is issuing a pamphlet descriptive of the Chicago & Milwaukee Electric Railroad extension. This is Arnold bulletin No. 11. The bulletin is handsomely illustrated, and gives an accurate description of the mechanical details and physical features of the system. The Arnold Electric Power Station Company is engineer and contractor, and undertakes specifications and contracts for power-house expansion.

THE BERGMANN ELECTRICAL WORKS, Berlin, N., Germany, will be pleased to send its elaborate new export catalogue No. 8-E to any one interested in electrical supplies. This catalogue contains 234 pages of illustrative and descriptive matter, dealing with conduit tubes, switchboards, switches, cutouts, lamp-holders and other devices. Prices, dimensions and shipping weights are also quoted. Other price lists in English, German, Spanish and French may be secured by addressing department "J," 33-35 Hennigsdorfer strasse.

THE MICHIGAN CENTRAL RAILROAD COMPANY is distributing a new California and Colorado folder, giving detailed information concerning its through-car service from eastern and western connections at Chicago. This folder is splendidly printed and embellished with numerous illustrations of typical scenes in the country which the service covers. The cover page is printed in colors, and represents a portion of an orange bough, both in blossom and in fruit. This folder may be secured by writing to W. H. Underwood, general eastern passenger agent, 486 Ellicott square, Buffalo, N. Y., or to O. W. Ruggles, general passenger and ticket agent, Chicago, Ill.

THE BALL & WOOD COMPANY, Elizabethport, N. J., is adding a new department to its business—that of flange welding and pipe bending. The increasing use of high-pressure and superheated steam has developed the need of pipe joints which are absolutely reliable, and in the process the company is bringing out, the use of forged-steel flanges welded to the pipe will eliminate weak spots in the steam joint, the pipe and flange being made homogeneous. Contracts have been let for a new smithshop at the Ball & Wood works, for the purpose of doing this work. It is expected that the shop will shortly be in full operation. Mr. O. M. Jones has resigned his position in the New York sales office of the National Tube Company to become the manager of the new department of the Ball & Wood Company. Full information may be secured regarding this work by addressing the Ball & Wood Company, welding department, 17 Battery place, New York city.

THE CENTRAL ELECTRIC COMPANY, 209 East Jackson Boulevard, Chicago, Ill., has established a record for quick recovery from adverse circumstances. As was announced last week the plant of the company was destroyed by fire on the morning of Saturday, February 11. The new quarters at 209 East Jackson Boulevard were arranged for within one hour after the regular time for opening the office. Before noon complete office equipments, including typewriters, desks and new stationery, had been secured. By ten o'clock the same night 10,000 announcements had been distributed to the trade, calling attention to the excellent condition in which the company had placed itself for the prompt execution of all orders. The company states that it is now in a position to make good all promises of prompt attention to orders and enquiries. Normal conditions are restored, and save the effect of new surroundings, business is moving forward in natural channels. The company is sending to the trade a small booklet giving views of its present location, and thanking the members of the electrical fraternity for their generous and practical sympathy, which helped to sustain the company under the trying conditions following the disastrous fire which involved the destruction of its long-established plant.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 10. NEW YORK, SATURDAY, MARCH 11, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSISTANT EDITOR

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10
Copies supplied for only one year back, each 25

CONTENTS.

EDITORIAL:
Electricity in Agriculture ... 397
Electrical Methods in Optical Pyrometry ... 398
Will the Automobile Displace the Tramway? ... 399
Telephone Engineering—XIV, by J. C. Kelsey ... 400
An Electric Drive for Hydroextractors ... 402
American Electrochemical Society ... 402
An Important Italian Hydroelectric Installation, by Enrico Bignami ... 403
New York Motor Boat and Sportsmen's Show ... 405
The Proposed Central Power Station at Washington, D. C. ... 406
Fuel Economy in Steam Power Plants—III, by William H. Booth and John B. C. Kershaw ... 410
Electric Plant in Formosa ... 412
Transfusion (Electrical), by James J. Edmondson, M. D. ... 413
Electrical Notes from Europe ... 414
The Ionic Theory of the Arc and Spark, by Professor Henry Crew ... 416
Wireless Telegraphy in the Home ... 421
Electricity in Agriculture, by C. L. Durand ... 422
First Annual Convention of the Bell Telephone Company Managers ... 423
The New Cunard Liner Caronia ... 423
Important Marconi Invention ... 423
Meeting of Electrical Contractors and Electrical Supply Dealers ... 423
Strike on the Interborough Rapid Transit Company's System in New York City ... 423
BOOK REVIEWS ... 424
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 426
Electrical Patents ... 428
INDUSTRIAL SECTION:
The Largest Electric Motor Ever Built ... 429
A New Cook Protector ... 429
Improved Angle Wall Sockets ... 430
The "Firefly" ... 430
Novelties for Fixture Work ... 431
"Hiko" Electrical Specialties ... 431
Small Motors Wanted ... 431
New Form of Arc Lamp ... 432
A New Cable Clamp ... 432
Enclosed Automatic Engine ... 433
Open Air Telephones, by George A. Long ... 434
Reynolds-Corliss Engines ... 434
CURRENT ELECTRICAL NEWS ... 435

ELECTRICITY IN AGRICULTURE.

The introduction of electrical power for farmwork, whether it be for use in the field or in the barn, is taking place but slowly. They seem to be getting ahead in this direction rather more rapidly in Europe than we are in this country, but even abroad the electric motor is being applied but slowly, and only under most advantageous conditions. It is easy to show that the electric motor is an economical source of power for a large farm. In certain communities where the individual farms may be small, but where a certain amount of cooperation is possible, the electric motor has its advantages. This latter condition exists in southeastern France, where there are many waterfalls, but where the neighboring towns or factories do not give a full load on the station. In this section they have found it to pay to encourage the use of electricity for farmwork. The advantages of lighting farm buildings are, of course, of considerable importance, because of the inflammable nature of the contents. Where one motor may be kept fairly busy on several farms, the load which the station can obtain is such that it will make rates low enough to attract the farmers' custom.

The work which is now being done on farms in France and Germany includes practically everything except haulage. There are several systems in use for plowing, and the machinery in the dairies and the barns, whether the latter be for thrashing grain or other purposes, is, in a number of cases, now driven by electric motors. The reports from these plants seem to indicate that the system is working profitably.

In this country there are, it is true, some few instances where the farm machinery is driven by electric motors. Such applications are on large farms. On some of them an isolated plant has been constructed, which lights all the buildings on the farm, and supplies power for operating the motors. Of course, such a system would not be economical for every farm. It is probable that it would pay only on large farms. But there would seem to be a good many localities where wind power might be used to advantage. The variable character of the supply would not be particularly objectionable, as there is no need to follow a fixed routine in doing farmwork. During stormy weather, when work outside can not be carried on, there is generally sufficient wind to supply power for doing indoor work, and when a windmill is installed for doing this work the addition of a storage battery makes a satisfactory lighting system possible.

Given a windmill located at the barn, there may seem to be no necessity for adding a dynamo, but with a simple wind drive all the work must be done at one point. Adding an electric system enables work to be done at any part of the farm, and the additional advantage of lighting by the best system known.

Where conditions do not justify the investment required for a power plant on the farm, whether it be operated by steam, gasoline or wind, there still may be a good field for the electric motor which derives its supply from a neighboring power plant. The load in general would be a desirable one for the station; hence low rates for power could be made. It is probable that where a motor is installed, lights would also be put in the house and farm buildings. Even should the work of any particular farm be too light to justify the purchase of a motor, the supply company or others might build up a very profitable business by renting out semi-portable motors. These could be carried from point to point, as the traction engine is used to-day.

We have not yet reached a stage in our automobile development where the farm horse can be replaced, and as long as a horse is necessary on a farm, the stand may be taken that there is no need for any other power; but there are few farms which keep all their horses busy all the time, and the work which must be done by the horses could be done by a smaller number if another source of power were available for occasional work. It is a field which is at least worthy of investigation by the manager of the light and power plant situated in a small country town.

Digitized by Google

ELECTRICAL METHODS IN OPTICAL PYROMETRY.

Two purely electrical methods of temperature measurement were discussed recently, and some of the advantages and disadvantages pointed out. Stress was laid upon the comparatively small cost of such instruments, since this makes it practicable for every laboratory to be equipped with a satisfactory instrument. There are, however, instances when neither of these instruments can be applied. These occur when it is impracticable to introduce the electrical pyrometer into the place where the measurement is to be made. The inability to do this may be due either to the temperature existing at that point, or to the mechanical difficulty of inserting the pyrometer. Some other method of temperature measurement then becomes necessary.

This need is being met by optical methods of temperature measurement. The instruments which have been devised make use of several phenomena, which have been the subject of an important study by Messrs. C. W. Waidner and G. K. Burgess, of the National Bureau of Standards, Washington, D. C. Some of them are purely optical, depending merely upon the measurement of luminous radiation. The term "optical pyrometry," however, is very properly made to include measurement of temperatures at which there is little or no visible radiation. In a certain class of instruments, while the measurement depends upon the luminous radiation, the adjustment is secured through electrical means. In still another class of pyrometers the determination depends upon a purely electrical effect.

To make use of a measurement of radiant energy, such as light or heat, for determining temperature, some relation must be established between the amount of radiation of a body and its temperature. There are several laws for this, all of them deduced by empirical methods. They hold with more or less accuracy throughout certain ranges of temperature, and researches indicate that they are applicable to temperatures above those measurable by other methods. There are certain limitations to these laws which have a significant bearing on their application to temperature measurements. The radiation from a hot body depends not only on its temperature, but upon special properties of that body which are not well understood. Thus, two bodies may be maintained at the same temperature, and yet the radiation of one will differ from that from the other. The temperature determinations depending upon a simple measurement of radiation will give exact results as long as the temperature of one material is considered, but will not give concordant results when applied to another material. The recognition of this fact has led to the definition of "black body," this being one which radiates all the energy which it receives, but which does not reflect nor transmit any. It may, however, be possible, in the laboratory at least, to place a body under such conditions that it will behave as a black body; but, unfortunately, this condition can not always be attained in practice. If it could be, optical methods of measuring temperature would be simple and exceedingly accurate.

As is well known, determinations of luminous radiation which depend upon the eye are subject to serious errors, but, fortunately, the laws connecting luminous radiation and temperature are such that this method of determining temperature permits of great accuracy. The luminous radiation of a body increases many times faster than its temperature, so that, other sources of error being eliminated, an approximate measurement by optical means would give a far more accurate temperature determination. It is this law which has been taken advantage of in industrial applications for temperature determinations. The expert in charge, after long training, acquires considerable skill, and estimates temperatures by means of the brightness and color of the material with which he is working. Much dependence has been placed upon this method, for want of a better one, but obviously it is entirely unsuitable for scientific work, and there is too great a chance of error even for industrial purposes. The need of more exact methods of conducting industrial operations is now well recognized. This relation between temperature and luminous radiation which has made it possible for the eye to estimate approximately the condition of a material affords an opportunity for a simple and accurate method of temperature measurement. Comparing the luminous radiation from a body whose temperature is desired with that of another body which has previously been calibrated enables the temperature of the former to be determined with considerable accuracy, but it must not be forgotten that the temperature of the two bodies may not be the same, since the character of the radiation of the two will probably be somewhat different. This fault would be serious for scientific work if the relation between temperature and radiation of the body to be investigated could not be determined. For industrial application this difficulty is not serious, since then the necessity is not to determine the absolute temperature, but to be able to reproduce a certain temperature.

In all pyrometers whose readings depend upon luminous measurements, a standard of comparison is employed, and by varying the radiation from this or the body being investigated, a comparison is made and the temperature deduced from this. The variation may be made by reducing the amount of light radiated from suitably adjusted screens, and there are a number of ways of accomplishing this. Although the variation may not be accomplished by electrical means, it has been found that an incandescent lamp offers the most satisfactory standard, simply because it is easier to reproduce a given condition in an incandescent lamp than in other luminous bodies. The variations may, however, be brought about by varying the current through the filament of the incandescent lamp. This is a pretty method, and has an advantage in that the color of the light changes with a change in temperature, following more or less the color changes of the hot body being examined, and making, in general, a more exact adjustment possible. The comparison may be made directly between the filament and the hot body, or between two screens, each illuminated from one source. The former method is possibly the simpler of the two. It has been applied in two ways: by means of a telescope an image of the hot body under investigation is brought into the plane of the filament of the incandescent lamp, or the telescope may be omitted and the fila-

Digitized by Google

ment viewed with the hot body as a background. The current in each case is adjusted until the whole or a definite portion of the incandescent filament can not be distinguished from the background. Both of these methods permit accurate work to be done, provided the necessary precautions are taken. It must be remembered that not only are the radiations from the different bodies at the same temperature different, but each of the incandescent lamps will have its own characteristic, so that each standard must be independently calibrated, and the lamp must be handled with care, so as not to upset its constants. These are the precautions which should be observed in the use of the incandescent lamp for photometric standards.

There is still another method of pyrometry, depending upon an electrical effect. In this a thermoelectric couple is used, and an image of the hot body focused upon it. In this, optical measurements are not made directly. The method is subject to the errors of thermoelectric pyrometry, but may have advantages in certain classes of work.

The art of pyrometry has advanced greatly within the last ten years. Electrical methods have played no small part in this, and even though they can not be used directly, they may be used with advantage with methods depending upon other effects. It is difficult to estimate the importance of this art, but it will doubtless make possible advances in many industrial applications which heretofore have been thought unattainable.

WILL THE AUTOMOBILE DISPLACE THE TRAMWAY?

From time to time, as the automobile has been improved, it has been suggested that probably the new vehicle would displace the tramway or the car running upon a special way. To uphold this view it has been stated that the automobile bus will not cost any more to operate, if, indeed, it would not be cheaper because of the saving of expenses of laying and maintaining a track. It is also thought that a vehicle which is not confined in its movements to a track could make better time, because it would be able to run around an obstacle, whether it be a slowly moving vehicle or another car of the same system which has met with an accident. Other supposed advantages are the elimination of tracks from the streets, and the ease with which a route may be changed and advantage taken of several parallel streets when traffic on one particular route becomes dense.

The question has been examined by Mr. Henry M. Sayers, who gives his conclusions in the *Electrician* (London), for February 17. Mr. Sayers concludes that the advantage rests with the tramway. It is true his consideration is limited only to London conditions, but he points out the limits of his deductions. He finds that, comparing two of the larger companies in London, one operating nearly 1,400 buses, and the other operating 520 tramway cars, while the former carried fifty per cent more passengers, in order to do this, over 100 per cent more miles were run. The operating cost per vehicle-mile was greater. Thus, he finds that the cost per bus-mile was about 15.7 cents, while the cost per car-mile was only 12.1 cents. The cost per passenger transported was still more in favor of the tramway company, for it costs the bus company 2.4 cents for every passenger carried, while it cost the tramway company only 1.25 cents. These are the costs of operating the vehicles only. When the cost of maintaining the track and the pavement is added to that of operating the tram-cars, the advantage still remains in favor of the tramway system. Allowing for this, it was found that the cost per vehicle-mile of tramway was 15.1 cents, while the cost per passenger was 1.56 cents. These are to be compared with those quoted above for the bus system, since the latter has no track to maintain.

As to the advantages of freer movement on the streets, it is held that these are offset by the greater speed at which it is permissible to operate the cars. It is a very different thing to control a rapidly moving vehicle which is limited to a certain narrow strip of the street, than to control a vehicle which may run anywhere. In other words, when the driver must guide his vehicle, as well as control its speed, he should not be allowed to attain a maximum speed as high as that of a tramway car. According to this, the bus would lose much, if not all, which it would gain by being able to dodge or pass around other vehicles. There is a good deal of logic in this argument, and no doubt the general public would take this position.

As against the objection to tracks on the street, it is pointed out that the tramway company pays for the privilege of placing them, either by a direct tax or by maintaining more or less of the pavement of the street. With the bus system there is no such return. Instead of maintaining a street in good condition, the buses assist in wearing.

It is held by some that the expense of operating a gasoline or steam bus can be made less than that of operating an electric tramway car. If this be the case—and Mr. Sayers does not admit it—he thinks that the proper thing to do would be to change over our electric systems, and use gasoline or steam-moved cars on the tracks. Thus, the saving in operating expense, due to the use of a track, would be added to by that brought about by the new motive power.

It is admitted that these conclusions are not generally applicable, for, with decreasing traffic, the point may be reached where the cost of maintaining the track and the pavement may be such a great proportion of the total cost of operation as to make the tramway the more expensive of the two systems. Where such conditions obtain, it would be proper to adopt the automobile bus, provided the prospect of increased traffic is not sufficient to warrant a greater expense for the tramway system. The proper place for the automobile omnibus is along routes where they may serve as feeders to existing railway systems. In this field there will still be a considerable choice of system, for it may be found that the so-called trackless trolley system would be better than a pure automobile system, particularly when it is expected to convert the system to a tramway later on. A combination of an electric automobile and a trackless trolley system has some advantages for rural districts, as the vehicle would not be entirely dependent on the overhead system, and would be able to pass over routes where overhead conductors were not provided. It could charge its batteries while running under the trolley, and use this charge in passing from one route to another. The batteries for this service need not be very heavy, and the bus could cover a large area where even a trackless trolley system would not seem warranted.

Digitized by Google

TELEPHONE ENGINEERING—XIV.

BY J. C. KELSEY.

TELEPHONE SYSTEMS WITH SLIGHTLY CHANGING LINE CONDITIONS.

The first three systems discussed, Bell, Kellogg and Stromberg-Carlson, belong to the cut-off relay class, in which the line conditions go through a complete cycle of change. When the subscriber removes the receiver the line becomes charged. When the operator inserts plug to answer, the line discharges and an instant later the complete insertion of the plug charges the line again. This change in line conditions manifests itself in a severe receiver click, followed by a much milder click. The severe click comes from the opening of the line, and the rapid rate of change in the magnetization of the induction coil. The milder click is caused by the comparatively slow growth of the current in the line upon the introduction of the plug, by reason of the impedance of the induction coil.

The Sterling and the Western Electric Company No. 8 systems belong to the permanently bridged and balanced relay class, in which the entrance or withdrawal of the plug causes no change in the condition of the line. As a result, the subscriber is not aware of any receiver clicks coming from the operator's actions.

There is another class of systems, rather a combination of the above classes, in which the line signaling apparatus is permanently placed in the circuit, and the entrance of the plug increases the amount of current in the line circuit for talking purposes. We have found that it is the opening of the line that gives the severe receiver click, while the reintroduction of battery on the line gives but a mild click, which is governed by the time-constant of the induction coil.

Such a system has been designed by Mr. H. P. Clausen, of the American Electric Company. For ingenuity and daring this system deserves the highest place. The systems so far discussed have either cut the line lamp out of circuit entirely or have paralleled the line lamp by the cord lamp, but Mr. Clausen simply parallels the line relay by the cord relay, causing it to become inoperative. For efficiency and good operation, hundreds of systems and thousands of subscribers bear daily witness to its excellence.

Fig. 23 reveals this system, which is ostensibly a three-strand system, yet having many characteristics of the two-strand. For instance, one side of the talking circuit serves as a test terminal. This means that the busy testing devices

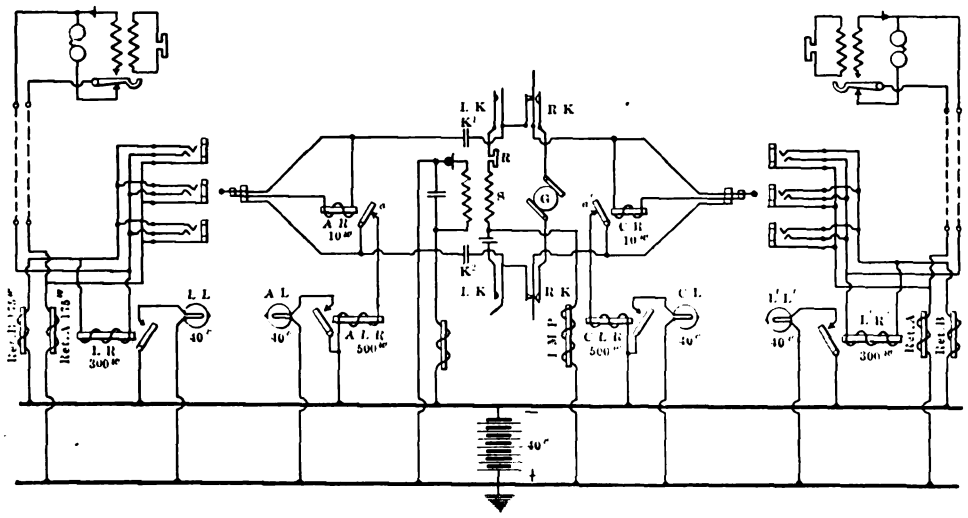


FIG. 23.—TELEPHONE SYSTEM WITH LINE SIGNALING APPARATUS PERMANENTLY IN CIRCUIT.

are of a two-strand nature and great precautions have to be taken to prevent the plug tip touched to the test terminal from lowering the potential of the line, and giving the talking subscribers a disagreeable series of clicks. A use of a talking strand for lighting the cord lamps reveals a two-strand characteristic.

Removing the receiver from the hook causes current to flow from the negative terminal of a forty-volt battery, through retardation "Ret B," through the 300-ohm line relay LR, through the instrument, thence back over the line to the test terminals, thence to positive battery through retardation "Ret A." Relay LR becomes energized, attracts its armature, causes line lamp LL to light; also a pilot relay, not shown in sketch, to become energized and light a pilot lamp, also not shown.

The operator plugs in and lamp LL and the pilot lamp are extinguished, because the ten-ohm cord relay AR has been placed in parallel with 300-watt relay LR and has weakened it to such an extent that it releases its armature contacts.

Lamp AL, the answering supervisory signal, is also extinguished, as the receiver being off the hook causes AR to become energized and attracts its armature. This breaks the contact *a*, which breaks the circuit of the answering lamp relay ALR which opens circuit of AL.

The operator throws key LK, ascertains number desired, and makes a test in the usual manner. The sleeve of the jack or test terminal is normally at positive or ground potential. Likewise, the tip of the plug is at same potential. Therefore, the touching of the tip to the test terminal causes no test current to flow and the operator plugs into the jack and rings the subscriber with RK.

Had the line been busy a negative potential would have existed on the test terminals and testing currents would have flowed from the busy sleeve to the plug tip, thence through the operator's receiver R through the induction coil secondary S, thence through IMP the safeguarding test impedance, measuring several thousand ohms, to ground. Each time the operator touched the terminal she would receive a resulting click, definite and reliable.

The act of plugging in lights the calling lamp CL, as battery has a path through the relay CLR, through contact *a'* of CR, through sleeves of plug and jack, thence to ground through the retardation "Ret A."

When the subscriber answers the relay CR is energized, prevents L'R' from operation, opens contact *a'* and deenergizes relay CLR, thereby opening circuit of CL.

When the parties hang up receivers the lamps AL and CL light and operator pulls down the connection.

The retardation coils A and B individualize the circuit, prevent cross-talk, cut down extraneous noises and regulate the flow of direct current. The relay in the cord circuit has high impedance, but of itself is not enough to prevent cross-talk nor to reduce extraneous noises. Subjected to considerable static strain this system is comparatively quiet, although not exactly balanced.

Another system of this class, shown in Fig. 24, reputed as belonging to the North Electric Company, reveals a well-balanced system with a natural busy test and using three strands.

Permanently bridged across the line circuit is a tandem relay with 300-ohm windings and connected to a twenty-four-volt battery. When the subscriber removes his receiver the relay is energized

Digitized by Google

and contact *a* is closed. This causes line lamp LL to light, the circuit being contact *a* of LR and contact *b* of relay COR.

When the subscriber removes receiver the line is charged with twenty-four volts flowing through 600 ohms and the natural line resistance. When the operator inserts the plug to answer, the line conditions are changed because the cord relay AR with its 115-ohm tandem windings parallels the 300-ohm windings of LR and the resistance of the circuit is lowered 435 ohms, which allows a corresponding increase in the line current. As the induction coil impedes the rise of the current, the subscriber only hears a mild click.

The insertion of the plug operates relay COR and opens circuit of LL at *b*. Supervisory lamp would also be darkened, as relay AR is energized and opens the lamp circuit at point *c*. To prevent the sleeve circuit from being opened at back contact *c* and thereby releasing relay COR the inner contact *d* puts 300 ohms in series with COR and thus holds the relay at all times. In parallel with lamp AL are two resistances in series, one 200 ohms and the other 300 ohms. They will not dim the lamp in any way and serve to prevent the releasement of COR. As the relay AR attracts its armature there is an instant of time when the cutoff relay circuit is open. As COR is a low-resistance relay, it will quickly demagnetize, but all the time the circuit may be open between the contacts *c* and *d* the circuit is still closed through COR and the 500 ohms. This will temporarily hold COR, or preferably delay its releasement until contact *d* is closed.

The operator answers with LK and tests for desired number. Both plug and jack sleeves are normally at positive or ground potential and no testing current flows. If the desired line is busy a negative potential exists which will cause current to flow from the busy sleeve to the tip of the testing plug CP, thence to ground through the upper winding of relay CR. Energy is therefore stored in the core of the relay CR. When the tip is removed the energy in the core dissipates and the rapid change in the magnetization of CR develops a pressure which forces a current through the bridged operator's receiver. The waiting subscriber also hears the test made as the condensers K^1 and K^2 make a path through the instrument.

Inserting the plug in desired jack lights CL in series with C'O'R' and opens contact *b'* so that line lamp L'L' will not light when party answers. When the party answers, relay CR is energized and LR as well. Contact *c'* is broken, CL is extinguished, contact *d'* made, which puts 300 ohms in series with COR and makes sure the energization of COR.

When the subscribers hang up receivers, AL and CL light up.

hook that both relays LR and COR would become actuated. But the relay COR is adjusted, so that when placed in circuit with LR, the line and instrument, it will not become actuated.

LR will become energized, light lamp LL through contacts *a* and *b*. The operator inserts the plug and line lamp LL

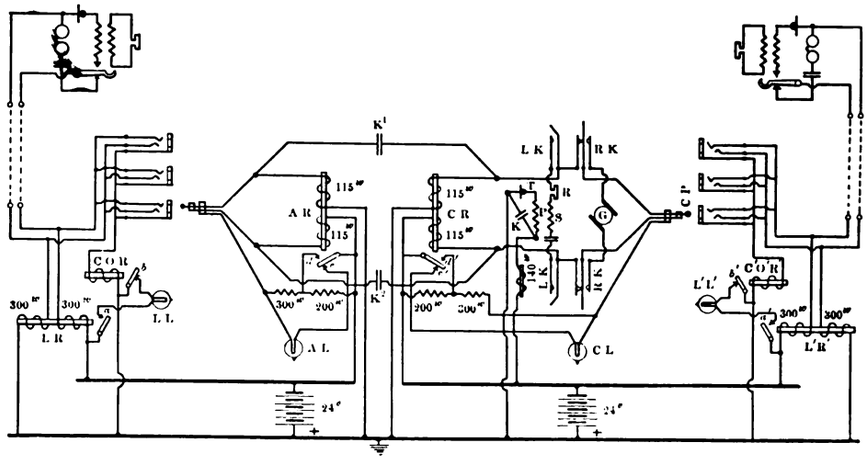


FIG. 24.—TELEPHONE SYSTEM WITH LINE SIGNALING APPARATUS PERMANENTLY IN CIRCUIT.

This system makes use of line and cord pilot signals, single-voltage lamps and has the only natural busy test in the independent list. The use of two batteries reminds one of the Kellogg system. Experience with thousands of subscribers bears out what inspection plainly shows, that this system is one of the successful commercial systems.

Another system of the same class is shown in Fig. 25, reputed to be used

is extinguished as COR is actuated by being placed in series with ALR, a relay of 450 ohms resistance. COR opens contact *b*, relay ALR closes contact *c* and causes both lamps AL and CL to become lighted. But since the subscriber is waiting the relay AR in parallel with LR will be energized and opens circuit of lamp AL at *d*.

The operator, throwing LK, communicates with subscriber through condenser

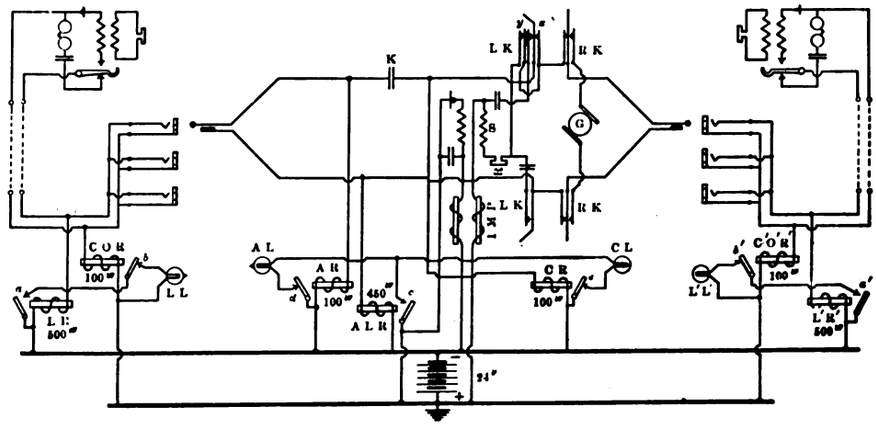


FIG. 25.—TELEPHONE SYSTEM WITH LINE SIGNALING APPARATUS PERMANENTLY IN CIRCUIT.

by the International people. Unlike the American and North, it is a two-strand system, and necessarily has to make use of rather bold expedients. It will be noticed that the line circuit consists of two relays in series with a twenty-four-volt battery. It looks reasonable that when the receiver is removed from the

K on tip side and sleeve side of the circuit. If the desired line is not busy, she plugs and rings with RK. Inserting the plug makes no change in the lamp already lighted but relay C'O'R' is actuated, being in series with ALR of 450 ohms. The adjustment is necessarily close, somewhere between 450 ohms and 600 ohms

Digitized by Google

for the shortest lines. Each line would have a particular adjustment and this can be called a weak point, for a relay has to be most carefully adjusted to discriminate between 450 and 600 ohms.

When the party answers, relay CR is actuated and opens contact *e* which extinguishes lamp CL. Battery is furnished for conversation through the COR relays in the line circuit and relays AR and CR in the cord circuit. These relays balance the circuit, individualize it and free it from cross-talk. However, LR and COR furnish enough energy for talking because the use of key LK cuts off CR from the called party when the operator breaks in on the conversation.

Had the line been busy the test terminal would have been at negative potential instead of positive and the clicks would have resulted. But the tips of this system are normally negative while the test terminal is normally positive. A false test would result. To get around this the negative potential of the tip is removed while the test is being made and the tip of the plug connected to ground or positive through the receiver and a suitably high impedance to prevent the sudden lowering of the potential of the talking circuit. This is done by LK, in which contact *x* is broken and contact *y* closed. Then the testing current flows from the negative test terminal through plug tip, contact *y*, receiver R, secondary winding S, through impedance IMP and to ground. The receiver notes the click and owing to the high inductance of IMP the talking subscribers are but faintly aware of a test being made on the lines.

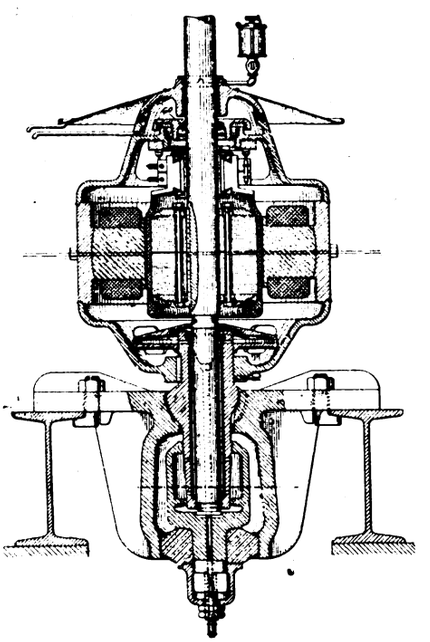
If the operator listens on a conversation, the receiver and secondary and two condensers are thrown in series on one side of the line, and the electrical condition of the line is changed as CR is removed from the circuit. But this case is rare in a common battery system. There is no necessity for listening.

When the subscribers hang up, relays AR and CR release armatures, lighting up AL and CL; withdrawing plugs deenergizes ALR and lamps go out.

The underground railway system of London is operated only in part by electricity, steam locomotives still being employed on a number of the lines. When the electrification of all the subways is completed, as planned, one will be able to travel sixty miles underground without running twice over the same piece of track.

An Electric Drive for Hydroextractors.

An electrical drive for hydroextractors has been recently patented by William L. D'Olier, of Philadelphia, Pa. The invention relates to apparatus, such as is employed in laundries, dyeing establishments, and the like, or in any relation where it is desirable to separate liquids from solids, liquids from liquids, or solids from solids by means of centrifugal action. The invention comprises a centrifugal machine of any well-known type driven by an electric motor, the whole being so disposed that the motor and centrifugal may deflect from a given normal position under the



ELECTRIC DRIVE FOR HYDROEXTRACTORS.

influence of dissymmetry of the parts themselves or on account of the unsymmetrical loading of the centrifugal machine. An electric motor is also employed which is directly connected to a centrifugal machine, the centrifugal machine being mounted above the electric motor, the rotating elements of the motor and the machine being both secured to a rotatable vertical shaft, which shaft bears at its lower portion. The fixed and rotatable elements of the electric motor are so arranged that, when the motor is loaded, there is a tendency to float the rotatable elements of the motor, the shaft and the centrifugal machine, so that the centrifugal machine is, in fact, magnetically floated, whereby the friction effects are greatly reduced. The centrifugal machine is arranged above a floor or platform, the motor driving the same by direct connection and located below such floor or platform.

American Electrochemical Society.

The annual convention of the American Electrochemical Society will be held at Boston and Cambridge, Mass., April 25, 26 and 27. The headquarters will be at the Hotel Lenox, Boston.

The following papers have been promised:

A. Reuterdahl, "The Interdependence of Atomic Weights and Electrochemical Equivalents."

C. Hambuechen, "An Optical Method of Observing a Diffusion in an Electrolyte."

A. B. Albro, "The Microstructure of Silicon and Silicon Alloys."

Dr. L. Kahlenberg, "Paper on Osmosis."

Professor C. F. Burgess, technical paper.

Professor H. R. Carveth, "Electrolytic Precipitation of Chromium."

Doctor J. W. Richards, "Conduction in Electrolytes."

Professor J. C. Blake, "The Migration and Coagulation of Colloidal Suspensions."

C. G. Richardson, "Water Power of the Canadian 'Hinterland.'"

R. C. Snowdon, "Electrodeposition of Silver."

R. C. Snowdon, "Adherence of Nickel to Nickel."

Ernst Fahrig, "Treating Low Grade Ore and Tailings by Electrolysis."

Carl Hering, "Removing Solvents During Electrolysis."

A. Lodyguine, "Some Experiments with the Reduction of Titaniferous Ores into Steel and Titanate of Iron. Experiments with the Reduction of Different Oxides of Lead by Electric Current." "Some Results of Experiments with the Electrodisposition of Metals on Aluminum."

H. M. Goodwin, "On Billitzer's Method of Determining Absolute Potentials."

G. A. Hulett, "A Low-Voltage Standard Cell."

A writer in a current issue of a contemporary, states that the ordinary acid solutions should not be used as a flux in soldering electrical connections. The acid solutions will attack the insulation if they come in contact with it. A noncorrosive flux can be made by dissolving rosin in alcohol.

Digitized by Google

An Important Italian Hydroelectric Installation.

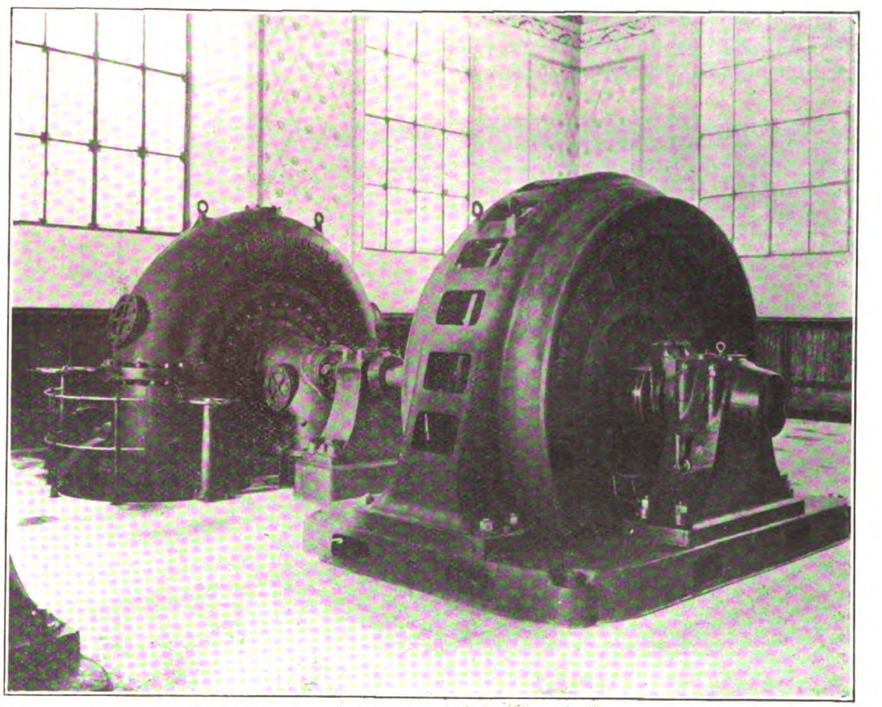
Description of a New Water-Power Station Planned by Italian Engineers and Equipped Entirely with Italian Machinery.

By Enrico Bignami.

IN RECENT years many electric installations have been made in Italy, particularly for developing water powers, and before long every small village will have, it is believed, its own. But those which have been made up to this time—at least the more important ones—have been carried out entirely or in part with material and machines furnished by foreign houses. Now, however, the rich and busy district of Royaume counts, among others, an important hydroelectric installation which was made recently, and entirely by Italian firms, nearly all of these being of Milan.

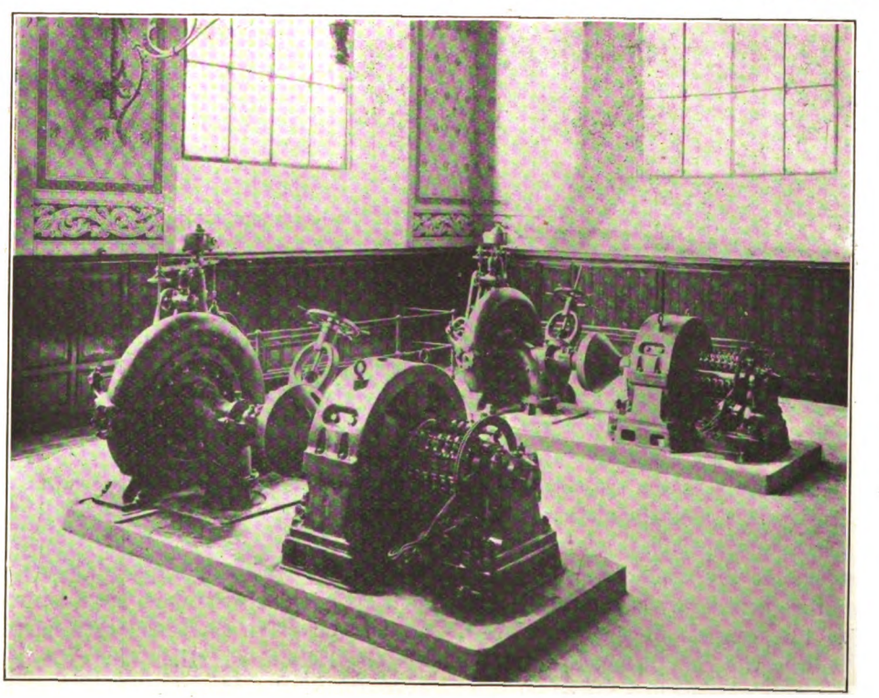
This installation is at Zogno, in the province of Bergamo. It makes use of a branch of the Brembo, the utilization of which was proposed in 1889 by an Italian engineer, Signor Guiseppe Villoresi. Following him, the Societá Anonyme pour Entreprises Électriques Conti, of Milan, acquired the rights, and, having overcome much local opposition, obtained a concession and constructed a plant, which was put into service a few months ago.

The quantity of water which the company may use is estimated at ten cubic metres per second with a fall of 57.6 metres. This gives a power at the shafts of the turbines of 6,000 horse-power. The head works are in the neighborhood of the village of San Pellegrino, which is celebrated for its mineral baths. They consist of a curved dam fifty-two metres long, with the lower part stationary, constructed of concrete, and the upper part adjustable, according to the Poiret system. There is an intake house furnished with three gates and a waste weir, etc. The dam is founded on rock, at a depth of eight metres below the bed of the river. These foundations were made during the winter, without it being necessary to adopt any special system of work. The flow of the river was deflected so as to leave first one half of the bed of the river dry, and then the other. The banks of the river were graded to correspond with the intake works, and covered with stone. The canal for conducting the water away from the dam is 7.5 kilometres long, and it winds, in part, along the side of mountains, and in part through tunnels, one of these being more than a kilometre in length. It passes through two inverted siphons. The discharge canal is 500 metres long. There are four pipe lines, each formed of a steel pipe 1.3 metres in diameter and 102 metres long. There is, in addition, a fifth pipe for driving the exciters.



TURBINE AND ALTERNATOR, HYDROELECTRIC STATION AT ZOGNO, ITALY.

The station is situated in the suburbs of Zogno. It is a large building and—sometimes rare for such installations—is very carefully designed with respect to its architecture. It contains four Francis double turbines, each rated at 2,000 horse-power when operating at 315 revolutions per minute. These are directly connected to three-phase alternators, without the use of elastic couplings. One of the alterna-



EXCITER UNIT, HYDROELECTRIC STATION AT ZOGNO, ITALY.

Digitized by Google

tors is held as a reserve. The voltage of the generators can be varied from 2,400 to 2,600. Two small Pelton wheels, rated at 150 horse-power each, and operating at 600 turns per minute, drive the exciters. To each alternator are connected three three-phase transformers, rated at 600 kilovolt-amperes each. These raise the tension to 24,000 volts.

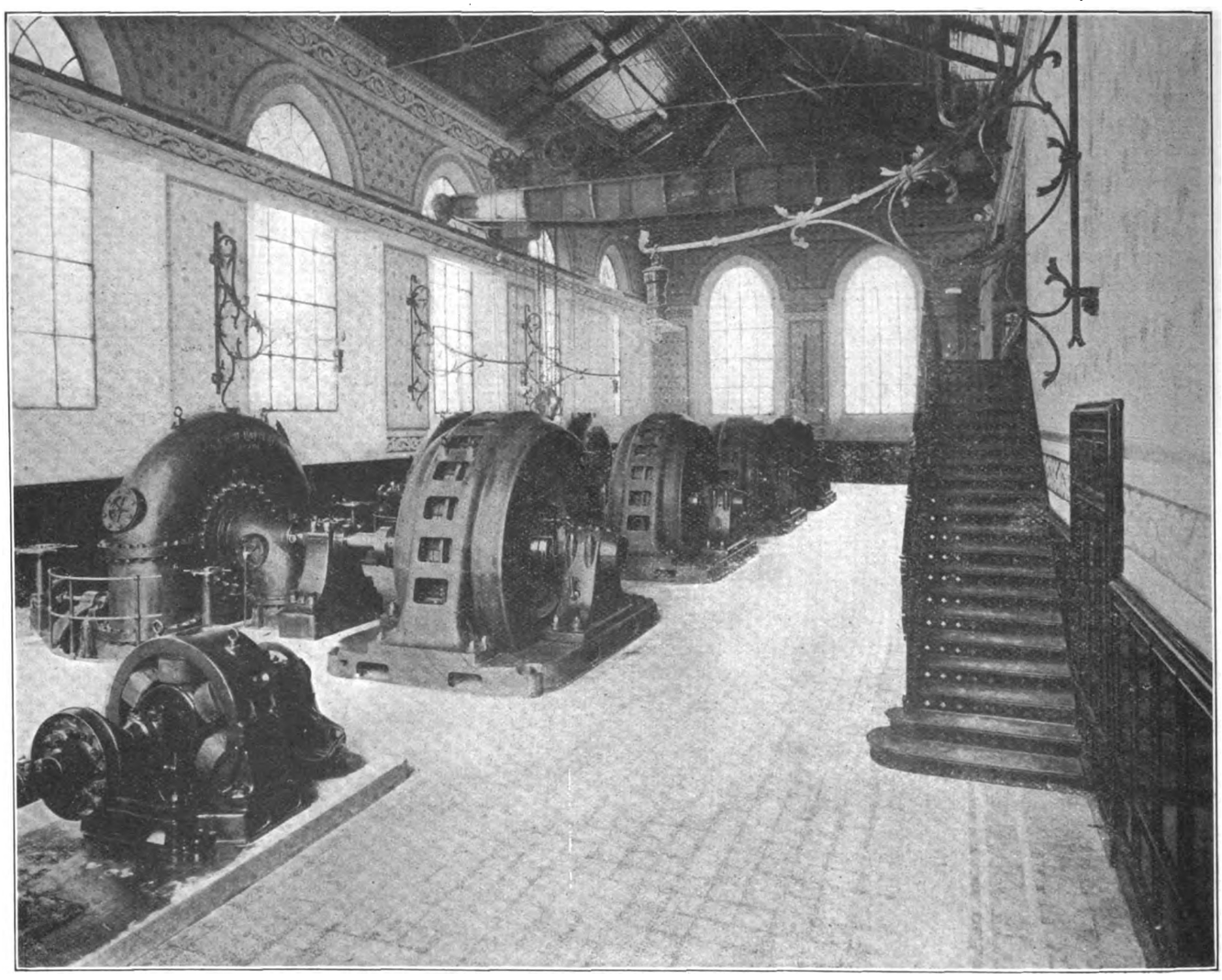
The distributing switchboards are rather remarkable technically, for no switches or marble is used in their construction, and the high-tension and low-tension circuits are separated completely. All the elements of the switchboard are separated. This gives complete reliability for the station operators, guarantees the plant against fire, and carries, in addition, other noteworthy advantages.

The line consists of five wires, each 8.5 millimetres in diameter. In the mountainous sections it is placed on poles a great distance apart. Along the plain the distance between the poles is sixty metres. These poles are of a new type, and are elastic in the direction of the line. This type of pole is due to an idea of Signor Ettore Conti, the engineer for whom the company is named. He had in mind not only elastic poles, but also believed that, should all the wires break simultaneously, the neighboring poles could be depended upon to take up the tension, which would decrease gradually as the strain was transmitted from pole to pole. On this hypothesis he has been able to diminish notably the weight of the poles, and, as a consequence, their cost.

The line runs from Zogno to Arcore, and has a length of 35.5 kilometres. From Arcore the energy is distributed to Monza, Carate, Desio, Seregno, Meda Mariano, Bovisio, Seveso, Mombello and all the districts lying between these large centres. On account of an agreement between the Société Edison de Milan and the Société Conti, the energy supplied by the Brembo plant takes the place of that formerly distributed from the Paderno installation, so far as its sale in the territory of Monza is concerned. It will be more profitable to the Société Edison to dispose of the energy transmitted from Paderno at Milan. The Société Conti has also taken the place of the Société Monzese.

The patriotic feeling of the Italians is flattered by this installation, which has been carried out—and profitably—entirely by home industries, which have thus shown again that they can compete successfully with foreigners. The electrical part was planned and carried out by Gadda, Brioschi & Company, of Milan. The screens, water gates and all mechanical accessories were furnished by Larini & Nathan, of Milan, and the turbines by Riva & Monneret, of Milan, also. The pipes were furnished by the Forli works, the iron poles by the Savigliano works, and the insulators by the Société Richard & Ginori, also of Milan.

The Société pour Entreprises Électriques Conti is indebted for its success to its management. The company also



INTERIOR VIEW OF POWER-HOUSE, HYDROELECTRIC STATION AT ZOGNO, ITALY.

Digitized by Google

owns an installation at Cerano-Trecate, and is planning to construct one at Buffalora on the Tessin, and a third at Vigevano, where 6,000 horse-power will be generated, which will be transmitted to Milan.

POWER-HOUSE, HYDROELECTRIC STATION AT ZOGNO, ITALY.

TRANSMISSION LINE FROM HYDROELECTRIC STATION AT ZOGNO, ITALY.

National Electric Light Association.

The National Electric Light Association announces that the Jury of Awards of the St. Louis Exposition has awarded it a gold medal for its publications and its work in advancement of the electric lighting industry.

The data asked for by the association, to be used for the annual revision of its "Municipal Lighting Statistics," are being returned this year with unusual promptness.

The first list of questions for the 1905 question box, edited by Mr. Homer E. Niesz, 139 Adams street, Chicago, Ill., has been sent out. The list contains 444 questions, covering twenty-six headings. This list has been sent out to all of the electric light companies in the United States and Canada, and to electrical manufacturers, engineers, dealers and technical colleges. Answers are desired from all who are competent to reply to any one or more of the questions. These replies should be received by March 24.

New York Motor Boat and Sportsmen's Show.

At the Motor Boat and Sportsmen's Show, held at Madison Square Garden, New York city, February 28 to March 9, there were a few exhibits of interest to electrical people.

The Edison Manufacturing Company, Orange, N. J., had an exhibit of primary batteries and spark coils. A number of the motor boats and gasoline engines in operation at the show used these batteries and spark coils.

The Marinette Gas Engine Company, Chicago Heights, Ill., had a gas engine on exhibition, which was direct-connected to a nine-kilowatt, 125-volt generator.

The Electric Launch Company, Bayonne, N. J., had a number of auto-boats on exhibition, and a thirty-foot electric launch in operation in the large pool in the centre of the building. Included in the Electric Launch Company's exhibit was a General Electric mercury vapor rectifier, used in charging the batteries of the electric launch.

William Roche, New York city, had an exhibition of spark coils and dry batteries.

C. F. Splitdorf, New York city, exhibited a number of spark coils, among them a new form of coil which has been brought out especially for marine work. These coils are all provided with a new form of vibrator which has lately been applied to the Splitdorf coil.

The Dayton Electrical Manufacturing Company, Dayton, Ohio, had an exhibition of Apple ignition dynamos.

The Metz & Weiss kerosene engine was represented by a number of engines in operation. One of these was direct-connected to a generator which supplied energy for operating the electric sign over the company's booth.

It is proposed to fit lightships Nos. 71 and 72 with apparatus for wireless telegraphy. These lightships are located on the Diamond Shoals on the coast of North Carolina.

Digitized by Google

The Proposed Central Power Station at Washington, D. C.

Mr. Bernard R. Green, superintendent of Library Building and grounds, Washington, D. C., has submitted to the speaker of the House of Representatives, the report made to him by Professor S. Homer Woodbridge, of the Massachusetts Institute of Technology, on the plans for the new central power station for a number of the government buildings at Washington. The purpose of the new station is to supply heat for properly warming the buildings in cold weather, and to supply power for all purposes, including lighting, pumping, elevator service, mechanical work of all kinds, ventilation, etc. Also to remove and dispose of all steam boilers and engines of every kind, and all electric and other power generators now in the several buildings.

The report takes into account the following existing buildings: White House, Treasury Department, State, War and Navy Departments, Winder Building, Court of Claims, Washington Monument, Bureau of Engraving and Printing, Post Office Department, Smithsonian Institution and National Museum, Army Medical Museum, and the following new buildings now under construction: Municipal Building, Department of Agriculture, National Museum—practically thirteen buildings in all. The Smithsonian and old National Museum, being already connected mechanically, are treated as one. The projected Hall of Records, west of the State, War and Navy Building, has not been included in the estimates because not yet definitely authorized by law, but it may readily be connected to the central station plant when constructed.

The nine buildings of the executive group in present use contain seventy-three boilers, aggregating some 4,500 nominal horse-power, under which are burned annually from 20,000 to 23,000 tons of coal. The buildings are furnished with engines, generators and steam pumps, approximating, in the aggregate, 2,500 horse-power. There are employed in connection with this segregated system 145 attendants in various capacities.

To these boiler, fuel and attendance figures, relating to the buildings now in use, must be added those pertaining to the equipment and operation of three large projected plants, if the isolated method of equipment and operation is extended to the new Municipal, National Museum and Agricultural buildings, making a probable total of eighty-five boilers, burning some 35,000 tons of coal annually, 3,500 horse-power in engines and other mechanisms, and 190 employés for operating the twelve segregated plants.

The principal item of cost to be incurred in any execution of the proposed plan of centralization is the interest chargeable to the investment required for—

1. The purchase of land; the building of a power-house suitable in proportions and arrangement for the proposed use and also appropriate in architectural design for a place among the monumental buildings it is to serve; the purchase of boilers and accessories of furnishment for the building, including provision for coal storage and for coal and ash-handling, engines and generators, electric storage battery, condensing and economizing apparatus, traveling cranes, and other apparatus, switchboards and electrical outfit, and mechanism for heat distribution.

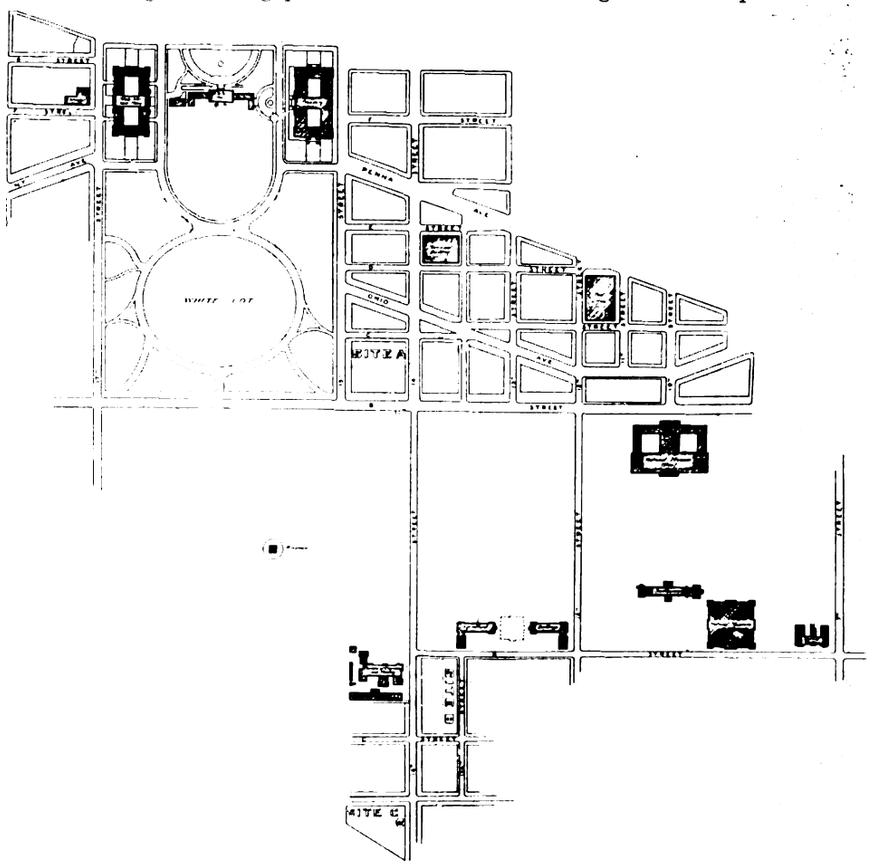
2. The connection of the several buildings with the central plant, by a piping system for the carriage of heat and by electrical conductors for the transmission of electric energy for power and lighting purposes, and the protection and insulation of such piping and cables.

3. The modification of apparatus already installed or in use in present buildings; the grafting of the piping and wiring systems of the present buildings onto the new system of distribution and return.

To such items must be added the losses on discarded material in present installations and which can not advantageously be incorporated in a central power-house installation; any increased expenses of operation, maintenance and repair over similar expenses incurred with the present segregated installations, and the further expenses incident to losses due to leakage of electrical and thermal energy from connecting cables and pipes between station and buildings.

The leading items of profit due to centralization are the various economies obtainable in the operation of an aggregated plant of modern type. These include:

1. All items pertaining to the purchasing, carriage, storing and handling of fuel, the grade and market price of fuel and the handling and disposal of ashes being considered; (2) the efficiency of the boilers and the increased power value of steam produced because of higher pressures allowable than would be justifiable in buildings occupied by large numbers of employés; (3) the providing of power and lighting and the cost of electrical production and distribution instead of purchasing such current from and with



MAP SHOWING LOCATIONS FOR PROPOSED CENTRAL POWER STATION, WASHINGTON, D. C.

Digitized by Google

profit to a mercantile corporation; (4) the utilization of the usually wasted heat in exhaust steam and in combustion gases; (5) the reduced cost of labor because of the compactness of equipment; (6) the considerable aggregated space which would be vacated and made available for offices and storage or other uses in the several buildings from which boilers, engines, generators and other mechanisms would be removed and in which the storage of coal and ashes would be discontinued; (7) in the abatement of the risks of fires and of the nuisances of smoke, gases, heat, dust, noise and vibration and of other inconveniences and losses incident to boiler work within occupied buildings.

The selection of a location for a central station should have due reference to the location of present buildings and their requirements and to the probable sites and sizes of such future buildings as the plant may be called upon to serve. The location, furthermore, should be favorably situated for easily and inexpensively furnishing fuel to the central station, and for similarly disposing of ashes, and also for obtaining tide-water for condensing-engine purposes.

By the study of available records the centres of balance of both thermal and electric consumption have been determined. Both of these centres lie close to square No. 230, bounded by the streets B and C and Fourteenth and Fifteenth N. W. It was deemed advisable to make a careful study of the entire problem with first reference to a location of the station at that most central and consequently most favorable of all points.

Square No. 230, the location of the highest economic value, is designated as Station A.

The subsidiary reasons in support of the selection are:

The location is accessible by electric tramway, by which the power station may be connected direct with the steam railway and from which the steam railway coal cars may be drawn, preferably at night when passenger traffic is suspended. The tide-water may be brought to the site by piping carried through a large and vacated sewer in the close vicinity, and waste water may be disposed of through the same sewer-way. A large future growth of the plant may be provided for by acquiring the square No. 229, north of and adjacent to 230, and by closing and occupying the short and narrow street between the two areas. Such an extension would accommodate a station building sufficiently large to house a boiler, engine and generator station of three or four times the size required for present demands.

In the proposed station in place of the present seventy-three boilers in twenty or more isolated stations, aggregating some 4,500 horse-power, a central station equipment, which shall include boilers for the three additional and large buildings, may not contain more than ten boilers of 400 horse-power each, all in one boiler room. On an emergency, high-efficiency boilers having a nominal capacity of 4,000 horse-power could be easily forced to a 6,000-horse-power steam output.

The central station, or power-house, located where proposed would be in close proximity to some of the principal government buildings, and should be designed to comport with the architecture which does now or shall in future characterize them.

In the accompanying cross-section of the building the floor of the basement is shown on the same grade with the street, and the spur tramway tracks are carried into that part of the station which will become central by any such enlargement of the building as is outlined. Cars may be run on a level grade into the building, where coal may be dropped into pockets and thence carried by conveyers either to the large storage hold above or else to the boiler-room pockets. Ashes may be carried by conveyers from boilers to storage pits, and raised from the pits by mechanical conveyers to cars. Cars may be run under the engine room, and machinery may be lifted or lowered through the trap-door by the traveling crane. The basement space and height afford ample room for condensers, pumps, piping and apparatus connected with the power and heating systems, and that part beneath the boilers furnishes ample space for the handling and conveying and storing of ashes and for locating and operating the conveying machinery. Between the shown and the prospective boiler sheds is a room for coal storage having the capacity for a fortnight's supply under conditions of average maximum demand.

Provision is made for utilizing the heat of combustion gases escaping from boilers to chimney by means of superheaters and economizers. The boilers should be of a type to safely and economically furnish superheated steam at from 175 to 200 pounds pressure to the square inch.

The central station site, thus tentatively located in the position of highest available working economy and with reference to the largest probable demand for space, is advisably equipped with apparatus and devices for ensuring the fullest economy of installation and operation.

From the engine standpoint, the problem presents its most interesting difficulty. The engine to be harnessed into work of the character in question should be of the simplest type, both as to mechanical principle and to operating mechanism. It should be usable without difficulty as a non-condensing engine, and without waste of steam. It should also be capable of furnishing power with a maximum efficiency under high-vacuum condensing conditions. The modern steam turbine, now emerging from the experimental into the development stage, is better adapted, in the simplicity both of its mechanical principle, and of its construction, to the wide range of exhaust-pressure conditions incident to the method in question than is the high grade, but complex, mechanism of the modern condensing engine.

In regard to thermal transmission the report states that heat may be conveyed from a central station to the buildings of the executive group either by steam or by water. The various advantages and disadvantages of the two systems are discussed and the preference is given to water as the most appropriate vehicle for heat conveyance.

For the purpose of reducing the first cost of installation and also the after-cost of heat loss from pipes, the pipe plan submitted for Station A is proportioned for a working-pressure difference between the feed and discharge sides of a centrifugal pump of 200 feet hydraulic head, or 100 feet propulsion and 100 feet "suction." Such a drop of pressure on the "suction" side of the pump is made practicable because of the hydrostatic head of 122 feet to which the circulating system would be subjected, due to the height "above reference" of the fourth floor of the State, War and Navy Building. Such static pressure would neutralize the "suction" effect of the pump, and, with the pump working on the cooler side of the heater, would prevent any liability of a vapor "break" in the water.

It is further advised that the water be circulated in such manner that in the coldest weather it shall lose not more than thirty degrees in temperature in complete circuit, and that the ratio of the length of time the water may be retained in the buildings to that it shall be in traversing the pipes shall be made as large as practicable.

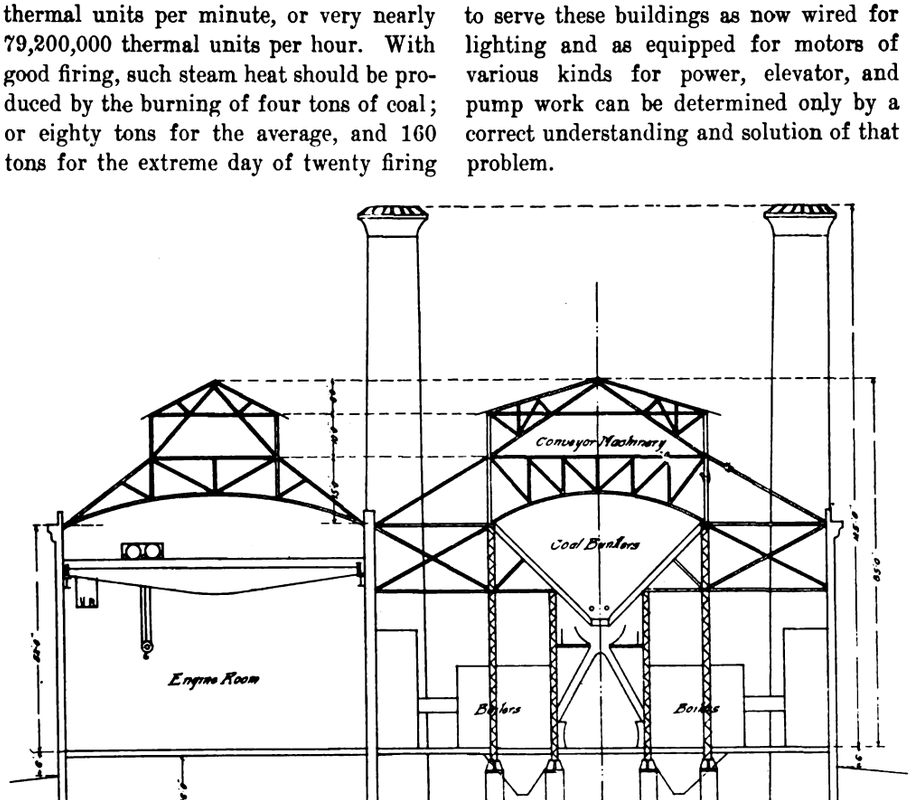
The maximum quantity of water proposed for the system for the executive group is 11,500 gallons per minute, or,

Digitized by Google

roughly, 88,000 pounds. The maximum drop in temperature proposed for severe weather is thirty degrees, making the corresponding heat quantity approximately 2,640,000 units per minute. It is computed that the average heat quantity passed into the pipes will be fifty per cent of the above named, or 1,320,000 thermal units per minute, or very nearly 79,200,000 thermal units per hour. With good firing, such steam heat should be produced by the burning of four tons of coal; or eighty tons for the average, and 160 tons for the extreme day of twenty firing hours; a probable total of some 16,000 tons for the heating season.

The estimated heat loss from transmission pipes is 0.25 thermal unit an hour per square foot of pipe surface and for one degree of temperature difference between the pipe surface and the earth temperature outside the walls of the trench, the pipes being embedded in granulated cork. The average water temperature is estimated at 150 degrees, and that of the earth at forty-five degrees Fahrenheit. The average loss per square foot of pipe surface would then become twenty-six and one-half thermal units per hour. That loss per square foot multiplied by the total area of the pipe surface, namely, 64,000 square feet, gives 1,696,000 thermal units per hour as the average loss. This quantity is 2.14 per cent of the heat supplied to the pipe system, and is equivalent to 0.0848 ton of coal per hour, or 2.04 tons per day of the heating season of two hundred days, making a yearly total of 408 tons.

A careful study has been made of the many factors which enter into the complex problem of the transmission of electric power and of current for lighting to the respective buildings of the executive group. The type of current best adapted to serve these buildings as now wired for lighting and as equipped for motors of various kinds for power, elevator, and pump work can be determined only by a correct understanding and solution of that problem.



Cross-Section of Proposed Central Power Station, Washington, D. C.

The adoption of the high-potential alternating-current system would make necessary a change of that current at the buildings into low-potential electricity, for which transforming apparatus would be required. The quality of copper and insulation suited to the two kinds of current, the subdivision of the cables into those for power and those for lighting, the installation cost of transformers, the cost of increased attendance in connection with transforming service, the energy lost in the process of transformation as well as that of transmission, the cost of changing present and costly direct and low-potential equipment already installed in buildings, and of adapting the systems to the alternating current, have proved to be serious obstacles to the use of that type of service. The further considerations of the far greater adaptability of the direct current to all the general purposes for which electricity is used in this group of buildings; of the relative simplicity of the direct current and the reliability of its action; the ready control of as well as the uniformity of the intensity of the current furnished by it for incandescent lighting, affecting both the luminosity and life of lamps—that most important part of the entire electric service—have contributed to the argument in support of the superior fitness of the direct-current service to the general use and conditions prevailing in the buildings of the executive group.

The investigation has rendered it evident that for the average transmission distance and for the average transmission load, and for the nature of the work peculiar to this case, the low-potential direct current is preferable to the high-potential alternating current for power and light distribution from the central station A.

The land required for a central power plant building is in any event likely to become government property, as will also much more, if not all the land lying north of the Mall, and west of the present botanical gardens and south of Pennsylvania avenue. In the following estimate, it is therefore assumed that the lot designated as "Site A" will eventually become government property, and its cost is not charged to the account of the central plant.

The estimated cost of Station A is as follows:

Building for twenty 400-horse-power boilers and corresponding engine, generator and coal-storage capacity, 176 feet by 250 by 80 feet = 3,520,000 cubic feet, $450,000.

Proportion of building chargeable to proposed immediate plant, $225,000.

Ten boilers, 4,000 horse-power, at $14 per horse-power, $56,000.

Economizers, at $5 per horse-power, 4,000 horse-power, $20,000.

Boiler piping, feed-water heaters, pumps, etc., $18,000.

Coal and ash-handling machinery, $15,000.

Traveling crane, $7,000.

Engines and generators, switchboard, condensers, etc., 2,350 kilowatts, $204,450.

Electric storage battery, $120,000.

Rotary pumps, tank, supplementary heaters, etc., $3,000 per 1,000 gallons per minute, 11,000 gallons, $33,000.

Piping, pumps, and motors for supplying condensing water, $2,900.

Trenching, transmission piping, insulation, $91,590.

Changes in buildings for heating by water, for entrance, and for connecting

Digitized by Google

distributing mains with present or altered heating systems, $60,300.

Electric cables, conduits, entrance to buildings, etc., $195,300.

Changes in buildings for lighting and power, including elevator equipment, service pumps, etc., $118,500.

Total cost of instalment, $1,173,040.

Installation expenses, per annum, $57,-555.

Operating expenses, per annum, $211,-855.

Cost of operating equivalent segregated plant, $327,677.

Total operating costs and investment charges, aggregated plants, $211,855.

Annual profit in aggregated plants, $115,822.

In addition to Station A, two other locations for the station were considered, known as "Site B" and "Site C."

"Site B," opposite the Bureau of Engraving and Printing, was chosen as the best location to be given a power plant on the south side of the Mall.

If located at "B," the character of the building, in matters of material and of architectural features, would admit of a lower construction cost than at "Site A." The value of this item of saving may be placed at approximately $70,000 for the proportional part of the building chargeable to present requirements.

The piping required for the transmission of heat by water and to the Post Office and Bureau of Engraving and Printing by steam for drying, etc., from this station to the buildings would be $131,850, and would be $22,950 greater than for Station A.

The carefully estimated costs of electrical cables and conduits for the distribution of power and light from this station to all the buildings of the executive group would be $288,000, as against $195,300 for "Site A." While, therefore, there might result a possible saving of $70,000 in the power plant building, such saving would be offset by the difference in costs in the transmission systems, amounting to $20,850 for the heat pipes and trenches, and to $92,700 for the electric cables and conduits, or to a total increase of $43,550 in the cost of installation. The loss in operating costs in heat loss would be increased as the lengths of piping are greater and as pipe surfaces are larger. Those surfaces are in a ratio of 1 for "Site A" to 1.42 for "Site B." The increase in heat loss would be equivalent to 200 tons of coal per year.

The cost of obtaining condensing water from the Potomac would be greater for "Site B" than for "Site A." In the matter of piping, the increase would be $1,400, and that in power required during the summer months, when exhaust steam can not be utilized, would be equal to some fifteen horse-power for twenty hours per day; or, for the one hundred and thirty days, the saving would be approximately the cost of twenty-four tons of coal.

An extreme location for the station, known as "Site C," would be at the foot of Fourteenth street, on the bank of the Potomac. The principal advantage to be claimed for this location is the distance of "smoky chimneys" from the buildings served and the city in general.

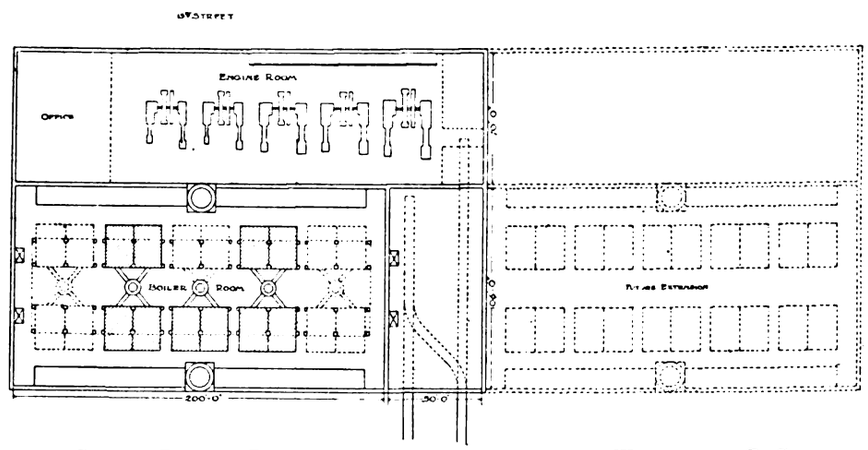
Possibly the character of the building at that site might be so simplified, in stripping it of all ornate features and constructing it of cheap but substantial material, as to reduce costs $50,000 below those of a building suitable for "Site B," or $120,000 below those noted as probable for "Site A."

There would be required a further total of 2,200 running feet of twenty-inch pipe and trenching, costing $16,500 additional.

The longer distances from this site to the buildings of the executive group would make necessary a hydraulic head, or pressure, of 122 feet propulsion and 122 feet "suction" for circulating water through the transmission system, a pressure so great as to be of questionable safety in application under existing conditions of static head. The remedy would be in larger and more costly main pipelines.

The most economical production and distribution of electrical current for power and lighting from this station would make it advisable to employ a dual method of high-potential alternating current for lighting and high-potential direct current for power service. The use of high-potential circuit so reduces the sizes and costs of copper conductor wires as to make the expense attending the installation of cables and conduits $30,050 less than that for the corresponding installation for electrical distribution from "Site A." The reduction includes the cost of the required transformers. Additional changes within the buildings would be required, to adapt the power and lighting systems to the changed currents, at a cost of $35,-600. Likewise, a change in the number and capacity of the power-house electrical generating units would be made necessary, such change eliminating the storage battery and increasing the engine and generator capacities, and reducing costs of power-house installation $41,250.

The costs of the complete electrical installations, excluding buildings and boilers and the boiler-room piping and furnishing—all of which would be required for heating—are as follows for the sites "A," "B," and "C," the storage battery being included for sites "A" and "B," and the service for the Bureau of Engraving and Printing being included and omitted as indicated:



Ground Plan of Proposed Central Power Station, Washington, D. C.

	Site A.		Site B, with Bureau.	Site C, without Bureau.
	With Bureau.	Without Bureau.		
Power-house equipment	$303,250	$280,500	$308,300	$243,250
Transmission system	195,300	162,650	287,800	192,600
Changes in building equipment	118,500	118,500	118,500	154,100
	$617,050	$545,650	$709,750	$539,900
Estimated total annual saving	84,211	59,902	77,665	55,836
Per cent return on investment	13.70	10.60	10.90	10.30

The report concluded with a summary of the advantages and disadvantages of the central station and the various sites, and a recommendation that a central station be immediately erected on "Site A,"

Digitized by Google

FUEL ECONOMY IN STEAM POWER PLANTS—III.[1]

BY WILLIAM H. BOOTH AND JOHN B. C. KERSHAW, F. I. C.

To produce superheated steam has proved more difficult than might be anticipated, owing to the variable conditions of the furnace. To prevent superheater tubes burning away, steam is often made to rush through them at a high frictional velocity, whereby its pressure being reduced twelve, fifteen and even twenty-five pounds, much of the gain of superheating is sacrificed. In separately fired superheaters no tube will stand a temperature above, say, 1,400 degrees Fahrenheit. Few will stand more than 1,000 degrees Fahrenheit to 1,200 degrees Fahrenheit. But a furnace worked with any regard for fuel economy has a temperature of waste gases of 2,500 degrees Fahrenheit or 3,000 degrees Fahrenheit. All separately fired superheaters that do not possess a system of water control and temperature reduction are made safe against the high furnace temperature by an enormous inlet of cold air through the grate or door, or through special air openings. As the superheater must inevitably reject its gases at, say, 700 degrees Fahrenheit, the surplus air is all rejected at that high temperature, and a large proportion of the advantage of superheat is lost. The separately fired superheater should abstract the surplus furnace heat in a rational manner, and this is best done by means of a shield of water between the furnace and the superheater. The advantage of the water protection shield in advance of the superheater tubes is that the feed-water for all the boilers of the set may be passed through the tubes and raised to the boiler temperature. The advantages of thermal storage are thus secured, for these are chiefly confined to the high rate of evaporation at which a boiler can be forced when fed with fully heated feed-water. Not only is priming reduced or prevented, but the whole working of the boiler is rendered more efficient.

To secure superheat economically, it is first necessary that the steam-way through the superheater tubes should have an area equivalent to twenty-five to fifty per cent in excess of the boiler steam pipe. The ordinary small-tube superheater, if given so much equivalent area, would not then cause the serious loss of pressure it now causes, but it would burn away more rapidly than it now does. In Germany, where, probably, small tube superheaters have a larger allowance of area, this burning out does occur rapidly, but it is said to pay to burn out tubes rather than to sacrifice so much pressure. There is no need to do either where water control of superheat is adopted, as proved by six years of steady work without deterioration. But a first-class water-controlled superheater, though it may last indefinitely, will cost double or treble as much as an ordinary uncontrolled superheater. In return for this, it will supply feed through the water-control pipes at full boiler temperature, thus increasing the efficiency of the boiler considerably as well as the output.

In the manufacture of steam fit to be used in an engine, economy demands its production in distinct stages. The water, duly purified, is first raised to the temperature of condensation by the exhaust steam. This may be, say, 100 degrees Fahrenheit. It is next raised to a temperature of, say, 250 to 300 degrees or upward, by means of the residual heat of the waste gases. If still below boiler temperature the feed-water may be raised to that temperature by the water-control apparatus of the superheater, and in separately fired superheaters by the water screen which protects the superheater pipes from too direct fire action. The boiler then comes into action and adds heat to the feed-water. All this heat ought to become latent. None of it ought to go toward raising feed temperature. Indeed, in the absence of the last-named stage of feed heating a live steam heater should form this stage.

The boiler should produce steam which contains the maximum possible amount of heat per cubic foot, and is capable of performing work in the smallest possible cylinder. Unfortunately for economy cylinders are made of material which exchanges heat with the steam, particularly if wet, and, despite all precautions, steam enters the cylinder loaded with water and can not lose heat without liquefaction taking place. If superheated its water contents are evaporated and its volume is increased. It can travel faster because its molecular kinetic energy is greater. It loses nothing at drains, and though it loses temperature it does not become wet so long as any superheat continues. It furnishes heat to the interior walls of the cylinder and reduces those exchanges of heat which increase steam consumption by twenty to fifty per cent. Little or no superheat need remain at the point of cut-off, and there is then contained in the cylinder the greatest amount of heat possible at the given pressure. For the first cylinder of a compound engine steam should be superheated. The superheating of the steam between the cylinders is a matter of dispute. It ought to be economical, and, if it fails to be so, the cause is perhaps connected with the absence of drainage of the receiver. Engineers who have intermediate receivers capable of reheating would perform a service if they would make commercial tests under the two conditions during a series of alternate weeks.

Superheating should therefore be considered as one of the final stages of dry steam production, the actual final stage being the cooling of the steam to saturation temperature by means of the heat-absorptive effect of the cylinder walls. Superheating is necessary to economy because cylinders are not adiabatic. With superheated steam, cylinders are nearer to adiabatic conditions. The economy from a given expenditure upon superheaters is to be found by suitably equating first cost charges, cost of stoppages to renew tubes and maintenance generally with the economy of fuel that superheat will secure. There are only two classes of superheaters, the cheap apparatus without control and the apparatus with water control, of which class there is only one representative. Comparison would be therefore out of place by the authors.

THE WASTE GASES.

The temperature and chemical composition of the waste gases passing from every large boiler plant ought to be regularly ascertained, the work being carried out by a man specially trained in technical gas analysis. The absence of smoke is no guarantee that combustion is being carried out in an economical manner, and only by constant testing of the exit gases can one be certain that the fuel is being burned without undue excess of air. The significance of air excess becomes manifest when one considers the following figures:

With gases containing only four per cent of CO_2 and a chimney temperature of 400 degrees Fahrenheit, 4,380 British thermal units are lost for every pound of fuel burned, *i. e.*, 32.4 per cent of the total heat value of the fuel. It may be objected that this percentage of CO_2 is much lower than that present in the flue gases of electricity works, but the authors believe that this percentage is not exceeded in many works where no special attention has yet been given to this question and where no CO_2 testing apparatus has yet been installed. In nearly every

[1] A paper read before the Institution of Electrical Engineers, London, England, January 12. The first part appeared in the ELECTRICAL REVIEW, February 25.

Digitized by Google

case where automatic or other CO_2 testing apparatus has been purchased and used the authors know that all the earlier tests have been under five per cent of CO_2, proving that under the every-day conditions of work obtaining in these plants unduly large volumes of air were being admitted. Where no economizer is installed the loss of heating power is even greater, for the gases then pass to the chimney at a temperature of from 600 degrees Fahrenheit to 700 degrees Fahrenheit, and the heat losses rise to 6,570 and 7,665 British thermal units, or to between forty-eight and fifty-six per cent of the total heat value of the fuel.

Taking now the case where the boiler plant is under scientific control and by constant testing the percentage of CO_2 in the exit gases has been raised to twelve per cent, the loss of heat with chimney gases at 400 degrees Fahrenheit is reduced to 1,540 British thermal units, or to 11.4 per cent of the total heat value of the fuel. In the one case, only between forty-four and sixty-eight per cent of the heat can possibly be utilized, while in the other 88.5 per cent of the thermal value of the fuel may be converted into useful work—either in the boilers or in the feed-water apparatus. Engineers would therefore be wise to give most careful attention to this question of excess air supply to the boiler furnaces, and to make proper provision for the constant sampling and testing of the exit gases.

Having drawn attention to the great importance of this subject, the authors do not propose to describe all the various apparatus and methods to be used in sampling and testing the exit gases. A few general remarks on the subject may, however, prove of value as a guide to practice in this matter. The examination of the exit gases should cover the following points: (1) color and appearance, (2) draught and temperature, (3) chemical composition. Daily tests should be made for these on each boiler of the plant, and in the main flue and at the base of the chimney. To facilitate this work, special sampling and observation holes must be constructed at the various required points in the brickwork of flues and boiler settings by use of thirty-inch lengths of wrought-iron pipe, one and three-fourths inches inside diameter. The pipes should have a flange screwed on the top, and should be set in the brickwork with cement. When not in use for testing purposes, they must be closed with an iron bolt or with cotton waste. When new boilers are installed, these sampling holes should be left when setting the boiler.

Iron pipes are not to be recommended for sampling flue gases, since such pipes corrode and become choked. Many low tests of CO_2 are, in the authors' opinion, due to the use of iron pipes for sampling purposes. Three-foot lengths of hard potash glass tubing three-eighths of an inch in external diameter should be employed. This glass stands a very high temperature without softening or fusing, and does not combine with oxygen at a red heat.

These glass sampling tubes must be removed from the flues when not in use for sampling purposes, and cleaned with a tube brush from adhering dust and soot. Fixed filters for retaining soot and dust are also bad in practice, since, if small, they speedily get stopped up, and, if large, they hold a large volume of gas and prevent the tested sample from being truly representative. They also increase the dangers of air leakage, and are to be condemned on that account. Lengthy lines of iron connecting pipes are also not to be recommended. The sample of gas from boiler flues ought in fact to be collected as near as possible to the flue itself, and only glass and rubber should be employed for connecting the sampling apparatus to the flue. Many of the CO_2 test results now being obtained are, in fact, of dubious value, owing to the neglect of these elementary precautions in sampling.

With regard to temperature determinations in the flues and at the chimney, these may be made either with a water pyrometer—a high temperature mercury thermometer—or with one of the various forms of electrical resistance pyrometer.

For ascertaining the heat inside the combustion chamber of the furnace one of the photometric methods should be employed. The theoretical temperature attainable in the furnace by the combustion of coal lies between 3,500 degrees Fahrenheit and 3,700 degrees Fahrenheit; the maximum attained under practical conditions is about 2,800 degrees Fahrenheit. The temperature of the exit gases should not exceed 400 degrees Fahrenheit when chimney draught is employed; when artificial draught apparatus is installed the exit gases may be reduced to atmospheric temperature, if this is practically possible.

Draught tests can be made with any form of water-gauge reading to one-sixteenth of an inch. A portable U-tube gauge, that can be carried about, may be employed for testing the draught in individual boilers, but it is well to have a fixed draught gauge at the chimney base and on the main flue. Here again a glass tube is to be preferred for connecting the gauge to the flue. This tube should be removed at short intervals and thoroughly cleaned and washed.

If automatic recording apparatus be installed for taking the CO_2 temperature, or draught tests, glass tubes should be employed whenever possible for the necessary connections to the flues, and all the precautions already named must be taken to keep the tubes clean and free from deposits. The apparatus must be placed in all cases as close as possible to the flues from which the samples of gases are collected; otherwise the volume of stale gases in the connecting pipes and air leakage at the joints will cause error. When water jet air pumps are employed to draw the sample gases through the apparatus, a separate water tank with a filtering attachment should be used for supplying the pump, otherwise stoppage of the apparatus is likely to occur at inconvenient times by dirt, etc., collecting in the jet of the pumps. The results obtained by all recording instruments require checking occasionally by independent tests with other apparatus.

DRAUGHT, ETC.

A good draught is only an aid to economy when other conditions are good. Too good a draught must not be employed with a thin fire, for it will cause too large an influx of air. Fuel of a large size will stand a powerful draught, but also demands a thick fire. With a good draught it may occur that the closing of the damper will not only check the rate of combustion of the fuel, but will cause smoke by reducing the indraught of air through the door grids. Boilers are thus best partly regulated by dampers which close the ashpits, rather than altogether by dampers in the flues. The ashpit damper properly applied and used will prove an aid to economy.

The production of a chimney draught with a temperature of waste gas, say 300 degrees Fahrenheit above atmospheric temperature, points to a consumption of heat about one-ninth of the total heat produced in the furnace. This fact points to a minimum air supply, which implies maximum furnace temperature and best efficiency of heating surface. Under normal conditions, however, from twenty to thirty per cent of the total heat of coal goes up the chimney. It is claimed that a fan draught can be produced with about one per cent of the total engine power, and that the use of a fan must

Digitized by Google

therefore effect a great fuel saving. A fan will not save fuel unless it enables this to be burned more efficiently as above. A fan draught will give economy if by its aid a flue feed-water heater can be installed to reduce the excessive temperature of the flue gases. To use full effect heaters a high and expensive chimney is needed. Fan draught must therefore be considered in the light of enabling an economy in chimney construction to be effected, and full use made of feed heating apparatus. It is also useful as enabling boilers to be forced to rapid steam production, and presents itself as a safeguard against sudden load in lighting stations and as a means of surmounting the load peak without excessive boiler plant. Fan draught is thus useful as a means of reducing capital expenditure on chimneys and boilers by promoting the rate of combustion of fuel at higher rates per unit of grate area. It enables the thickness of the fire to be regulated in better accordance with the fuel size and generally promotes elasticity. It is also useful in enabling the hot gases to be compelled to pass over all the heating surface, and baffles may be introduced that would otherwise be perhaps too great a hindrance. Its economy in other cases appears to demand the fullest practicable reduction of the calories in the exhaust gases by feed heaters, which in large stations may well be in two stages, and perhaps by air heaters for furnace supply.

When, however, it is attempted to utilize the last remnants of waste heat let it be remembered that we are, so to speak, working near the lower end of the curve of expansion, and that for each item picked up with one hand we are paying out with the other. All attempted economies, therefore, may cease to be commercial economies before they cease to reduce fuel expenditure per kilowatt.

CONCLUSIONS.

Finally, may the authors point out that the best results can only be attained if scientific methods of control are employed in relation to feed-water fuel, waste gases and draught. Automatic apparatus for testing flue gases or any other product can never take the place of a trained chemist; for an automatic apparatus demands not less, but more skill in its control and management than ordinary apparatus, if the records obtained by it are to be of permanent value. The results now being obtained by CO_2 recorders in many electricity works are, in the authors' opinion, of doubtful value, owing to the lack of trained expert assistance in their management.

Automatic apparatus of all kinds is, we admit, of great service, but not in the direction popularly supposed. It enables one skilled and efficient man greatly to increase the number and extent of his duties, and practically to treble or quadruple his efficiency; but it does not, and can not give accurate and valuable records when placed in the hands of untrained men.

It is remarkable that engineers, after their long experience of automatic stoking appliances, should imagine that automatic testing apparatus will achieve the impossible. In each case the best results can only be attained when the automatic apparatus is under expert supervision and control; and for testing apparatus, the expert control required is that of a specially trained and skilled chemist. In the working of a large modern boiler plant the chemist is, in fact, as much in place as in a chemical works, and the recognition of this truth will undoubtedly promote the economical working of such plants.

The following words, written over sixty years ago by the pioneer in the movement to obtain more scientific use of coal and fuel in steam raising (we refer to that remarkable man, C. Wye Williams), are still applicable to the position in this year, 1905, and there are a few present who would guess that they were a quotation from a book entitled "The Combustion of Coal," published in the year 1841 in Liverpool, and dedicated to the proprietors of the City of Dublin Steam Packet Company:

"It may be asked how it has happened that hitherto the smokeless combustion of fuel has not been effected. I answer, because the chemistry of combustion has been neglected, not in the laboratory, but in practice; and because the construction of our furnaces has been too much left to those who know little of the chemical properties of the materials which are consumed in them."

RULES FOR SAMPLING FUEL.

As each barrow load or fresh portion of fuel is taken from the pile or store heap a count is kept of the number used, and the whole contents of each tenth or twentieth barrow or portion are placed on one side, in a cool place, under cover. Care must be taken that the barrow or portion selected for the sample does not contain an unfair proportion of lumps or smalls.

At the end of the day, or period for which the sampling is to be carried on, the heap of fuel obtained for sampling purposes, as described above, is transferred to a sampling plate, and the larger lumps are all crushed down to walnut size. Should no sampling plates be available, four of the iron plates used for covering man-holes and boiler flues may be utilized to obtain a hard, clean surface on the floor of the boiler house, and the crushing down of the sample may be carried out on these plates with any heavy and flat lump of iron at hand. The heap of fuel, after this first crushing, is thoroughly mixed by turning over and over with a shovel. The heap is then flattened down, two lines are made across it at right angles with the edge of the shovel, and two of the four opposite sections are selected to form the reduced sample. The lumps in this are again crushed, the sample is again mixed, and the quartering operation repeated, until about eight pounds or ten pounds of fuel only remain, with no lumps that will not pass through a one-fourth-inch sieve. Two one-pound tins with ordinary or patent lids are filled from this remaining heap of fuel, after thoroughly mixing the same with the hands or with a small shovel. One of these tins is to be sent per parcels post to the fuel expert for analysis; the other is to be kept for reference in case of dispute.

Electric Plant in Formosa.

United States Consul Fisher, writing from Tamsui, Formosa, states that, in the early part of 1904, the engineering department of the Formosan government commenced work on the construction of an electric plant on the upper course of the river Shinten, about ten miles to the southeast of Taihoku. Water power will be used, and will be supplied by a canal cut from the upper course of the south branch of the Nansei river, which flows down the mountains in a series of cascades. The length of the canal is 7,200 feet. The width of the canal at the bottom is from eleven to twelve feet, and the discharge will be 250 cubic feet per second. This is intended to give 1,000 horse-power, but 650 horse-power will be sufficient for the present requirements.

The plant will be equipped with two McCormick turbines, each of 384 horse-power and 450 revolutions per minute; two three-phase Westinghouse alternating-current generators of 250 kilowatts capacity, at 11,000 volts and 450 revolutions per minute; and a McCormick exciter turbine of forty-nine horse-power, together with a Lombard governor. The plant will supply current for lighting the cities of Taihoku and Tamsui, and also for an ice plant, sawmill and other works in the first-mentioned city. The cost, including the construction of the canal, will be approximately $175,000.

Digitized by Google

TRANSFUSION (ELECTRICAL)—A STUDY OF THE THEORY AND PHYSIOLOGICAL EXPERIMENTS AND THERAPEUTICAL APPLICATION OF CURATIVE AGENTS THROUGH THE TISSUES BY STATIC ELECTRICITY.[1]

BY JAMES J. EDMONDSON, M. D.

Electrostatic currents while passing through the body can be made to carry along medicinal or antiseptic substances.

The joint action of static electric currents of high tension with an agent which is transferred by the action of the currents produces a permeation of all the tissues in the path of the current.

In electrolytic processes not only chemical changes are brought about, but there is also a wandering of molecules. In decomposing dilute sulphuric acid by a current of one ampere the cell in which this experiment is made contains a membranous diaphragm. After several hours the concentration of the acid on one side of the membrane shows the transference of acid by the electric current. This wandering of molecules is easily explained in accordance with the well-known theory of electric osmosis. By this the fact is established that electric currents cause a transference of the molecules of chemical substances. The human tissues may be considered as acting like the membrane in the above experiment. An antiseptic is transferred in an analogous manner to the seat of disease.

A chemical decomposition of the antiseptic does not take place. The high-tension currents merely act as a vehicle or means for conveying or producing a flow of the agent to the seat of disease.

PHYSIOLOGICAL EXPERIMENTS.

For the purpose of determining positively that electrostatic currents can be used to carry agents through the tissues of the body, a large, powerful, specially constructed static machine was used.

Preparations of iodine, mercury, and formaldehyde, which had been made after a great deal of experimentation, were employed in these physiological experiments.

Several guinea pigs were treated with these preparations and upon subsequent tests, involving the viscera, permeation was evident, and in goodly proportion.

Proof has thus been obtained that electric transfusion of medicaments is certain and safe.

This means a revolution in therapeutics, for the stomach can be relieved of a function which does not belong to it. It is therefore possible to feed the patient abundantly—a great factor in combating many diseases.

Any disease that can be cured by the absorption of drugs taken into the stomach can be cured more rapidly and safely when the medicants are carried to the seat of the affection by transfusion (or electric osmosis), and many morbid conditions that can not be reached by agents taken into the stomach can invariably be medicated by this method.

The method is especially applicable to affections of a microbic origin. It has been used very successfully in the treatment of tuberculosis. The results of the treatment are: rapid diminution of the symptoms, the cough, and the bacilli in the sputum; nearly instantaneous cessation of the fever and nightsweats; and, as a further consequence, a quick recovery of strength and return of sleep and appetite.

It is remarkable how easily and in what a short time children can be benefited by this method in tuberculosis.

An important feature is found in the circumstance that, as the remedy can be applied directly to the seat of the disease in any part of the body, it will leave the stomach entirely unaffected and unmolested by medicaments; so that the stomach is able to perform its function of nutrition, so important to maintaining the strength of the patient and facilitating the cure.

As a secondary action of the electric currents it may be mentioned that, besides their healing effect, they are very useful in stimulating and vivifying the organism and exhilarating the patient.

We can not expect the cure of tuberculosis from the internal medication with so-called specific remedies—such as creosote, guaiacol, or raw meat, juice of meat, etc.—which are employed in many different ways, according to circumstances, climate, nor to the confidence put in them, all these remedies having no effect whatever on the real cause of the disease. In reality, our means of fighting against tuberculosis have, heretofore, been reduced to climate, good hygiene, and suralimentation.

Inasmuch as it is accepted that tuberculosis is caused by the activity of the "bacillus tuberculosis," it follows that, if the bacilli in the lungs could be destroyed without injury to the patient, a certain means of curing the disease would be found. In order to render antiseptics useful and effective, a process is necessary by means of which minutely small quantities of the antiseptics can be rendered effective, and as this can not be done with the antiseptic alone a joint action of the antiseptic with another agent aiding in the destruction of the bacilli is requisite to the solution of the problem. The anatomy of a tubercle shows that by its own growth it throws out a wall of connective tissue around itself which is utterly impregnable to medicaments borne by the circulation.

Formaldehyde is a true antiseptic, but pure formaldehyde coalgulates albumin and could not be passed directly into the blood, as it would coagulate the blood and cause death by forming thrombi.

Formaldehyde can be passed into the lungs through the tissues by means of static currents of electricity and the bacilli thereby destroyed.

In order to be convinced of this, one has merely to consider the four operations which compose the method as now employed.

The first operation consists in disinfecting the affected parts of the lungs by means of formaldehyde forced through the pores of the skin. The second has for its object to incite the pulmonary circulation by means of metallic brushes, containing a solution of formaldehyde in special doses. The third serves to produce a cutaneous counterirritation (derivation) by means of the electric current; and, last, the fourth aims at disinfecting the throat and lungs by inhalation during action of the electric current at high tension, the air being charged with formaldehyde.

It may be taken for granted that tuberculosis in all its stages may be treated successfully by the transfusion method.

There have been many surprises at the results obtained with patients who seemed to have passed beyond the point where any help could reasonably be expected.

It is to be hoped that those suffering from this disease can be treated while in the first stage; then they should all be cured.

There have been cases of miscellaneous character treated by transfusion with evident success, but thus far the work has been principally in connection with tuberculosis.

The results of a large number of cases of tuberculosis under this treatment were very satisfactory, and point to a prospect for curing the greater percentage.—*Medical Bulletin.*

A telephone service between Sasebo and Tokio, Japan, a distance of about 1,000 miles, has been completed. It is reported that the service will be inaugurated in a few days between Sasebo and Moji, Hiroshima and Tokio.

[1] Abstracted.

Digitized by Google

Electrical Notes from Europe.

By Our Special Correspondent.

A HYDRAULIC plant is now in operation for supplying the locality of Bellegarde, which is situated not far from Geneva, Switzerland. It uses a high fall on the Rhone, about five miles from the lake. The plant has been installed by the Société des Forces Hydrauliques du Rhone, and uses Brown-Boveri machines of the three-phase type. At present there are eight alternators in the station and eight exciters, each machine being connected to a separate turbine. A fifty-foot head of water is obtained. The water is brought by a canal cut in the rock and by penstock. The turbines, of the Francis type, furnished by Escher, Wyss & Company, run at 114 revolutions per minute in the case of the alternators, while the smaller ones for the exciters run at 450 revolutions. The alternators have capacities ranging from 900 to 1,500 horse-power. They have a horizontal fifty-pole field, revolving inside a fixed armature ring of the slotted type. Current is furnished at 1,000 or 2,000 volts to different industries in or near Bellegarde.

Among the new tramway systems which have been lately installed may be mentioned a very complete and modern system in the city of Neuchatel, Switzerland. The company which now operates the electric tramways was formed by the fusion of the steam and the animal traction companies. Current is supplied at 580 volts from the city electric plant, but two of the lines are arranged so that they can take current from the hydraulic station at Clees. The system, as now laid out, includes five different lines, which have a total length of twenty miles. There are some very steep grades on these lines. All lines but one use a nine-millimetre overhead wire. One of the lines employs an octagonal wire of 100-square-millimetre section. The lines are supported on iron poles within the city and on wood poles outside the limits, by means of the usual cross-wires, or rosettes are used in other cases. At present there are forty cars running on the system, including ten trailers. There are also three trailers which are fitted out as postal cars. A number of ballast cars and a snow-plow complete the outfit. Most of the mechanical parts of the rolling stock have been supplied by the Compagnie de l'Industrie Suisse, of Neuhausen. Different varieties of cars are used on the lines. Most of them have two motors of eighteen to twenty-five hors power with reduction gearing of 1:4.5. Some cars are forty feet long and are equipped with forty-horse-power motors built by the Oerlikon Company.

Electric motors have been very successfully applied in a large dyeing and calico-printing establishment in the north of Italy. The plant is located at Novara, in the neighborhood of Milan, and is operated by the Stampená Lombardia. Power for the motors is taken from a hydraulic plant at Fars, which is situated some twenty miles from the works upon the Quintino Sella river, which is a branch from the great Cavour canal. The hydraulic plant is equipped with Oerlikon machines, which are driven by vertical turbines. The latter are built for a small head of water and a large output, as the fall is less than ten feet. The two turbines are connected with the dynamos by bevel gearing and cable-belt transmission, the latter consisting of ten cables. The turbines, of 250 horse-power each, make thirty-three revolutions per minute and drive the alternators at 500 revolutions. The alternators give 5,200 volts, three-phase current at fifty cycles. An exciter is coupled to each alternator. The high-tension line from the hydraulic plant follows the canal to the Milan-Novara railroad. The line is mostly overhead. At the Novara works the voltage is lowered to 400 volts by two transformers of 180 kilowatts each, which are contained in a masonry tower. The secondary switchboard is placed on the ground floor of the pavilion, and there is also a steam engine and a rotary group which serve to supply current when the hydraulic station is stopped for cleaning the canal. The rotary group consists of a sixty-five-horse-power, three-phase motor direct-coupled to a generator. It furnishes the lighting current for the works. A pulley is placed on the shaft between the motor and generator so that an engine can run the latter when desired. The motors in the main establishment are used to operate different machines, especially the machines for printing upon fabrics.

A new type of postal automobile has lately been adopted in Milan. It runs between the different post offices and collects the mail from the letter boxes. The car is equipped with an electric motor and battery. It is of somewhat large size and is divided into two parts. The platform in front contains the place for the motorman and the controlling apparatus. The inside is fitted up for sorting the mail and is well ventilated, lighted and heated. When passing from one letter box to another an employé sorts and stamps the letters, then forms them in packages which he passes to a second employé. The latter places them in compartments for each of the letter-carriers so that they can be rapidly distributed in the different quarters of the city. The new system effects a great saving in time, and it is expected that it will be used in all parts of the city before long.

Among the recent news relating to aerial telegraphy in Great Britain, it may be mentioned that the postmaster-general has made an agreement with the Marconi company by which the telegraph offices in the United Kingdom will be prepared to transmit messages to and from the aerial telegraph stations on the coast, to be sent between such stations or to vessels at sea. These telegrams will be forwarded at the sender's risk, and the rate is said to be $0.13 per word with a minimum amount of $1.56 per message. It is also reported that the Turkish government has now made a combination with the Siemens & Halske firm, which has a branch at Constantinople, to represent the aerial telegraphy interests. The agreement has in view the erection of two stations at a distance of 400 miles apart at the expense of the Turkish government. One of these posts will be located on the island of Rhodes and the second will be placed at the port of Derna, on the North African coast. In France two stations have now been opened on the coast, one at Porqueralles, and a second at Ouessant. They are prepared to send public messages. At the same time different kinds of new apparatus will be tried, as the government is not disposed to adopt any particular system of apparatus definitely before the International Aerial Telegraphy Congress is held at Berlin next spring. This congress is expected to decide many important questions, especially the use of a uniform type of apparatus which will allow all the different stations and vessels to signal to each other.

The Dolter system of surface contact,

Digitized by Google

which is in use on a short line in Paris, has now been installed on a section of tramway in Dresden, where it has been under test for some months past. The section is about 1,000 feet long. A car has been equipped to run over the section, with a magnetized bar underneath it for lifting up the armature in each contact block and thus making the circuit. A rail return is used. To provide for the lighting of the car at the points where the line changes over from surface to overhead, osmium lamps are used, supplied by a six-cell storage battery. The latter is also employed to excite the magnets of the bar. The trials have been favorable to the system, and it is said that the municipality has authorized the company to extend the Dolter system to all its lines. At present these lines use an accumulator car.

The Edison accumulator may soon find a rival in the new light battery which M. Jeantaud, the well-known electric automobile constructor, has just brought out. Some of the recent tests which were made at the Laboratoire Centrale, of Paris, showed that the capacity of the new element is considerably higher than that of the usual types. The battery is formed of lead positive and negative plates. Both plates are formed by pasting with a lead oxide preparation. The use of the composition (which is kept secret at present) allows of obtaining a voltage which is five per cent higher than the ordinary cell. With an equal mass of electrodes the capacity of the new cell is stated to be from forty to fifty per cent higher than with plates pasted with red lead and litharge. M. Janet, the director of the laboratory, made a series of official tests on the new cell, which was sent in a charged state. It started with a terminal voltage of 2.07 volts and after discharging the voltage was 1.7 volts. It delivered 41.2 watt-hours per kilogramme weight, at the rate of 5.5 watts per kilogramme. The electrolyte is sulphuric acid as usual, but a considerably higher density is used in this case, as it is 1.32 or thirty-five degrees Beaumé at the start and 1.16 or twenty degrees at the end of the discharge. As to the output of energy relative to the weight of the cell, the above test shows that it is considerably higher than the ordinary cell, as we have forty-one watt-hours per kilogramme instead of twenty-five watt-hours which is the average figure. This increase may be due to the great density of the electrolyte, and it remains to be seen whether the cell has a long life. Commenting upon these results, M. Hospitalier recalls the performance of a battery which M. Krieger used in a long-distance run with his automobile. He ran as far as 307 kilometres (190 miles) with a single charge of battery. The cells gave 2.15 volts at the start and the battery furnished thirty-eight watt-hours per kilogramme. It is a question whether in this case the cells were not deteriorated very soon, and nothing is known as to this point. The duration of the cell is a factor which must not be neglected in a practical test.

The Ritchie telautograph (American type) has been recently improved and reconstructed with different modifications by Georges, Isaac and Mambret, of Paris. The improvements are said to consist in the use of automatic electric regulation instead of mechanical devices, and the apparatus can be employed together with the telephone on the government lines. One advantage of this is that it will allow of countersigning orders which are sent by telephone, and this will be of considerable use in commercial transactions. The new system has been tested not long ago from Paris to Rouen, ninety miles distance, with ground return and is said to have operated very well.

The question of preventing accidents in factories and the different kinds of appliances for protecting workmen has been taken up in Paris by a technical commission of the Conservatoire des Arts et Metiers. An important step will be the establishing of a museum or place of exhibition and testing for different apparatus of security or hygiene, and will represent the latest progress along these lines. Drawings and photographs of different apparatus which can not be otherwise secured will be shown. In many cases it is intended to operate the machines by electric motors so as to show their efficiency in actual practice. The conservatoire will take all the needed measures to keep the exhibition up to date and new devices will be constantly added and given the necessary tests, while the old ones will be eliminated as they become replaced by improved devices. It is intended to afford free space and motive power to constructors who wish to have their apparatus tried here. The constructors will still remain in possession of their apparatus, which will be simply loaned to the exhibition for a certain time.

Some recent experiments made by the German physicist Paschen demonstrate the effect of a secondary or induced radio-action upon a photographic plate. He places pieces of platinum foil of different thicknesses upon a dry plate. The β-rays from radium bromide cause the shadow of the platinum foil to be projected on the plate, as is shown after developing. Next, the radium bromide is enclosed in a covering of sheet lead. Here the shadow on the plate is not as well defined and grows less as the lead covering is made thicker. The pieces of platinum foil which had a thickness below ten μ did not produce any shadow and in this case the photographic plate had a blackened spot which was diffused to some extent over the plate. The experiment seems to prove that the platinum foil placed on the photographic plate gave out a secondary radiation itself and it is this radiation which causes the blackening of the plate. The secondary radiation in the foil seems to be caused by the β-rays from the radium which pass through the lead coating. If the β-rays are considered to be the same as the cathode rays, we no doubt have a Rœntgen-ray effect in this case.

A system of electric road locomotive or motor-car which travels over the ordinary road and takes current from an overhead line is now in use in Germany, at Monheim, and a similar system is operated at Grevenbrück in Westphalia. A third line is running at Bielatel, Saxony. The trolley car is also used in France over a stretch of route near Fontainebleau and at other places. The plant at Monheim is one of the most recent and is now running very successfully. This locality is situated on the bank of the Rhine, and the new line connects it with the station of the Cologne-Düsseldorf railroad, which lies three miles distant. The Schiemann system of electric equipment is used here. High-potential current is furnished to the overhead line from a generating station at Solingen. The overhead system has two hard-drawn copper wires suspended from brackets upon poles. The latter also carry the high-tension lines which supply the town of Monheim with current. The type of motor-car is built on the lines of a large omnibus and takes current in any position on the road by means of a flexible cable which hangs from a specially designed trolley running upon the wires. The car is operated by a thirty or forty-horse-power motor. It carries twenty-six passengers. Besides this form of car the system uses a locomotive which is considerably larger and which is designed to draw one or more trailers. It has two forty-horse-power motors and carries freight and passengers. The trailers are usually freight cars of a special form. The above system has been running under very good conditions for some time past.

C. L. DURAND.

Paris, February 25.

Digitized by Google

THE IONIC THEORY OF THE ARC AND SPARK.[1]

BY PROFESSOR HENRY CREW.

Ordinary gases, of which air is a type, are, in their normal condition, slightly conducting; but they are, at the same time, such perfect non-conductors that it is only with extraordinary precautions that their conductivity can be measured. Many agents are known, however, which will change a gas into a fairly conducting medium. Among these are uranium rays, X-rays, cathode rays, ultra violet light, high temperatures.

In 1896, Thomson and Rutherford showed that the conductivity of a gas, when once produced, could be removed by either of two methods; namely, by filtering through glass wool and by passing the gas through an electric field. The first of these methods shows that the conductivity is due, as Thomson puts it, to "something mixed with the gas." The second method shows that this "something" is charged with electricity; and since the gas, as a whole, shows no electrification, it is inferred that both positive and negative electrifications are present.

This "something mixed with the gas," these invisible bodies carrying sometimes positive, sometimes negative, charges, these bodies which are "held up," so to speak, by the filter of glass wool, are the particles which are commonly called "ions."

Before passing to the ionic explanation of the spark, it will be necessary to consider briefly the two modes of ionization which are involved in the arc and spark, respectively:

1. Ionization by high temperatures.
2. Ionization by cathode rays.

1. Ionization by High Temperatures—It has been known for many years that hot air—not the "hot-air" of the boy on the street, but the white hot air of the laboratory—is a fairly good conductor of electricity. And it is a rather interesting fact that the earliest study of this subject is due to the French engineer, Du Fay, in 1725. Du Fay will be recalled as the man who discovered that there are two kinds of electrification which we now call positive and negative. (It may be mentioned incidentally that the earliest record of the electric spark is due to Dr. Wall[2] in the seventeenth century, who, by rubbing a piece of amber, obtained a discharge which he says "reminded him of thunder and lightning.") In 1873, Guthrie demonstrated, by experiment, that an insulated red-hot iron ball, in air, can not be permanently charged with positive electricity, but that it can be permanently charged with negative electricity. If, however, the ball is heated to a white heat, it can not retain either positive or negative electrification. It would seem, therefore, that an incandescent solid at moderate temperature emits positive ions; at higher temperatures, both positive and negative ions.

As a beautiful illustration of this may be mentioned the Edison effect which is obtained when an insulated metal strip is placed between the two legs of the carbon filament in an ordinary incandescent lamp. Such a metallic plate may be perfectly symmetrical as regards the two sides of the filament, but, when connected with the positive terminal of the lamp in operation, a very considerable current passes through the connecting wire. If, however, the plate be connected with the negative terminal, practically no current passes, which shows that glowing carbon emits principally negative electricity; a phenomenon of capital importance in the theory of the arc. The negative ions impinging upon the metallic plate reduce it to the same negative potential as that possessed by the negative leg of the filament; hence, no flow of current between them is possible. This phenomenon, which varies with many circumstances, has been elaborately studied by the two German physicists, Elster and Geitel.

2. Ionization by Cathode Rays—The following already classical experiment, described by J. J. Thomson only seven years ago, demonstrates a second mode of ionization which is as fundamental for the spark as ionization by incandescence is for the arc.

If D and E are electrodes, connected with a storage battery of one or two hundred volts, it will be found impossible, under ordinary conditions, to get any current across the intervening air.

But if a beam of cathode rays (which Perrin has shown to be composed of negatively charged particles, moving with a speed which is of the same order of magnitude as the speed of light)—I say that when a beam of cathode rays is allowed to pass lengthwise between "D" and "E," the gaseous medium, if the pressure be not too low, becomes at once conducting.

It looks, therefore, as if the gas molecules between D and E had become targets for the projectiles sent out by the cathode C, the result of the encounter being that either the rapidly moving particle is imbedded in the neutral molecule, thus rendering it a negative ion, or that the neutral molecule is broken up by the encounter, into two parts which act as oppositely charged ions.

The two modes of ionization just described have been established by a large mass of experimental evidence which is perhaps more familiar to many of you than to me, and which needs no further mention.

The fundamental proposition in the theory of the electric discharge, is that what we call an electric current is made up of streams of these small charged particles, the direction and speed of whose motion depend upon the intensity and direction of the electric field in which they are moving. The assumption here involved is merely the assumption that ions in an electric field behave exactly as other charged bodies in an electric field; say, the bell clappers in the "electric chimes" devised by Benjamin Franklin.

Evidence accumulated from various sources has led Thomson to the conclusion that negative electricity is not conveyed through gases by the ions of ordinary electrolysis, but by a particle which he calls a "corpuscle," and which has a mass approximately one-thousandth part that of the hydrogen atom. By others this body is called an "electron." On this hypothesis the current density becomes identically

$$i = (n_1 v_1 + n_2 v_2) e$$

where v_1 and v_2 are the speeds and n_1 and n_2 the number per cubic centimetre of positive and negative ions respectively.

Another fundamental proposition is that a corpuscle can not effect the ionization of a neutral atom unless it has the proper speed, and the speed which any particle of mass m carrying a charge e will acquire in a field whose intensity is x depends upon the time during which this field is allowed to act upon the particle.

$$m v = x e t$$

But the value of the time t here depends upon the length of the mean free path in the gas, while this in turn is inversely proportional to the pressure.

Having premised this mere skeleton of the electron theory, and having hinted at the evidence upon which it rests, we may, perhaps, devote the remainder of the hour to the consideration of two questions, namely, what are the criteria for a satisfactory theory of the arc and spark, and

[1] Presented before the electrical section, Northwestern University, December 16, 1904. Reprinted from February Journal of the Western Society of Engineers.

[2] Poggendorff. *Geschichte der Physik.*

Digitized by Google

how nearly does the electron theory satisfy these criteria?

Every theory must be judged in the highest court of appeal—the court of experimental fact; and among the facts which any competent theory must explain are the following:

1. The fact that the spark potential (*i e.*, the maximum potential difference which can be applied for an indefinite time without producing a spark) varies with the distance between the electrodes in such a way that for any given pressure there is one distance for which the spark potential is a minimum. This distance is called the "critical spark length."

TABLE I.

MEASURING OF CARR, SHOWING RELATION BETWEEN SPARK LENGTH AND SPARK POTENTIAL.

Pressure 1.05 MM.:	Gas - Air.	Pressure 2.6 MM.:	Gas — Hydrogen.
Spark Length. Millimetres.	Spark Potential in Volts.	Spark Length. Millimetres.	Spark Potential in Volts.
1	1826	1	1781
2	594	2	462
3	397	3	398
5	355	5	285
10	379	10	317

As a special case of this, and also needing explanation, is the classical result of Hittorf; namely, the fact that a spark under very low pressure will refuse to jump a gap of a single millimetre, while it will pass around a shunt circuit of air between three and four metres long.

2. A second fact is the existence of a "critical pressure"; that is, for any given distance between the electrodes, there is one pressure of the gas at which the spark potential is less than at any other pressure.

3. A third fact needing explanation is that the "critical pressure" multiplied by the corresponding spark length is a constant.

TABLE II.

MEASUREMENTS OF CARR, SHOWING RELATION BETWEEN SPARK LENGTH AND CRITICAL PRESSURE.

Hydrogen.		Minimum Potential 280 Volts.	Carbonic Acid.		Minimum Potential 420 Volts.
Spark Length. Millimetres.	Critical Pressure. Millimetres.	Product of Spark Length and Critical Pressure.	Spark Length. Millimetres.	Critical Pressure. Millimetres.	Product of Spark Length and Critical Pressure.
1	10.3	10.3	1	5.02	5.02
2	5.93	11.8	2	2.52	5.04
3	4.02	12.06	3	1.63	4.89
5	2.8	14.0	5	1.07	5.35
10	1.46	14.6	10	0.51	5.10

4. A fourth fact is that it requires considerably more electromotive force to start a spark across a gap than it does to keep up the sparking after it has once started. This "lag of the spark," as it is called, was studied by Faraday, as early as 1838, and has been observed by nearly every one who has used an induction coil. It is best shown, perhaps, by placing in parallel a set of vacuum tubes filled at different pressures.

5. Fifthly, there is the effect on ultra violet light in accelerating the discharge; that is, in diminishing the "lag."

TABLE III.

WARBURG'S OBSERVATION. THE NUMERATORS INDICATE THE NUMBER OF TIMES THE SPARK PASSED DURING TEN SUCCESSIVE APPLICATIONS OF THE POTENTIAL DIFFERENCES.

Potential Difference in Volts.	960	1440	1500	1920	2040	2940	3000	3960	5040	6000	7020	7920	8940
In the dark							0	1	1	2	4	7	8
							10	10	10	10	10	10	10
In daylight			1		8	8							
			10		10	10							
In the arc light through glass		10		10									
		10		10									
In the arc light	0		10										
	10		10										

6. A sixth fact is that the spectrum of air disappears from the light of the spark in air when self-induction is introduced into the discharge circuit; an interesting phenomenon discovered by Schuster and Hemsalech only a few years ago, 1899.

7. Seventh, there is the curious dark space, named after Sir William Crookes,

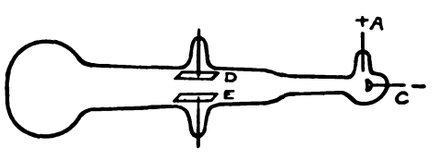


FIG. 1.—VACUUM TUBE.

that surrounds the cathode at low pressures.

8. In the eighth place, we ought to know why it is that an electromotive force of only thirty or forty volts is sufficient to operate an arc, while at least ten times this voltage is necessary to produce a spark in air.

9. Next, there is the strange fact that the anode in the arc is always hotter than the cathode; also the fact that a crater is formed in the positive carbon electrode.

10. Ten, the existence of the so-called counter-electromotive force in the arc.

11. And with this goes the remarkable behavior of the arc in, so to speak, disobeying Ohm's law; that is to say, with any given impressed electromotive force at the terminals of the arc circuit, we find that the electromotive force between the electrodes varies not directly, but inversely as the current.

This phenomenon is most beautifully seen in any form of the oscillograph which gives the electromotive-force curve and the current curve simultaneously; for then, one of these curves appears as the image of the other in a mirror placed parallel to the time axis.

12. The effect of chemical combination in reducing the potential difference required to maintain an arc. In the same category comes the effect of oxygen in preventing hissing.

13. And lastly, any competent theory ought to explain why it is that no Doppler effect is observed when an arc or spark is examined with the spectroscope.

The foregoing are but a portion of the phenomena exhibited by the electric discharge; but they are, I think, sufficiently varied and fundamental in character to form a severe test of any theory.

We now pass, therefore, to the second of the two queries proposed at the outset; namely, to what extent is the electron theory capable of accounting for these phenomena?

These thirteen facts have not been selected because they are all easily explained on the ionic hypothesis; on the other hand, some of them appear to me quite inexplicable; but it sometimes happens that the most important thing to be known about a theory is the points at which it fails.

Let us imagine the region between two electrodes, to be occupied by an ionized gas. If there is no potential difference between the electrodes, the positive and negative ions will encounter each other in the manner described by the kinetic theory of gases and will gradually unite

Digitized by Google

to form neutral atoms. The conductivity of the gas will thus gradually disappear.

If, however, there exists between the electrodes a field of electric force, it is evident that the positively charged ions will travel toward the cathode, and the negative ions toward the anode. Unless the potential gradient be very large, the ions will be gradually swept out of the field and the current will die down.

But if, by any means, the supply of ions be renewed at a constant rate, the current will keep up; not only so, but the current will increase with the electromotive force until a point is reached where the ions are being swept out of the field at the net rate of their production.

The maximum current then is produced by an electromotive force which clears the field of ions, as rapidly as they are produced. This is what Thomson calls a "saturation current."

If the potential difference between the

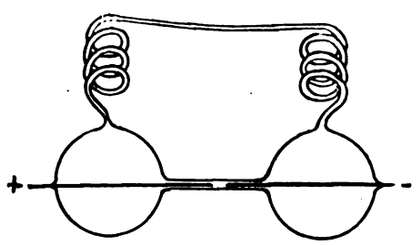


Fig. 2.—Hittorf's Tube.

electrodes be increased still further, a point will finally be reached where the ions will acquire such high speeds that they are able of themselves to produce new ions by collision.

The experimental results obtained by Thomson, Townsend and Schweidler are summarized in the figure on the screen. From zero to an electric field of 600 is the region in which all bodies, solid, liquid and gaseous, behave more or less alike; that is, they all obey Ohm's law. From 600 to 1,100 is represented the saturation current. At 1,100 begins the stage where the electric field produces its own ionization. In air, at atmospheric pressure, this potential gradient is about 30,000 volts per centimetre. It is this last region to which belongs the spark. If the facts summarized in the last figure on the screen have been correctly explained in terms of the ionic hypothesis, we are now in a position to explain the first of our thirteen experimental facts; namely, the existence of a "critical spark length."

1. For if the electrodes are very close together, and if all side discharges are prevented, the electric field will be very strong, but the amount of gas between the electrodes, especially at low pressures, will be very small; so small, indeed, that even if it be completely ionized, it will not furnish ions sufficient in number to carry any appreciable current nor will they furnish sufficient heat at the electrodes to enable these to produce ions by incandescence.

On the other hand, if the electrodes be widely separated, the electric field will not be sufficiently strong to produce continuous ionization by the velocity which it impresses upon the ions already there. Between these two extremes, at each of which practically no current is found, we may, therefore, reasonably expect a certain spark length at which the current will pass more easily than at any other. This is where the electrodes are close enough to produce the required electric intensity, and where, at the same time, the total number of ions between the electrodes is sufficient to carry a visible current, that is, a current which is able to produce light effects. This is the critical spark length so beautifully illustrated by Hittorf's experiment. See Fig. 2.

2. Passing now to the variation of spark potential with pressure, it is necessary to recall that the mean free path of a molecule varies inversely as the pressure. It is evident, therefore, that as the pressure diminishes in any spark-gap, the electric field has a longer time during which it may act upon an ion. For the time during which an ion is free to be acted upon, is proportional to its mean free path.

As the pressure diminishes, therefore, the ions more readily acquire the speed necessary to produce ionization by collision; and hence more readily start the spark.

If on the other hand the diminution of pressure be carried too far, the medium between the electrodes may become so impoverished in ions as to be unable to conduct anything but a minute leakage current; quite imcompetent to produce any luminous effects. Somewhere between these two lies the "critical pressure" which requires a minimum spark potential, already illustrated by the curve shown in Fig. 3.

3. Let us now pass to the third of our experimental facts; namely, Paschen's law, that the product of the critical pressure by the critical spark length is an invariant, so long as the potential difference remains constant.

We have seen that for any given spark length, there is a critical pressure, and we know, from the kinetic theory, that the pressure varies inversely as the mean free path. We have seen also, that for any given pressure there is a critical spark length, and that this varies directly as the mean free path. A very small induction coil will produce a spark four or five feet long if the mean free path of the ions is sufficient.

It is not surprising, therefore, that under the conditions stated, namely, constant potential difference, we find the product of these two oppositely varying functions of the mean free path to be a constant.

Let us denote the mean free path by λ, then what we should expect from the electron theory may be more clearly and briefly put, as follows: the critical varies inversely as λ; the critical spark length varies directly as λ. We might, therefore, expect that the product of these two would

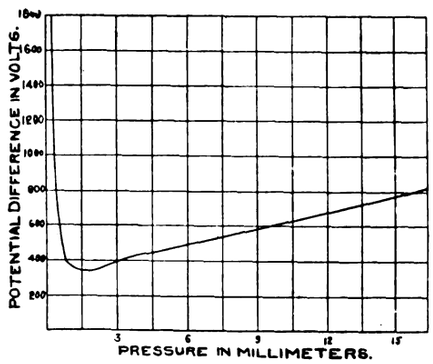


Fig. 3.—Carr's Observations.

be a function independent of λ; in other words, we might expect the product to be a constant so long as the potential difference is constant. This is precisely the fact discovered by Paschen[1] in his doctor's dissertation in 1889.

The experiments which Earhart has recently performed at the University of Chicago lead to results which at first glance are somewhat anomalous. He finds that when the sparking distance is reduced to something less than six wave lengths of light, the minimum spark potential is no longer 350 volts, but about one-tenth of this. But under the conditions of his experiment, the intensity of the electric field at the spark-gap is about one million volts per centimetre. Thomson has computed that a field of this strength will be able to drag the corpuscles bodily out of the surface of the metal, within which they are supposed to move with great freedom, provided the distance of the corpuscle from the surface of the metal is something greater than the millionth of a millimetre. The electron theory is, I think, quite capable of han-

[1] *Wied. Ann.* 37. (1889.)

Digitized by Google

dling this apparently exceptional, but well established case.

4. We pass now to the fourth experimental fact; namely, the "lag" of the spark. If the spark discharge is initiated by the electric field impressing upon the few stray ions which are found in the spark gap, a velocity sufficient to ionize their neighbors and if the potential difference between the electrodes is very little larger than that necessary to produce a spark, it would seem eminently natural that a little time should be required for this bombardment to produce ions sufficient to carry a luminous current; *i. e.*, a current producing luminous effects. And this is exactly what has been observed. Warburg[1] found that in some cases as much as three minutes elapsed between the application of the potential difference and the passage of the spark. On the other hand, so far as I am aware, no one has yet shown that, during the period of the lag and preceding the spark, there exists any current at all. Until this point is cleared up, we can hardly admit that the ionic theory of the "lag" has been established.

5. Next comes that surprising fact discovered by Hertz in 1887; that a beam of ultra violet light will bring about a spark between two terminals of an induction coil when the potential difference alone is unable to do it. Since ultra violet light is well known to render a gas conducting, it is, of course, not surprising that it should ionize the air between the electrodes and thus assist in starting the spark. But besides this, ultra violet light enables a negatively electrified body to emit corpuscles. Hence, if the ultra violet light falls on the cathode, we can expect assistance to the discharge in this way also.

If it be asked why light should assist in the discharge of a negatively electrified body rather than of one positively charged, the explanation would seem to lie in the fact that the negative ions set free from metals are the very minute corpuscles which move with much greater rapidity than the positive ions; and having much less mass, are more responsive to the electric forces which, according to the electromagnetic theory, appear in the wave-front of any beam of light.

Under normal conditions, of course, the corpuscles in the surface of the metal are attracted and held by the positive ions near them. The electric intensity in the wave-front acts upon these corpuscles, therefore, very much in the same manner that increase of temperature acts upon the molecules of a liquid to produce evaporation.

This phenomenon, therefore, which was discovered by accident in 1887, is one which might, to-day, be easily predicted by the electron theory.

6. Let us next consider the curious effect produced upon the radiation of the spark by the introduction of self-induction into the discharge circuit. Schuster and Hemsalech photographed the spectrum of the spark discharge upon a photographic film which was moving at the rate of 300 feet per second in a direction at right angles to the discharge. The curvature of the spectral lines so photographed indicates the speed of propagation between the electrodes, just as the angle between the two bow waves of a boat determines the speed of the waves in terms of the speed of the boat. This enabled Schuster and Hemsalech to separate the discharge into two quite distinct parts.

First, there is a series of lines which are apparently perfectly straight, showing that the speed with which their disturbance is propagated from one electrode to the other is very large when compared with 300 feet per second. These lines were found to belong to the spectrum of air.

Secondly, there is a group of lines which are distinctly and measurably curved. These belong to the metal of which the electrodes are composed. They constitute the luminous cloud which accompanies the spark and which is called the "aureole."

We have, therefore, in the ordinary discharge (*i. e.*, in a circuit including some capacity) two principal phenomena; first, a spark in air, a pilot spark, so to speak, which fills the region with gaseous ions; secondly, the electrodes are heated and the metallic ions are driven out into the spark-gap. These carry the oscillatory discharge which follows the pilot spark.

With this structure of the spark in mind, we are in a position to predict the effect of putting self-induction into such a circuit; namely, the period of oscillation will be increased, the metallic vapor will have time to diffuse through the spark-gap and most of the energy will be spent in heating this vapor instead of the air. Consequently the air lines in the spectrum will become relatively insignificant when compared, as to intensity, with lines due to the metal. This is exactly the fact discovered by these two English physicsts, Schuster and Hemsalech in 1899. The regular method now employed in the laboratory for ridding a spectrum of air lines is, therefore, to insert self-induction. See Fig. 4.

7. Passing next to what is perhaps the most striking peculiarity of the ordinary vaccum tube—the dark space of Crookes—which surrounds the cathode, it must be confessed that the explanation offered by the ionic hypothesis is not so satisfactory as might be desired. This want of clearness may, however, be merely my own want of comprehension. The argument is as follows: J. J. Thomson[1] has measured the amount of ionization at various points along the tube, from the cathode down through the negative glow, and he finds that the ionization is a maximum at points where the luminosity of the tube is a maximum; in other words, he finds that the more rapidly moving and the more slowly moving corpuscles are unable to produce as much ionization, in a given length of time, as those corpuscles which move with certain intermediate speeds. The dynamical explanation of this fact is not clear to me.

Just near the cathode there is an enormous drop of potential, the so-called "cathode fall"—this means that the electric intensity is here very great—in passing through this drop the negative ions acquire such a high speed that they pass through a considerable distance without producing much ionization. But these

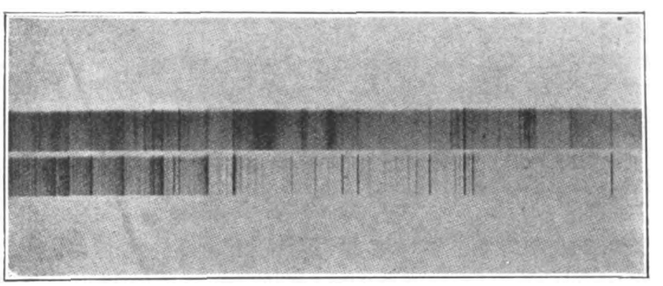


FIG. 4.—CARBON SPARK SPECTRA. (*a*)—WITHOUT INDUCTION. (*b*)—WITH INDUCTION. AIR LINES ARE ELIMINATED FROM *b*.

[1] *Wied. Ann.* 59. (1896.)

[1] *Phil. Mag.* 1. (1901.)

Digitized by Google

"secondary" ions, which Thomson calls the "descendants" of the primary corpuscles, will have greater power of ionization in passing through any given distance, and it is these, which, by their collisions with the netural gas molecules, produce the negative glow. The stream of negative corpuscles emitted by the cathode is supplied in all probability by the bombardment of the cathode by positive ions which have just acquired large kinetic energy by passing through the "cathode fall." The experimental evidence for this view is furnished by the experiments of Schuster and Wehnelt who placed a solid obstacle in the Crookes dark space and found that that portion of the cathode which was shielded emitted no cathode rays.

The stratified discharge is explained as follows: the region between the anode and the locus of ionization just described will tend to become filled with negative ions; for, since the positive ions originate in the negative glow, the electric field will carry them toward the cathode and leave the region between the anode and the negative glow entirely devoid of positive ions and entirely filled with negative ions. But according to Poisson's equation $\frac{d\,F}{d\,x} = 4\,\pi\,\rho$ if we have given a negative value of ρ as above assumed, then as we recede toward the anode, that is, as we diminish x, we must find F increasing; that is, an increasing field. Hence, the negative corpuscles present in this field may acquire sufficient speed to again produce ionization. When this is the case, we have a second negative glow. We may, in like manner, have this phenomenon repeated. This is the well-known stratified discharge.

8. We are now in a position, perhaps, to consider the eighth query, how can the arc be operated on thirty or forty volts, while for the spark ten times this voltage is necessary?

The first point here involved is the fact that the two discharges are started by totally different methods. In the case of the arc, the ionization is started by high temperature; in the case of the spark, it is started by a powerful electric field. In the arc, the high temperature is acquired by allowing the electrodes to come into loose contact in such a way as to localize considerable Joule heat in the electrodes, thus bringing them each to incandescence, so that each emits both positive and negative ions. The only voltage here called for, then, is a very small one—just enough to make the carbon tips white hot, the resistance being very small.

In the case of the spark, however, the resistance between the electrodes is practically infinite: the ionization must be started by the speed impressed upon the few stray ions already present, and the experimental fact is, that even under the most favorable circumstances, this requires between 300 and 400 volts.

The experiments of Schuster and Hemsalech have shown that after the arc and spark are each started, there is very little difference in their behavior.

The intermittent feature of the spark from an ordinary induction coil is, of course, a non-essential—due entirely to the intermittent character of the impressed electromotive force. The same is true of the alternating-current arc and of the oscillatory discharge from the Leyden jar. The typical arc is that furnished by the direct-current and the typical spark is that produced by a steady electromotive force, say a storage battery of 1,000 or more cells in series—the Glimmstrom of the Germans.

Two other questions now arise: does the spark require 350 volts only for the

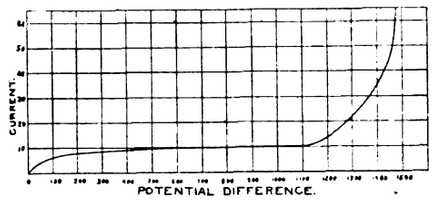


FIG. 5.—SATURATION CURVE.

purpose of starting it? And, since in the case of the arc, much less than thirty volts will heat ordinary carbon tips to incandescence, why the necessity of thirty or forty volts to operate an arc?

The reply to both of these queries is that the discharge is unstable whenever the resistance of the external circuit exceeds

$$\frac{(E - A)^2}{4\,\beta}$$

where A and β are defined by the following empirical equation which is the form Ohm's law takes when applied to the arc:

$$E = R\,i + A + \frac{\beta}{i}$$

This equation of Mrs. Ayrton[1] has been derived by J. J. Thomson from his view of the arc; namely, that a hot cathode is the essential feature, the cathode being bombarded by the positive ions to such an extent that it is kept incandescent. The only purpose of a hot anode is to furnish the positive ions for this bombardment—this is shown by Fleming's experiment in which he obtains a current easily between a cold anode and a hot cathode—the cathode meanwhile being kept hot by a second anode which is hot.

Summed up in plain English, the arc becomes unstable as soon as the current reaches a value too small to keep the electrodes hot; for, if the ionization is furnished by heating the electrodes artificially, a very trifling electromotive force sends a current through the region ordinarily called the arc.

9. The next question concerns the high temperature of the anode. This is a matter which, it seems to me, needs further investigation. It is well known that the anode drop is, in the case of the carbon arc, some four times as great as that of the cathode fall. The high temperature of the anode may, therefore, be due to the enormous kinetic energy acquired by the negative ions in passing through this intense electric field. On the other hand, it seems quite possible that this big drop of potential at the anode is due to the very liberal ionization which accompanies the high temperature of the anode.

For, since $\frac{d\,F}{d\,x} = 4\,\pi\,\rho$ the field strength F will increase (or decrease) very rapidly with x through any region where ions of one sign are abundant, and there will be ions of one sign—namely, negative sign—very close to the anode, where they are driven by the electric field.

This problem is certainly one where a more accurate knowledge of the distribution of ions throughout the arc is needed, and until this knowledge is obtained, the charge of incompetency must here be sustained against the electron theory.

10. An old puzzle in connection with the arc is the existence of a so-called "back electromotive force"—the phenomenon which we have numbered 10. I think the experiments of Hotchkiss[1] at Cornell have proved with very tolerable certainty that the arc has no *bona fide* back electromotive force in the ordinary acceptance of that term—at least if there is such an electromotive force it amounts to less than one volt and its existence is tremendously brief after the current is shut off. In this respect it is certainly very unlike any "back electromotive force" of polarization. The phenomenon left to explain is, then, the well-established anode drop and cathode drop, a phenomenon observed alike in the arc and in the vacuum tube. And these in terms of the electron theory, would be due to a distribution of ions presumably something like that in the figure on the blackboard, namely, a layer of positive ions near the

[1] "The Electric Arc," Mrs. Ayrton, p. 205.

[1] *Bull. Amer. Phys. Soc.* Vol. ii, No. 2, p. xix. (1901.)

Digitized by Google

cathode and a layer of negative ions near the anode.

Here again Poisson's equation shows that where either kind of ionization exists there is a change in the electric intensity, and hence a drop in potential. The drop in potential throughout the gaseous portion of the arc is small and constant[1]—which would be perfectly explained if we assume that in this region there are as many positive as negative ions in each element of volume. Here again the demand is for more exact knowledge of the actual distribution of ionization. Duddell thinks he has obtained evidence that this potential difference is really a thermoelectric effect; but it is very difficult to imagine a difference of temperature able to produce a potential difference of thirty volts, and yet a difference of temperature which can disappear in one one-thousandth of a second. In addition to this, as Mr. C. D. Childs has pointed out to me in a letter, the potential difference in the arc still remains, even when the anode is colder than the cathode; also we know of no other thermoelectric forces which are even of the same order of magnitude as thirty volts.

11. If we attempt the explanation of the fact that the potential difference between the electrodes of the arc diminishes as the current increases, we shall find that the minute anatomy of the arc, so to speak, is not sufficiently well understood to predict the equation with which Mrs. Ayrton has described the arc so perfectly.

But it is possible, by assuming two streams of ions in the arc, traveling with different velocities, and by assuming that the kinetic energy with which they bombard the anode and cathode is acquired by their falling through the anode and cathode potential difference, respectively—I say, it is possible by making these assumptions and equating the heat thus delivered at the poles to the heat which is radiated from the poles and which is spent in ionization, to obtain an equation which is practically identical in form with that of Mrs. Ayrton.

12. This same idea gives us at once the key to the next phenomenon on our list, *viz.*, the effect of chemical combination in reducing the potential difference between the electrodes, the current being kept constant. Since all the electromotive force required is just what is sufficient to maintain the proper incandescence, it is evident that if a part of the heat is furnished by chemical combination, less power will be required from the electrical source and hence with any given current less electromotive force will be required.

13. Passing now to the last phenomenon on our list, which lies in a somewhat different field, it has been thought by many observers that, if the light of the arc and spark is due to two streams of ions moving rapidly in opposite directions, from one electrode to the other, then one ought, in looking along the direction of the discharge, to see any spectrum line displaced from the position which it occupies when viewed at right angles to the discharge; in short, one would expect to find the Doppler effect here precisely as it is found in the case of the sun where one limb is constantly moving toward us and the other away from us. The yellow sodium line, for instance, has a distinctly different position in the spectrum of either limb of the sun from that which it has in the spectrum of the centre of the solar disc. But not the slightest effect of this kind has ever been detected in either the arc or spark. Hence it would appear that ions do not radiate while they are moving with uniform speed through an electric field. This experimental fact is in perfect accord with the electromagnetic theory of radiation as worked out by Larmor who has shown that the radiation of a moving charged particle depends upon the square of its acceleration and becomes zero, not when the velocity becomes zero, but when the velocity becomes constant. In other words, ions emit electromagnetic waves and become radiant practically only during collision.

We have now, I think, considered phenomena which are sufficiently numerous and sufficiently varied to prove that without some reasonable hypothesis, an intelligent study of the arc and spark is a practical impossibility.

The electron theory is very young—one can count its years upon the fingers of a single hand. The theory, as it stands to-day, is merely a first step toward a more complete description, based strictly upon experimental evidence. At the same time, so far as I am aware, the ionic hypothesis is the only one which has shown any degree of competency whatever. This theory has also the additional advantage of explaining at the same time, and without essential modification, the multitudinous and highly important phenomena of radioactivity, magneto-optics, and perhaps also the periodic law of Mendeleef.

On the whole it would seem, therefore, that the electron theory forms the best working hypothesis we yet have for the prosecution of further studies in this field. As Huxley has pointed out, most great truths are first regarded as heresies, and finally as superstitions. The electron theory is yet in the first stage, awaiting a second Newton who will do for the atomic system what the first Newton did for the solar system.

[1] J. J. Thomson. *Cond. Elec. Gases*, p. 422 and Fig. 121.

Wireless Telegraphy in the Home.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I have read with much interest Mr. W. J. Hammer's letter in the ELECTRICAL REVIEW of February 25, 1905, relative to his application of wireless telegraphy to domestic purposes. Every one must admit that wireless telegraphy is applicable to the starting of music boxes, to fire-alarm telegraphy, to the ringing of door-bells and the other bells that Mr. Hammer enumerates. I might say that when wireless telegraphy was first introduced, about five or six years ago, and the world was agog over the new art, the writer, to entertain and amuse a party of his friends, used it one evening at his home for the purpose of ringing the bell in a progressive game of cards. To this end a push-button connecting with the transmitter was arranged at the "head" table in one room, while the coherer with a short antenna was placed in an adjacent room. The arrangement worked quite successfully and the guests were delighted with the novelty of the affair. In this case also the apparatus used was made by Mr. W. J. Clarke. To advocate the use of wireless telegraphy to displace permanently an ordinary electric door-bell, however, is quite a different matter. The electric door-bell will operate nicely with two dry cells for twelve months or more, and the entire outfit may cost one or two dollars. Mr. Hammer uses twelve cells for the operation of his wireless call-bell. How long lived these cells would be is problematical, and I should not like to mention in comparison the cost and maintenance of the wireless outfit. Personally, while I am a great admirer of wireless telegraphy and a firm believer in its present and ultimate possibilities, I shall in the existing state of the art stick to the electric bell for the front door and for calling the kitchen-maid. I should not care to risk being called upon twice, thrice or oftener during the meal to adjust the ordinary filings coherer. Nor do I think the needs of the case are sufficient to warrant the employment of syntonic devices (and an expert to watch the devices) to avoid the clashing of the door bell and kitchen bell signals when either should be operated. I get over the difficulty of groping for the floor-push in the dining room by using a neat circuit-closer attached to the table with a flexible wire of sufficient length to allow for moving the table when desired. But as a novelty and a diversion, I would agree with my friend, Mr. Hammer, that this use of wireless telegraphy is very pretty.

WM. MAVER, JR.

New York, March 2.

Digitized by Google

ELECTRICITY IN AGRICULTURE.

BY C. L. DURAND.

The uses of electricity for agricultural purposes are continually on the increase in Europe, especially in Germany, where it is employed on a number of large farms. Many of the leading proprietors have been brought to see the advantages which they could obtain by the use of electric motors placed throughout the premises for carrying on the different operations connected with farm work. The installation of a small electric plant does not involve a great outlay of capital, at least in cases where the production is considerable, and there is no doubt that the modern methods which are coming into use will be quickly taken up once their advantages have been demonstrated. The well-known Berlin firm, the Siemens-Schuckert Company is among the leading spirits in promoting the use of current in agricultural work and has already put in a number of plants on some of the large farms in Germany.

Some of the different uses to which motors can be put are shown in the present engravings. One of these represents a dairy plant which is laid out on modern principles. In the rear is a mechanical churn of large capacity which is driven by belt from a small direct-current motor. A second motor is used to operate the butter-working machine, which is seen in the foreground. A model sheep-shearing plant is shown in another view. In this case a portable motor mounted on a four-wheeled truck is employed. The use of the portable motor is especially advantageous on a farm, as many different operations can be carried out by running the motor from one place to another, according to the needs of the work. A motor having about three-horse-power capacity is generally sufficient for most of the light work such as is shown here. In some cases the electric machines were installed on the premises originally for lighting, and afterward it was found that motors could be used to advantage; this keeps the plant running during the day and thus increases its efficiency.

One of the first applications of electric motors has been to drive threshing machines, and one of the engravings shows a plant of this kind. From five to twenty-horse-power motors are required, according to the type of thresher used.

Electric motors are found to cost much less to operate than the steam locomotives which are often used to run the threshers. Thus a ten-horse-power steam locomotive is estimated to cost from fifteen to twenty pfennigs ($0.038 to $0.050) per horse-power-hour, while an electric motor under the same conditions can be operated for eight to fifteen pfennigs ($0.020 to $0.038) per horse-power-hour. The present case illustrates the use of the new portable motor outfit which the Siemens-Schuckert firm is placing on the market. It drives the thresher by belt, and no change need be made in the case of threshing machines which were already adapted for use with steam engines. The portable motor can naturally be used for other operations when not employed here.

A question which has been much discussed of late is that of electric plowing. There is no doubt that motors will come into use extensively for this purpose. In this case electricity comes into competition with steam and under favorable local conditions the electric method has proved

ELECTRICITY IN AGRICULTURE. FIG. 1.—WORKING DAIRY APPARATUS. FIG. 2.—WORKING SHEEP SHEARING MACHINERY. FIG. 3.—HARVESTING MACHINERY. FIG. 4.—TILLING AND SOWING MACHINERY.

Digitized by Google

to be cheaper to operate, besides being greatly superior as to ease of handling. We illustrate one of the most recent methods of electric plowing which is used on some of the large German farms. It is known as the double-machine system. Two specially constructed portable machines known as plow-wagons are employed. The wagons carry a motor-driven cable drum and the steel cable is stretched across the field, having the plow attached to it in the middle. The plow is thus drawn back and forth between the two wagons and after one furrow is cut the wagons are advanced by the proper distance for cutting the succeeding furrow. Current is brought into the wagon by a separate drum which rolls upon wheels in the rear of the wagon and the cable is fed out along the ground as the wagon advances. The plow is given a speed of four or five feet per second, using motors varying from forty to sixty horse-power. The motor is designed so that it will give a 4,000-pound traction on the plow cable at the above speeds.

The First Annual Convention of the Bell Telephone Company Managers.

On February 21, 22, 23 and 24 a large number of telephone officials and managers held a conference at the Claypool Hotel in Indianapolis, Ind. The subject principally dealt with was the betterment of the telephone service.

A paper entitled "The Selection and Training of Operators" was read and discussed at the first session. This paper was presented by H. D. McBride, of the New England Telephone and Telegraph Company. A paper on the subject of "Local Service Tests and the Merit System of Grading Operators" was presented by A. S. Rogers, of Omaha. In the afternoon F. P. Valentine, of Boston, presented a paper entitled "Local Operating Methods and the Handling of Irregular Calls."

Other papers were presented at the sessions subsequent to the first day, as follows: E. F. Sherwood, "The Handling of Suburban Toll Traffic"; M. C. Rority, "Toll Service Tests and the Checking of Toll Revenues."

H. H. Kennedy presented a paper entitled "The Centre Checking System," and A. P. Allen read a paper entitled "Tariff and Routing Systems." A paper entitled "The Handling of Long-Haul Toll Traffic" was presented by J. L. R. Van Meter.

The officials of the Central Union Telephone Company, of Indianapolis, tendered a banquet at the Columbia Club, on the evening of February 23. The toastmaster was J. L. Richardson, president of the Central Union Telephone Company. Responses were made to toasts by F. P. Fish, president of the American Telephone and Telegraph Company; Angus S. Hibbard, vice-president and general manager of the Chicago Telephone Company; C. E. Yost, president of the Nebraska Telephone Company; Alonzo Burt, president of the Wisconsin Telephone Company; E. B. Field, president of the Colorado Telephone Company; H. B. Thayer, vice-president of the Western Electric Company; F. M. Hill, general manager of the Central Union Telephone Company; A. D. Wheeler, president of the Chicago Telephone Company, and the mayor of the city, J. W. Holtzman.

Among other well-known telephone managers there were present U. N. Bethell, vice-president and general manager of the New York Telephone Company; Henry M. Watson, president of the Bell Telephone Company, of Buffalo; E. J. Hall, vice-president of the American Telephone and Telegraph Company; T. Spencer, general manager of the Bell Telephone Company, Philadelphia; George F. Durant, general manager of the Bell Telephone Company, of Missouri; B. L. Kilgour, general manager of the Cincinnati & Suburban Bell Telephone Company; F. A. Houston, general manager of the New England Telephone and Telegraph Company; J. C. Reilly, general manager of the New York & New Jersey Telephone Company, and F. H. Bethell, general manager of the Chesapeake & Potomac Telephone Company.

The New Cunard Liner Caronia.

The new twin-screw steamship Caronia, the latest addition to the Cunard Line fleet, was docked for the first time in New York harbor on Sunday evening, March 5. The new steamship is 675 feet long, with a breadth of seventy-two feet six inches. Her smokestacks reach to a height of 150 feet above the keel. She is designed to have a speed of about twenty miles an hour, and is equipped with quadruple expansion engines capable of developing 20,000 indicated horsepower. These engines are of the Yarrow-Schlik-Tweedy system, so steadied by eccentrics as to reduce vibration to a minimum. The various quarters of the ship are fitted with the most modern contrivances. Electricity is made use of wherever possible, and adds very much to the comfort of quarters. The lighting is done entirely by means of electrical apparatus. Four seventy-five-kilowatt dynamos are required to supply current for power. In the illumination system over 3,000 individual lamps are used, and in addition to these there are powerful searchlights. Of course, the ash-lifts, freight winches and boat winches are operated electrically. In addition, there are electric roasters and other electrical novelties.

On Wednesday, March 8, a reception was given by the Cunard Steamship Company, when a large number of visitors made a thorough inspection of the ship.

Important Marconi Invention.

At a lecture before the Royal Institution, London, last week, Mr. William Marconi, the wireless telegraph inventor, announced an invention of great importance to the efficiency of his system. Mr. Marconi said: "I have been able very recently to construct a magnetic detector which will work a relay, enabling messages to be recorded on a tape by the ordinary Wheatstone recorder. The new receiver is far simpler than any yet devised for wireless telegraphy. It requires less attention, and is absolutely reliable. The principal advantage is, however, that the receiving speed is increased from 24 to 100 words a minute."

Meeting of Electrical Contractors and Electrical Supply Dealers.

During several days of last week the electrical contractors and electrical supply dealers were in conference at the Hotel Imperial in this city. The attendance was quite large and representative, and the business transacted related to standardizing of product and prices and a general conference for mutual benefit. A number of leading manufacturers were in attendance, and various committees representing all interests were formed and held meetings. Adjournment occurred Friday afternoon.

Strike on the Interborough Rapid Transit Company's System in New York City.

At 3 A. M. Tuesday, March 7, the employés belonging to various unions, embracing the greater part of the operating departments of the Interborough Rapid Transit Company in New York city, declared a strike on both the subway and elevated lines. The strike was declared jointly by the New York city organization of the Amalgamated Association of Street and Electric Railway Employés, the Brotherhood of Locomotive Engineers, and the Brotherhood of Locomotive Firemen. In anticipation of this trouble, the Interborough company managers had secured the services of a large corps of men, and every effort was made to keep up a schedule during the day.

Digitized by Google

BOOK REVIEWS.

"The Mechanical Engineer's Pocketbook." William Kent. New York. John Wiley & Sons. Flexible leather. 1,129 pages. 4½ by 6¾ inches. 192 cuts. Supplied by the ELECTRICAL REVIEW at $5.

This is the seventh edition and fortieth thousand of this well-known pocketbook. Four pages have been added on coal-handling machinery, and the section on electrical engineering has been further revised. A complete new index has been written, with about twice as many titles as were contained in the old index.

"Electric Lighting for the Inexperienced." Hubert Walter. London. Edward Arnold. Cloth. 88 pages. 4½ by 7 inches. Supplied by the ELECTRICAL REVIEW at $1.

This small handbook explains, in simple language, things about the electric light that every one who uses it should know. It describes the wiring of houses, the method of running the wire, accessories, lamps and fittings. A study is made of the proper method of lighting a house, the various rooms being treated separately. Some hints are given as to specifications and contracts, and advice for action during emergencies.

"Laboratory and Factory Tests in Electrical Engineering." George F. Sever and Fitzhugh Townsend. New York. D. Van Nostrand Company. Cloth. 236 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.50.

This book represents the laboratory work required in the electrical engineering course at Columbia University, where it is used as a text-book. It describes the various tests carried out, giving brief discussions of the theory, when necessary. Illustrated and special and commercial tests are given. The first section is taken up with the direct-current work, and part two with the alternating-current experiments.

"Producer Gas for Power Purposes." W. A. Tookey. London. Percival Marshall & Company. Boards. 137 pages. 4½ by 6 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 50 cents.

This little book is issued with a view to explaining the advantages of the operation and the application of gas producers to such as may desire to obtain reliable information on this subject in non-technical language. The different kinds of gas are described, and their properties explained briefly before taking up the subject proper. This is treated at some length. The cost of producing the gas is then studied, and a comparison made between the efficiencies of different forms of prime movers. Part two of the book deals with gas produced from bituminous coal. The different types of producers are described and illustrated. Part three contains some useful hints for attendants on producer plants. An appendix contains a description of some of the principle gas producers now on the market.

"La Bobine d'Induction." H. Armagnat. Paris. Gauthier-Villars, Imprimeur-Libraire. Flexible cloth. 224 pages. 5½ by 8½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.25.

This is a satisfactory study of the induction coil. The device itself is explained simply at first, and then an historical review is given. The theory of the induction coil is next studied, and the effect of different kinds of mechanical and electrolytic rectifiers is explained. The character of the secondary current is shown, and curves are given of disruptive voltages. The efficiency and power of coils are given, methods of construction and types of interrupters are explained, and the application of induction coils to wireless telegraphy, radiography and the ignition of internal-combustion engines are described.

"A Treatise on the Theory of Alternating Currents." Alexander Russell. Cambridge. University Press. Cloth. 408 pages. 6 by 9 inches. Numerous diagrams. Supplied by the ELECTRICAL REVIEW at $3.75.

In this volume the author has brought together the mathematical theorems which the electrician uses in his every-day work. In each case the analytical deduction is given, and frequently the application to existing apparatus is shown. The early chapters of the book deal mainly with inductance and capacity. Some practical formulæ are deduced, which it is thought will be useful to the engineer. Chapter twelve discusses graphically some problems in two-phase theory, and illustrates the useful application of solid geometry. In chapter thirteen the theory of alternating-current instruments is given, and approximate solutions shown. Chapter fourteen deals with the rotating magnetic fields, and chapter fifteen with fields surrounding parallel wires carrying polyphase currents. Chapter sixteen is a brief sketch of the method of duality, or of reciprocating a theorem.

"Diseases of Electrical Machinery." Ernst Schulz, with a preface by Sylvanus P. Thompson. New York. Spon & Chamberlain. Cloth. 84 pages. 5 by 7½ inches. 42 diagrams. Supplied by the ELECTRICAL REVIEW at $1.

It is rather strange that more books have not been published, dealing with electrical troubles. It is true that there have been several such books, some of them excellent in themselves, but these are all somewhat old to-day and deal principally with direct-current dynamos and motors. It would seem as though the man who has most to do with the care of electrical machinery has either little time or no inclination to give to the public in printed form the results of his experience. There are books in plenty dealing with the theory of electrical machinery and its construction, but there is a need for a complete treatise on the diseases of electrical machinery. This need will be met, in part, by the present work, which has been written by a German engineer, who spent twelve years as a constructor, and who has had the care of thousands of electrical machines. In the preface of the book Dr. Sylvanus P. Thompson points out some of the interesting features of electrical troubles, speaking particularly of dynamo machines. "Diseases," he says, "may be either congenital—I had almost said hereditary—or acquired. Some diseases affect particular races; others are special to particular climates. Some are incident to youth; others are a prerogative of old age. Some are sporadic, some epidemic, some transient, some chronic, some curable, some incurable." Constitutional diseases may arise from defective design or imperfect construction. Acquired diseases may come from overwork or neglect. To be able to get to the root of the trouble requires not only a familiarity with machinery, but experience with trouble. A wide experience is invaluable. Fortunately, the modern dynamo has developed into a strong, healthy creature. In the early seventies he was a weakling, subject to many infantile sicknesses, and apt at any moment to get into mischief, if not carefully nursed. "His limbs were racked by want of proper balance, and occasionally a sudden high fever caused him to shuffle off a mortal coil or two." In those days not only were the machines themselves far from perfect, but the treatment which they received was sufficient to make any dynamo spark angrily in protest. Mr. Shulz, taking up continuous-current machines, deals first of all with the armature troubles. He explains the usual difficulties, and points out the cause. He tells how to remedy trouble, and how to fit the brushes properly, pointing out the value of carborundum in grinding down commutators. Boosters receive special attention, as they operate under particularly severe conditions. The commutator, the proper method of construction, its care, and the care of carbon and metal brushes are treated satisfactorily. After explaining the different types of armature windings, the faults which may occur are described, and methods of detecting them and proper remedies pointed out. This chapter also describes the proper method

Digitized by Google

of starting motors, and describes their peculiar troubles. Chapter ii deals with single and polyphase generators. The most important faults here are short-circuits between the windings, as the slip rings rarely give trouble. Breaks, however, may occur, and the windings may be improperly connected. The different methods of winding are explained, and diagrams showing correct and incorrect methods of connection are given. The exciter here comes in for some attention. Chapter iii deals with single and polyphase induction motors, and chapter iv with single and polyphase transformers. A brief chapter on efficiency is added, which describes the usual meaning of this term, and shows how it is obtained. So far as it goes, this is an excellent work. It is clearly written, although the translator has not entirely got away from the German syntax. The reviewer thinks, however, the author could have made the book twice as good if he had made it twice as large, for there are many things which can not be explained in a work so brief, but which should be explained if the operator is to see clearly the causes for his troubles, and thus learn to avoid them. The book, as it stands, however, is a very welcome addition to electrical literature, and should be a great benefit to every operator. It will be no less helpful to the student.

"Producer Gas." A. Humboldt Sexton. Manchester. Scientific Publishing Company. Cloth. 220 pages. 5½ by 8½ inches. 32 figures. Supplied by the ELECTRICAL REVIEW at $3.25.

The author of this timely little work has placed at the disposal of the producer manufacturers much information of value in the way of elucidation of principles and classification of patents, but he has unfortunately passed over with a page of comment the most important subject to the engineer, *viz.*, the practical utility of producer gas in power plants. This is a most conspicuous omission in a work possessing so comprehensive a title. Considerable space is devoted to the metallurgical application of producer gas and it would seem that the author had held this most prominently in mind. It is especially unfortunate that, although dealing with British practice which has advanced, perhaps, further than in any other country, the only reference to actual operating economy of a producer plant to be found between covers should have been a few figures from rather antiquated tests based upon indicated horse-power. It is to be hoped that this important phase of the subject will be embraced in a succeeding volume. As a reference, the book is extremely useful, two preliminary chapters setting forth the elementary principles of chemistry necessary to a proper understanding of the subject, a third devoted to the properties of various gases, and an appendix containing useful saturated vapor tables, while the two remaining chapters and appendix present numerous modifications of the simple producer. An unfortunate choice of an expression for calorific value results in a hopeless admixture of English and metric systems. The necessity for the "centigrade unit" is difficult to see and the majority of American readers will be obliged to make the conversion into British thermal units for themselves. The merits and demerits of the "higher" *versus* the "lower" calorific values of gases (or, in the American parlance, "total" *versus* "effective") should have been brought out more prominently in connection with gas-engine performance. It is a subject that has provoked much discussion in this country, and a statement of British opinion or practice would have been opportune. In defining the commercial efficiency of a gas producer, due credit should be given for the heat reclaimed—either sensible or latent, from whatever source; also the grate efficiency should be included. On the other hand, extra heat required for raising steam above that reclaimed should be charged against the producer. If, in the case of the Dellwick-Fleischer water-gas method, this item amounts, as is stated, to fifteen to twenty per cent of the total fuel used, the ultimate thermal superiority of this process over the ordinary water-gas process is thus brought somewhat into question. The author's enthusiastic support of the system is therefore somewhat inexplicable, especially in the absence of more conclusive data from disinterested sources. On the important point of thermal efficiency of producers, the information is largely of a discursive character and unfortunately little data is presented. This general paucity of data of the practical kind throughout the book detracts somewhat from its authoritativeness as an engineering rather than a scientific work. In the classification of different forms and modifications of producers the author has done excellent work. The novel form developed by Mr. Thwaite—the cupola type—brings to attention a type but little known in this country. Those engaged in the development of the producer will find the descriptive appendix on various patented devices a convenient source of reference. A conspicuous omission is that of direct reference to or opinion concerning the peculiarities of suction producers. The suction plant is, to be sure, out of the question for large powers, but for small sizes it is bound to become popular, and a brief statement concerning its manipulation would have been timely. A discussion of the conditions which a good producer must fulfil brings the author out in an extensive discussion of tar destruction in which he recognizes the partial ineffectiveness of the reentrant principle such as embodied in the Wilson producer. This position is logical and accords with other authoritative opinion, yet it is difficult to reconcile with statements made in descriptions of the Wilson and Thwaite cupola producers that the combustion or gasification is "complete." In the Duff-Whitfield type, gasification is stated to be complete and the gas tar free. It is known that the formation of tar occurs under a definite relation of temperature and time. Under slightly changed conditions, the tar may be broken up into permanent gases and under excessive temperature these permanent gases are themselves disintegrated and flocculent carbon in the form of lampblack deposited. The sensitiveness of the tar destructor device to the unavoidable changes in operating conditions might profitably have engaged the author's attention. Superheating of the air blast is stated to have been attempted in order to augment the efficiency by partial recovery of waste heat, but no data or opinions are expressed as to its success or failure. The important subject of gas scrubbing and cleaning appliances receives entirely inadequate consideration in one paragraph. Centrifugal scrubbers are a distinctly modern development and should have at least received mention. In discussing the ideal producer, the author says: "first, cost should be small. This is, however, of much less importance than the other considerations." This statement is apt to be misleading; gas power in order to compete generally with steam power must suffer the greatest possible reduction in capital costs or fixed charges. The cost of a complete producer plant should be much less than that of a boiler plant, and a sacrifice of refinement might often result in actual operating economy in the end. In place of the complicated, costly and bulky by-product recovery plant is demanded a simple and easily adaptable producer. It is hoped that in thus dwelling upon the opportunities for elaboration or possible improvement, the real value of this book will not be overlooked. It is a valuable addition to a not overcrowded field of technical literature, and being practically the first work, will find ready appreciation in America. It is to be hoped that the near future will bring forth a revised edition dealing with the use of producer gas in central power stations, of which a number have been operating for some time in English territory.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Berlin Private Telegraph Exchange.

An interesting application of the Berlin printing telegraph system is here given by M. J. A. Montpellier. A central exchange has been established in Berlin, and the transmitting and receiving apparatus have been placed with a large number of subscribers. As they are operated by means of a keyboard similar to that of a typewriter, no special training is necessary. When one subscriber wishes to communicate with another, either to transmit a letter or an order, the exchange is called up and the two stations are connected together. In this way a permanent record is made of the message, both at the sending and at the receiving station. Another use of this system is being made, namely, that of transmitting news items of importance and market reports. The system is used, as well, for transmitting telegrams received in the ordinary way to the subscribers, or retransmitting telegrams which the subscribers wish to send. The rates for this service are as follows: a yearly rental of about $2.50 is charged for each instrument connected to a circuit. The subscriber also pays part of the cost of installing the system. This varies from $7.50 for a single circuit erected on wooden poles to $18.75 for a metallic circuit on iron poles. For each message a charge of about one cent for eight words is made. For retransmitting telegrams the charge is one and one-quarter cents, whatever the number of words. A description of the arrangement at the central exchange is given, the circuits being arranged somewhat as in a telephone exchange, though, of course, the wiring is different. The system is thought to be useful in other applications, such as the communication of orders between different parts of a large factory. The fact that a permanent record of each message is made gives it, for this work, an advantage over the telephone. It is not thought that the writing telegraph will take the place of the telephone, but it will supplement it.—*Translated and abstracted from L'Électricien (Paris), February* 18.

A Contribution to the Theory of the Jungner-Edison Accumulator.

An experimental investigation has been made by M. U. Schoop, to test the recent theory proposed by Roeber of the action of the alkaline accumulator. Roeber holds that there is a change of concentration at the two electrodes, although, as a whole, there may be no change in density. The method used is that of weighing the electrodes after a charge and a discharge. For this purpose the electrode is attached to one arm of a chemical balance, and the changes noted. The following conclusions are reached from this study: this method of experiment enables one to follow the change in weight of the electrode and of the electrolyte at the same time, and also permits a study of the change of the volume of the active matter and the phenomena of diffusion during passage of current. It was found that the changes in volume are greater for the active nickel than for the active iron. The conclusions are in agreement with Roeber's theory. At the two electrodes, differences in concentration are at first during the passage of current, while the concentration of the free electrolyte between the plates remains constant. During discharge the solution is concentrated in the nickel electrode, and is diluted in the iron or cadmium electrode. During charge the phenomenon is reversed. The polarization of concentration takes place principally at the iron electrode. It is probable that temperature influences notably the capacity of the two electrodes. The alkaline accumulator seems to have a temperature coefficient higher than that of the lead accumulator, and this coefficient is positive. The electromotive force increases with the temperature, and the temperature coefficient is independent of the concentration.—*Translated and abstracted from L'Éclairage Électrique (Paris), February* 11.

Foucault Currents in the Armatures of Continuous-Current Machines.

Foucault currents in dynamo armatures are generally treated very summarily. They are dismissed with the brief explanation that they are very small, and therefore unimportant so far as the dissipation of energy is concerned, and that they vary directly as the square of the frequency of induction. This, says M. R. V. Picou, is all wrong, and he backs up his assertion with an analytical examination of the matter. He deduces first a general equation for the Foucault loss in a sheet of iron disposed along the direction of magnetization. This equation consists of several terms, and the influence of these is obtained by making certain assumptions. From a study of the equation it is evident that practically the entire eddy current loss is concentrated in a superficial layer of very little depth. By applying his formulæ to a particular machine, the results of his investigations are shown. This machine is rated at 120 kilowatts, runs at 360 turns per minute, and has 180 slots. Considering first the body of the armature, he shows that the eddy current loss due to the alternations of magnetization is only eighty-six watts—practically negligible. Considering, however, the teeth of this armature, the effect of commutation must be recognized, and it is found that the Foucault loss on the surface of the teeth is 610 watts. The loss at the bottom of the slots is 160 watts, making a total Foucault loss of nearly 900 watts. The loss due to hysteresis in the same armature is about 1,000 watts, so that it appears that the eddy current losses are not negligible, but in a toothed armature are of the order of the hysteresis loss. Turning next to the Foucault loss produced in the face of the poles by the teeth of the armature, it is found that this amounts to twenty-five watts. The following is a summary of this investigation: the eddy current losses in toothed armatures are not negligible, and are of the same order as the hysteresis loss. The greater part of this loss takes place about the slots of the armature during commutation. The equations deduced for the loss show that it does not vary directly as the square of the frequency, and that, therefore, the usual method of separating it from the hysteresis loss is inaccurate.—*Translated and abstracted from the Bulletin de la Société Internationale des Électriciens (Paris), January.*

Armature Coils and Ozone.

In this communication Mr. J. Büchi comments upon a recent article by Mr. J. S. Highfield, who described some difficulty which he had had recently with high-tension alternators, and who attributed this to the formation of ozone and the production of nitric acid. Mr. Büchi does not agree with Mr. Highfield, and he thinks that an entirely satisfactory winding for a high-tension machine may be constructed, even if air be admitted to the windings. He believes that if this danger which Mr. Highfield fears existed, the trouble would have been experienced

Digitized by Google

at the many plants where high-tension alternators are used. In his experience, the trouble is brought about by a tendency of the designer to economize in the insulation of the separate conductors, because he felt that he could depend upon the excellent insulation of the closed micanite tube. Inspection of a defective coil of such a machine generally shows that the insulation between two conductors has become charred, indicating that a discharge has taken place between adjacent conductors. These defects can be entirely avoided by using ample insulation on the individual conductors, and by a suitable type of winding. Care should be taken not to use too much wire per coil—that is to say, to use a large number of coils, and to arrange the conductors so that the difference in potential between neighboring conductors is kept as small as possible. It is of the utmost importance that the very best quality of materials should be used in the varnishes and insulating compounds. He has found that oxidation of copper has taken place, owing to the use of an inferior quality of shellac which was not free from acid. The necessity for extra insulation on the three end coils is urged, for these are subjected to severe strains when the machine is suddenly switched on the line.—*Abstracted from the Electrician (London), February* 17.

Statistics of Electric Power Plants in Germany.

Some very complete statistics are here given of the electrical power plants in Germany. The plants are listed in alphabetical order, and the size of the city, the system used, the method of driving the normal load on the station, the number of arc and incandescent lamps and motors are given, where these have been obtainable. There are in this list 1,028 stations, with a total output of the generators of 434,882 kilowatts. There are, in addition, storage batteries representing an output of 96,065, making a total of 530,947 kilowatts. There are, besides these stations, eighty others, which did not furnish detailed information, and which hence could not be included in the list given. Thus, taken altogether, there are over 1,100 central electric stations in Germany. Of these 1,028 stations, 570 are operated by steam and have an output of 341,248 kilowatts. One hundred and nine are operated by water, with an output of 14,547 kilowatts. Ninety-four use gas engines and can deliver 10,050 kilowatts. There are two stations using Diesel motors; five, electrically driven, drawing power from other stations, one using wind power, and developing 220 kilowatts. These are simple stations. Of those using two or more systems of operating, there are 208 using water, with steam as a reserve. These have an output of 60,702 kilowatts. Sixteen combine water and gas; ten combine steam and gas; four, water and gasoline engines; four, water, steam and gas; one, gas, steam and gasoline, and one, water, steam and gasoline. There are three electrically driven, with steam as a reserve. Of these stations, twenty have outputs of over 5,000 kilowatts; twenty-seven between 2,000 and 5,000 kilowatts; twenty-eight between 1,000 and 2,000 kilowatts; fifty-seven between 500 and 1,000 kilowatts; 341 between 100 and 500 kilowatts, and 555 less than 100. These ratings do not include the accumulators. Taken together, these stations are connected to 5,687,382 incandescent lamps; 110,856 ten-ampere arc lamps, and motors aggregating 263,-036 horse-power. Reduced to fifty-watt incandescent lamps, this represents 11,-530,590 lamps, or 576,529 kilowatts. There are in use 247,366 meters. The greatest development in central station building in Germany took place in the years 1897 to 1900. The number of stations equipped during these years varied from 106 to 152. In 1901 the number constructed fell to eighty-eight, and since then has declined until it was only fifty-five in 1903, and eighteen for the first three months of 1904.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), January* 12.

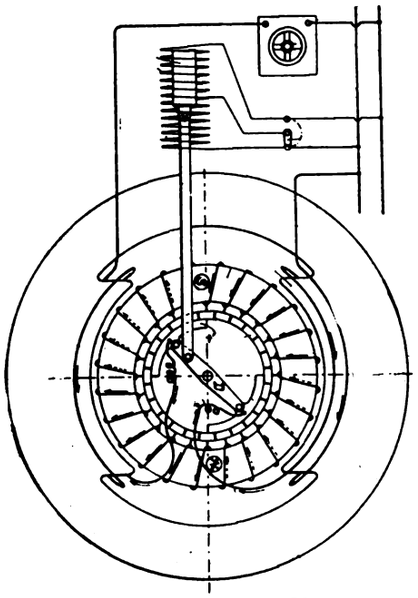
Electric Plant for the Nilgiri, India, Cordite Factory.

The government of India has built a cordite factory in the Nilgiri hills, choosing this site because of the very even temperature of the climate. The site had a further advantage in being near abundant water power, and an electric plant was installed to utilize the Karteri falls, about three and one-half miles from the factory. A dam was constructed across the river which forms a reservoir containing seven and one-half million cubic feet of water. The area of the drainage basin is about ten square miles. The minimum flow has been found to be 181 feet per minute. This has never been reached since 1877. The supply would last forty-five days of twelve hours each, using 600 cubic feet per minute, and this is at least thirty per cent more water than will be required by the factory. With the present height of the dam it is probable that the factory could be worked for twenty-four hours a day for eleven months in the year, six days in the week, and twelve hours for the twelfth month. The dam has been designed so that another eight feet may be added to its height, which will enormously increase its storage capacity and allow a twenty-four-hour run for the entire year. The effective fall from the dam to the power-house below the falls is 624 feet, giving very nearly one horse-power for every cubic foot per minute. The pipes carrying the water from the dam to the power-house are twenty-four inches in diameter. They are of double-riveted steel, laid on concrete piers. The receiver pipe is placed back of the power-house, and is thirty inches in diameter and thirty-seven and one-half feet long. It is supplied with a relief valve and air vessels which act as cushions. The equipment consists of six turbines, each capable of delivering 230 horse-power. They are direct-connected to four three-phase, 125-kilowatt generators, delivering current at 5,000 volts between any pair of terminals. There are two smaller turbines of thirty-seven horse-power each, driving the exciters. The three-phase machines are run in parallel. The line from the power-house to the factory passes through hilly country and across two streams. It has one span across the river. The factory covers a large piece of ground, roughly one mile long and a quarter of a mile in breadth. The transformer house is placed in as central a position as possible. There are here high-tension and low-tension switchboards and four three-phase step-down transformers, each rated at 120 kilovolt-amperes. The voltage is lowered from 5,000 to 380 on the low-tension side, the pressure between any one phase and the neutral point being 220 volts. This is the pressure used for lighting the factory. The cables in the factory are laid underground on the solid system. They consist of three-core cables insulated with paper, covered with lead, and placed in earthen troughs which are then filled with pitch. There are eighteen motors in use at the factory. These are all of the three-phase type, and vary in output from three to forty-five horse-power. All the larger motors supply the starting resistances in the motor circuits. All the lamps are placed in special air-tight fittings, and all fittings and conduits are connected to the earth. The power-house and transformer house have been built large enough for an additional unit.—*Abstracted from the Electrical Review (London), February* 17.

Digitized by Google

Electrical Patents.

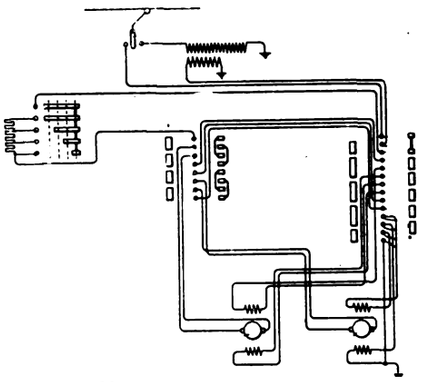
An improved alternating-current motor has been recently patented by Robert Lundell, of New York, N. Y. (782,863, February 21, 1905). The invention relates particularly to that class of alternating-current motors which is furnished with a commutator and which may be operated from a two-wire circuit. The object of the invention is primarily to construct a motor which may be self-starting with or without load. Other objects are to provide a motor which may be quickly reversed from a distance without undue complication, which will give a great starting torque and a high efficiency, and which will operate without injurious sparking at the commutator under various loads and speeds. It is a well-known fact that if a laminated field magnet is used in connection with an ordinary series-wound motor, the same may be made to run on a single-phase alternating-current circuit. It is also well known that an armature having a commutator can be made to run in an alternating-current field if certain coils in the said armature are



ALTERNATING-CURRENT MOTOR.

short-circuited upon themselves, though wholly disconnected from the primary circuit. Mr. Lundell has employed in his invention a combination of the principles which govern the operation of a series-wound motor and those which govern the rotation of a partly short-circuited armature, which is caused to rotate by the secondary or the induced currents in the short-circuited coils. The motor consists of a field magnet connected with a source of alternating-current supply and an armature having a winding, the coils of which are connected to a commutator. Means are provided for causing two or more adjacent coils of the armature winding to become traversed by currents from a source of supply, while the remaining sections of the other adjacent armature coils are subjected to the effects of local currents which are induced in the remaining sections of the armature winding.

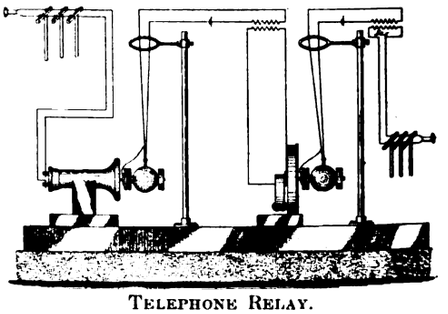
A motor-control system patented by Maurice Milch, of Schenectady, N. Y., has been assigned by him to the General Elec-



MOTOR-CONTROL SYSTEM.

tric Company, of New York (783,124, February 21, 1905). The invention relates to control of motors which are designed to be operated either from a direct-current or an alternating-current circuit. In this invention the motors and the control system are so designed that the motors may be satisfactorily operated without overloading when they are connected with the direct-current source. Each of a plurality of motors is provided with a field-winding, divided into a plurality of sections, and the control system is arranged to connect the field-winding sections of each motor in multiple when the motors are connected to the alternating-current source. The motors are connected, two in series, with the field-winding sections of each motor also connected in series when the motors are connected to the direct-current source. When used on railway work, a transforming device is provided on the car or train for reducing the alternating-current line voltage to a value such that each motor may be operated under an impressed voltage in the neighborhood of two hundred volts. The control system and the field connections of the motors are so arranged that the motors may be connected two in series for direct-current operation, with the field connections so changed that the motor will have speed and torque characteristics suitable for the particular case in hand. If the voltage of the direct-current source is in the neighborhood of six hundred volts, this object is accomplished more satisfactorily by dividing the field-windings of the motors into two sections, which are connected in series when the motors are operated as direct-current motors and in parallel when they are operated as alternating-current motors. This arrangement renders it possible to operate the motor as an alternating-current motor with a comparatively small number of ampere-turns on the field, a condition which is essential for efficient operation, and to double the number of field-turns when working on direct current. The motors are thus operated on direct current with the field strength great enough to prevent overloading and on alternating current with a field strength low enough to give the most efficient operation.

William W. Jacques, Boston, Mass., has secured a patent (781,207, January 31) for a telephone relay. The object of this relay is to restore to the telephone line the impulses which may have become attenuated by reason of the long distance of the line. The inventor has discovered that, by the use of two relays, each consisting of a receiving telephone and a microphone, the receiving telephone of the second being connected in circuit with the microphone of the first, the one relay having its parts delicately constructed and its normal pressure made exceedingly light, while the other relay has its parts more massive and its normal pressure heavier, the first relay being used essentially to magnify the telephone waves, while the essential function of the second is to correct the distortion of the first, fresh energy may be introduced into the circuit



TELEPHONE RELAY.

at one or more points. The apparatus consists essentially, then, of a "magnifying relay" and a "correcting relay," the combination of these two being designated by the inventor as a "compound relay." The invention further consists of means for so connecting two or more such compound relays to the wires of the main telephone circuit as to magnify and correct telephone waves transmitted over the circuit in either direction. Two compound relays associated together, one of which operates in one direction along the line, while the other operates in the other direction, are designated as a telephone repeater.

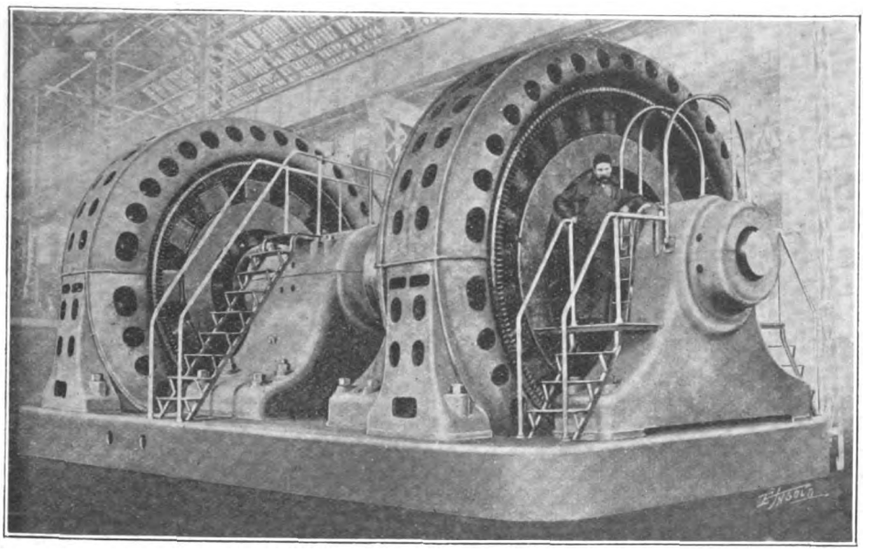
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Largest Electric Motor Ever Built.

The largest electric motor ever built is now being installed at the plant of the Shawinigan Water and Power Company, Shawinigan Falls, Quebec. This was recently constructed by the Allis-Chalmers Company at its electrical works in Cincinnati, and embodies in its design the characteristics of the Bullock alternators, which have proven singularly successful in their application. It is a synchronous motor of 8,000 horse-power. The rating of the generator operated by this motor, on standard specifications, is 5,750 kilowatts at 300 revolutions per minute. The combined machines, in addition to their enormous capacity, are remarkable for concentrating in an exceedingly small floor space a volume of 12,000 kilowatts.

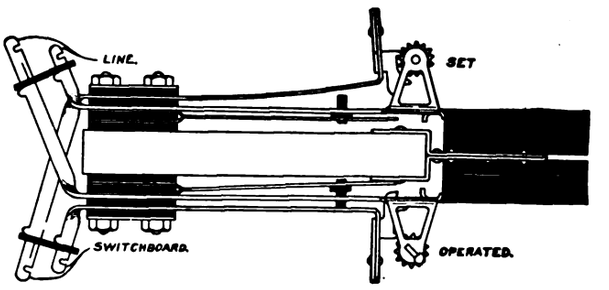


THE LARGEST ELECTRIC MOTOR EVER BUILT.

The photograph of the machines, which is shown herewith, was taken while they were being tested at the shops, by the Bohrend system, under full load conditions, corresponding to 7,200 kilowatts on the generator, with the expenditure of no more than 300 kilowatts in order to produce the same losses in the machine which exist under full load conditions. The working of the generator and motor forming the frequency changer at Shawinigan Falls will be carefully noted by electrical engineers in all parts of the world, and if it is as successful as the builder confidently anticipates, the result will be a valuable addition to existing data on the subject of alternating-current machinery.

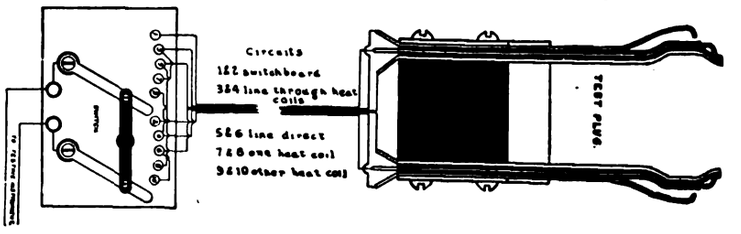
A New Cook Protector.

The latest central exchange protector manufactured by Frank B. Cook, Chicago, Ill., is shown in the accompanying illustrations. This is designated as No. 8, and while still adhering to the general lines of Cook's No. 444 protector, the apparatus is simpler in point of number of pieces per pair. The No. 8 protector has only four spring pressure contacts normally in series in the line circuit for each pair of protectors. Two of these contacts have two bearing points each. In restoring the coils to position after operating, it is only necessary to press the circuit-controlling spring back into position. All of the parts are mounted on a heavy metal bar, and this bar is intended to be permanently connected to earth. Neither bolt nor soldered connections are used in transposing the line and switchboard terminals.



SECTION OF NO. 8 PROTECTOR.

All of the alarm springs are connected to a common conductor. This is intended to be connected to an alarm signal, the other side of the signal being connected to earth. The alarm circuit is closed through only one contact, and while considerable trouble has been occasioned by this alarm circuit in some installations, the manufacturer states that this part of the apparatus has been so carefully worked out that it is now positive in operation. The heat coil, which is very sensitive, comprises a metal pin soldered by an easily fusible solder to a metal spool, upon which is wound several inches of silk-insulated resistance wire. The thickness of the insulation separating the wire from the spool is about 0.002 of an inch. The metal shell which encases the coil proper is formed over at both ends, completely encasing the fusible solder. The solder is thus protected from atmospheric exposure. As the heat-producing coil is concentrated around the fusible solder, the heat is applied directly to the solder, thus ensuring quick and uniform operation of the coil. The variations in outside temperature or air draughts will not affect the operation, the windings, spool and all vital parts of the coil being enclosed.

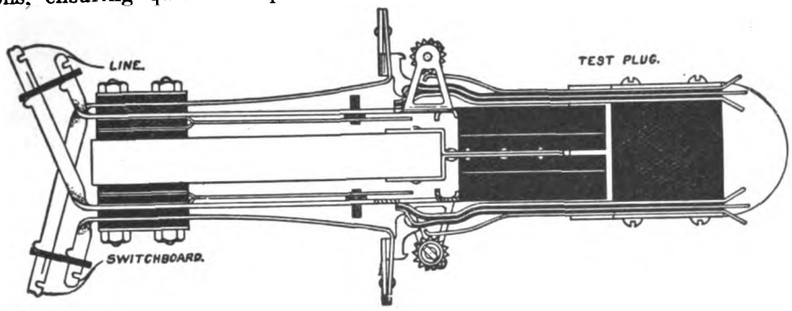


TEST PLUG AND SWITCH.

When the No. 8 coil operates it turns

Digitized by Google

on the pin through a small arc of a circle. This allows the solder to give slightly without actually breaking the solder connections, ensuring quick and permanent



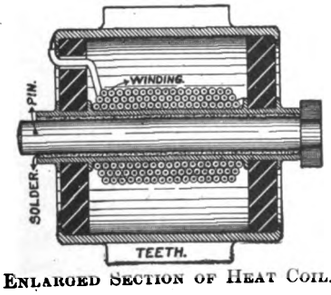
No. 8 Protector with Test Plug Inserted.

resoldering. The low fusing point of the solder ensures its melting before the winding will become hot enough to injure the coil.

The No. 8 heat coil and protector, when operated by either a heavy or a light current, opens the switchboard circuit, closes the alarm circuit, and grounds the line circuit, all in one operation.

One of the carbon lightning arresters is normally connected to the line and separated from the grounded carbon by mica not less than 0.005 of an inch thick. A potential of more than 350 volts is required to arc across this space. As an added protection, the carbon arrester always remains in circuit.

This No. 8 protector has been in an experimental state for about a year, but



Enlarged Section of Heat Coil.

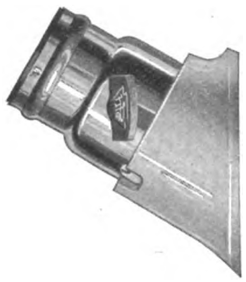
exploiting it has been delayed until all defects could be remedied. The model has been submitted to prominent and expert engineers throughout the country, and has been received with a high degree of satisfaction.

With regard to the patents upon self-soldering protectors which have been issued, and which are not in litigation, Mr. Cook states that patent No. 776,219, issued November 29, 1904, covers broadly the self-soldering apparatus for switchboard protection which Mr. Cook has made. This patent will not expire until 1921. It is also stated by the manufacturer that he is not manufacturing any apparatus under the Rolfe patents.

A great many pairs of this new protector have already been sold. One of the most notable orders was for the new Cleveland (Ohio) Citizens' telephone exchange. This order was placed by the Automatic Electric Company, and calls for 8,000 pairs of protectors. Other orders have been received for exchanges throughout the country.

Improved Angle Wall Sockets.

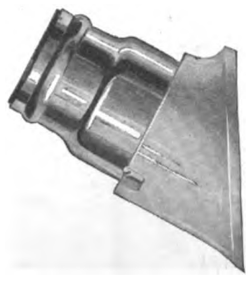
The H. T. Paiste Company, Philadelphia, Pa., has recently improved the design of its "P-K" angle wall sockets.



Angle Socket with Key.

The new bases are of a tapering shape, that eliminates the awkward appearance of the old style, and make a much more graceful appearance when placed on the wall.

In addition, these bases are provided with "knockout" slots, of a very thin partition of porcelain, which can be easily knocked out with a small tool. This enables the wall socket to be used with both open or cleat type and concealed type of wiring. When used with the concealed



Keyless Angle Socket.

wiring there are no unsightly slots in the base.

The new wall sockets hold the lamp at an angle of sixty degrees from the vertical, an angle which gives greater diffusion to the light and a more graceful hang to the lamps.

Samples and bulletins will be sent on request to any one desiring them.

The "Firefly."

This is a unique and inexpensive little device for flashing a number of electric lamps, that has recently been invented by Dr. C. O. Schneider, 84 Adams street, Chicago. It will flash from one to three sixteen-candle-power lamps, one to six eight-candle-power lamps or one to twelve four-candle-power lamps on either direct or alternating current. The opening and closing of the circuit are caused by expansion and contraction of metals due to heat produced in a resistance coil by the electric current. The mechanism is

Lamp Flasher.

extremely simple, entirely automatic and noiseless in operation.

The contacts are heavy platinum and will last for many months as the spark is extremely small. This is due to a heating coil being so connected that it also acts as a shunt across the break to prevent an arc.

The "Firefly" will flash the lamps from fifteen to thirty times per minute and together they use less current than if the lamps were constantly bright. By means of an adjustment screw the interval between flashes can be regulated, thereby materially changing the effect. By turning this screw down the lamp will remain bright a greater length of time, while unscrewing it will have the effect of lengthening the period of darkness.

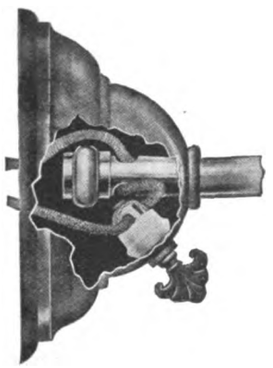
To connect the flasher it is inserted in one lead to the sign or attraction, while the other wire is undisturbed, thereby avoiding all possibility of short-circuiting. After the current is turned on it requires about a minute for the coil to warm after which it will cause alternate light and darkness, producing an action and animation that has an immense power of attracting attention.

To the White steam car belongs the honor of being the first automobile to take part in an inauguration parade. In the great pageant of last Saturday the Twenty-third Regiment, National Guard of the State of New York, used a White car as an ambulance. The car carried several of the surgeons and also the medical and surgical supplies and a stretcher. As it glided noiselessly along behind the regiment, it was greeted with liberal applause from the half million of spectators, in which the President enthusiastically joined.

Digitized by Google

Novelties for Fixture Work.

The very general application of electrical apparatus for the illumination of hotels, apartment houses, restaurants

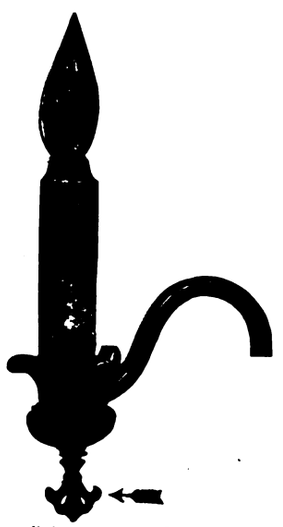


CANOPY SWITCH.

and, in fact, all kinds of interiors, has created a demand for a type of fixture that would be easy to install and have the

KEY-ARM SWITCH.

same self-contained features as the present-day gas fixture. To meet this demand, the Sarco Company, 906 Sixth avenue,

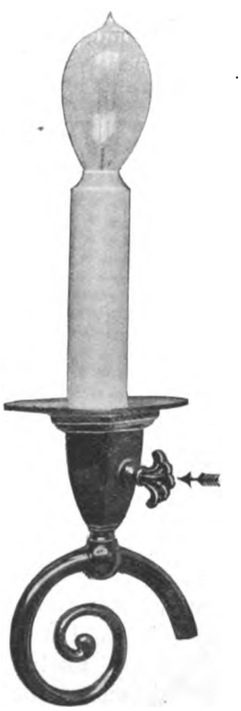


"NOSCRU" SWITCH IN BASE OF FIXTURE.

New York city, has created an adaptation of its "Noscru" key-arm switch, the applications of which may be seen from the accompanying illustrations. By the use of this key-arm switch the work of the fixture fitter is made very easy, and it is possible to make use of a wide variety of

ADAPTATION OF "NOSCRU" KEY-ARM SWITCH.

decorative forms. Where the "Noscru" key-arm switch is inserted in the chandelier line, it has a place analogous to the gas cock in the gas fixture. A valuable



ADAPTATION OF "NOSCRU" KEY-ARM SWITCH.

feature of this key-arm switch lies in its being absolutely screwless. The ends of the wires are passed through terminal bushings, making a long wiping contact with the blades of the key-arm switch. The very small size of the key-arm switch makes it applicable for an elaborate fixture, without in any way detracting from its symmetrical appearance.

The new "Noscru" canopy switch has an especially valuable feature to the chandelier fitter. This canopy switch can be used for any bracket or fixture by simply boring a five-sixteenths-inch hole in the canopy, body or base, pushing two wires through the holes in the porcelain body of the switch, bending them over, replacing the cap, and fastening the locknut.

The Sarco Company has made up these fancy fixtures in a large variety of forms. The selection is such that a suitable lighting fixture can be secured to satisfy the choicest requirement.

"Hiko" Electrical Specialties.

The Atlantic Manufacturing Company, Allenhurst, N. J., is the manufacturer of Hickley's "Hiko" commutator compound for carbon and copper dynamo and motor brushes. The company states that ten per cent greater output with less heating is secured with the use of this compound. The material stops sparking and lubricates the commutator. If the machine is started with a smooth commutator, the compound will keep it perfect, producing a desirable glazed surface, and increasing the life of the commutator and brushes.

The material contains no acid, and is not a conductor. It will not get between commutator segments and short-circuit them. It is also claimed that it will not in any way clog the brushes.

Another specialty which this company manufactures is the "Hiko" carbon brush. These brushes are especially adapted for street railway and other service where it is difficult or inconvenient to get at the commutator to apply a commutator lubricant. The company guarantees these brushes to give very much increased mileage in street railway service. There is no scratching of the commutator, and the edges of the brushes remain sharp and clean.

Small Motors Wanted.

The Heald Machine Company, Worcester, Mass., has occasion to use quite a number of small motors, about one-fifth to one-quarter horse-power, running at about 3,000 revolutions per minute. The motor which the company has been using is not quite strong enough to suit, and the company is looking for a motor that will be in the neighborhood of seven inches in diameter and seven inches in length, not including the amount of shaft which projects for the pulley. These motors should be shunt-wound for 110 or 220 volts, either direct or alternating current.

Digitized by Google

New Form of Arc Lamp

Louis F. Bogia, Jr., 146 North Seventh street, Philadelphia, Pa., has placed on the market a new form of electric arc lamp. In this lamp a number of features which have caused more or less trouble with prior forms of arc lamps have been eliminated. At the same time, those elements which have made for success in other lamp structures have been retained and modified or simplified, the idea being to secure a lamp which would be accurate in operation, reliable and certain at all times.

For controlling the feeding mechanism one substantially built combined solenoid and magnet is used. The movable core or armature, to which the carbon-feeding mechanism is rigidly attached, is lifted and lowered to a precise point of adjustment. The actuating mechanism is given the same strength and stability throughout its entire range, and every movement in feeding and regulating is powerfully aided and accelerated by this combination apparatus.

The actuating mechanism is extremely simple in design, and wear and tear is

ARC LAMP WITH CASING AND GLOBE.

very much reduced, due to the fewness of the parts. With the exception of one essential hinge-joint in the clip there are no rotatory joints in the whole structure. Each movement is normally in a perpendicular direction, affording a minimum of friction.

When the current is cut off, the carbon pencils are brought together with such force that any foreign formation which may have accumulated at the carbon points is disintegrated and thrown off.

The contact device moves independently when the carbon feeds through the

INTERIOR OF ARC LAMP.

clutch. There are no wires or cables or thin sheet-metal contact brushes. When a new carbon pencil is being inserted in the lamp, the contact device rises with it, and, as it ascends, is arranged to rub firmly against the walls of the enclosing metallic tube. In this way the contacting surfaces are automatically cleaned at each trimming. In recarboning, also, both pencils pass through the bottom holder. This is of solid construction, and is bored to the proper size. Carbons which are large or out of line, and liable to cause trouble in the upper structure, can not be placed in the lamp.

The lower holder is provided with a gauge in the form of an encircling ledge or ring, marking the height to which the upper carbon stub—if used for the stationary pencil for the next turn—is placed in retrimming. This holder is also adjustable in length, so that various grades and forms of carbon may be employed.

The solenoid coil is fireproof and will not bake or burn out. It is also insulated from the heat of the arc by dead air spaces, these spaces being again separated by a non-conducting partition.

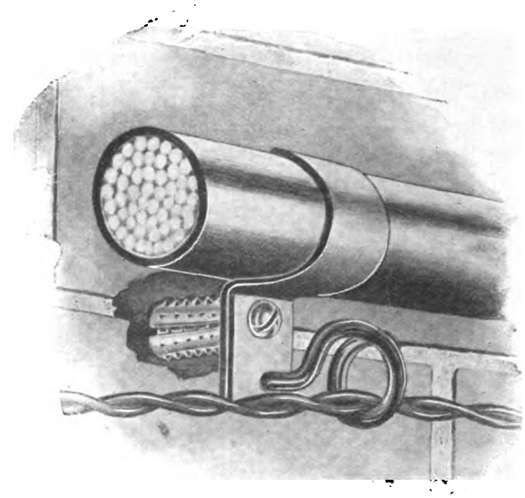
A New Cable Clamp.

The Diamond Expansion Bolt Company, 9 Murray street, New York city, has placed on the market a new cable clamp which has been named the "Long-Saut," the general arrangement of which is shown by accompanying engraving.

As will be seen, this arrangement provides a secure fastening for attaching pipe conduits or lead-covered cables to brick, stone, concrete or wood, as well as a support for bridle rings to carry bridle wires.

The clamps are heavily galvanized and made in four sizes for carrying lead-covered cable from three-quarters inch to two inches diameter. The bridle rings are made with machine thread for screwing into the clamp and can be furnished either galvanized, brass or enamel, and will not dent or injure the lead-covered cable in any way.

But one expansion shield (furnished with the clamp if desired) is required for fastening this clamp to the masonry. This alone is a great saving as it requires the drilling of one less hole than when spike dogs and separate bridle rings are used, besides the fact that the clamps cost less than the other articles. The expansion bolt ensures a more secure fastening than where cable dogs are used.



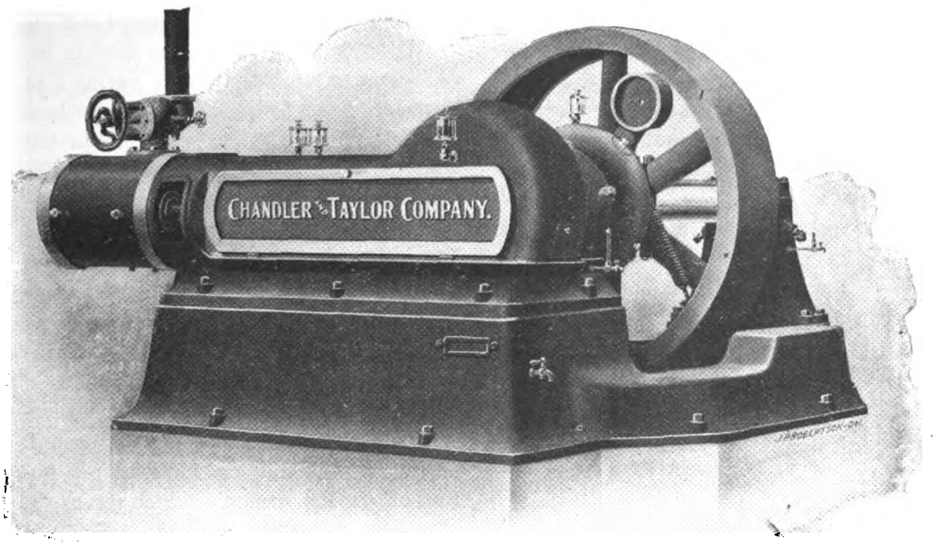
EXPANSION BOLT CABLE HANGER AND BRIDLE RING CLIP.

Cable clamps put up with Diamond expansion bolts can be taken down without injury to the conduit. Another advantage derived from the use of this clamp is that it can be used alike for attaching to wood or stone walls. The expansion shields used with the clamp can also be used with standard bridle rings where it is desired to set them separate from the clamps.

Digitized by Google

Enclosed Automatic Engine.

The Chandler & Taylor Company, Indianapolis, Ind., builds the enclosed automatic engine shown in the accompanying illustration. The frame of the engine is designed so that it will not only be strong and rigid enough to take care of the rated capacity of the engine, but also to have the strength and rigidity necessary to work under heavy overloads. The frame is also designed so that when the engine is assembled it will keep all the working parts in perfect alignment. It will, as well, catch and retain all oil used about the engine. The cross-head guides are bored out with the same boring bar which faces the end of the frame for the cylinder fit, thus ensuring perfect alignment of the cylinder with the bed.



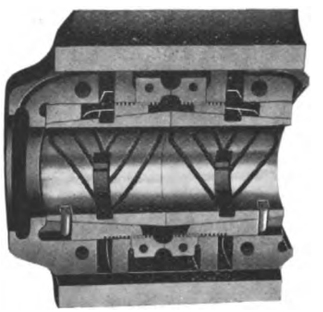
CHANDLER & TAYLOR ENCLOSED AUTOMATIC ENGINE.

The diameter of the shaft used in the engine conforms to the recommendations made by the committee of the American Society of Mechanical Engineers. Each shaft is made from a steel forging. The crank wheel is a casting, and the crank pin is cast integral with the wheel, and is reenforced by a steel core. The crank wheels are forced on the shaft under hydraulic pressure, and when in place, the shaft and crank wheel are turned true from the shaft centres.

The cross-head is a heavy casting of steel, and is provided with a large boss into which the end of the piston rod is screwed. The piston rod is held solidly in position in the cross-head by a heavy locknut. The shoes are wedge-shaped on the inner side next to the pin, and fit upon a similar wedge in the cross-head, the wear being taken by sliding one wedge upon another. The shoes when adjusted are held rigidly to the cross-head to prevent any motion between them.

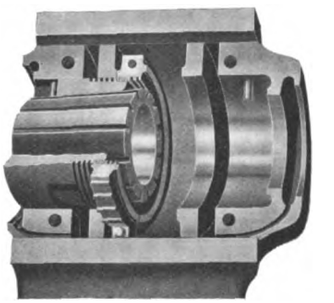
Direct-connected units require for the best service a peculiar construction of adjustment of the boxes for the crank shaft. The shaft must always be maintained concentric with the field frame of the generator, or otherwise the armature would be out of centre with the pole-pieces, and this would cause sparking at the commutator and other troubles.

To overcome this result, the Chandler & Taylor Company has embodied in its design what it calls a "self-centering and self-oiling" main crank bearing. As this main crank bearing, next to the crank disc, receives the brunt of the work, it must be arranged so that it can be adjusted very accurately when wear occurs. The bearing proper of this box is made of babbitt metal sleeves which completely surround the journal, and which are made cone-shaped on the outside surface. The larger bases of these cones butt together in the centre of the bearing. These sleeves are completely surrounded by some cone-shaped cast-iron wedges which are threaded on the outside surfaces, and which can be drawn together toward the centre of the bearing by some split nuts, which completely encircle them. When an adjustment is made, the nuts are turned, the wedges drawn together, and the sleeve thereby compressed equally at all points around the journal; and for this reason, the centre of the shaft is maintained in the same line in which it was originally set up. In addition to this adjusting feature, the shells are cored out so that an oil chain gives the bearing a copious supply of oil, and if there is any excess of oil supply, it runs out of the bearing and is returned by proper grooves to the oil well below. The bearing is perfectly rigid, because all of the parts are made interchangeable and fit together metal to metal, without any intervening liners.



SELF-CENTERING MAIN CRANK BEARING.

One of the most important features of this bearing is that it is possible to renew the bearing shells without removing the shaft from the engine. After the cap of the bearing is taken off, the crank shaft is simply moved enough to relieve the pressure on the bottom shells, and the old ones are removed and new ones slipped in place. The shaft immediately comes to its original central position when new shells are in place.



CAST-IRON WEDGES IN SELF-CENTERING BEARING.

The pedestal bearing furnished is what is generally known as the dynamo type, and consists of a box mounted on three heavy cap screws, which makes the bearing self-aligning. Also, it can be adjusted for any wear due to the weight of the wheel and armature.

The governor is of the Rites type. The valve used is a double-ported gridiron valve, and is extra light and quickly acted upon by the governor. The valve is perfectly balanced, and is so arranged that it will lift off of the valve seat and automatically relieve the pressure if an undue quantity of water should collect in the cylinder.

The Chandler & Taylor Company reports that one of its 100-kilowatt engines has been operated on less than seventy-five cents worth of oil in a week's continuous run. This includes both cylinder oil and engine oil.

Digitized by Google

OPEN AIR TELEPHONE SERVICE.

BY GEORGE A. LONG.

With the rapid development of the telephone and the various uses to which it has been put, probably one of the greatest strides made in recent years to serve the public was the introduction of the street corner pay station.

It is but a few years ago that the public

PUBLIC PAY STATION TELEPHONE, CLOSED.

pay station made its appearance in drug stores, depots, etc. Now, however, there have been installed over one hundred and thirty thousand pieces of apparatus of this type, and they have proven one of the best paying branches of telephony. There is none more profitable to the operating company and more satisfactory to the general public than the automatic pay station, which comprises part of the equipment of practically all progressive companies; the larger companies having their superintendent of pay stations, and he his force of assistants.

In all cities throughout the country the public pay-station sign is to be found and the operating company does not consider its territory properly covered unless all public places are provided with stations of this sort. The Bell companies have obtained excellent financial results with these instruments and collections amounting to as high as $250 per month have been made from a single station.

The public, however, are not supplied with the telephone until they can have it as handy as the mail box.

In all cities and towns where there is telephone service a person familiar with conditions can select numerous locations where the street pay station should come in for a large amount of business. The installation of such sets has so far proved entirely satisfactory to the companies that have added them to their equipment. In some cities the operating company has arranged with the city officials, in consideration for the privilege of placing street stations, to give the public free use of them for calling the police, fire department or hospitals, it being understood at the telephone exchange that all emergency calls from these stations can be made without charge.

There is no reason why these stations should not supersede the police telephone system now in use, if the operating company could make proper inducements to the city. The police could send in their reports to headquarters over these public stations and if such an arrangement should come about there would be no more boxes on the street than at present

PUBLIC PAY STATION TELEPHONE, OPEN.

and the blue police box now so common would be a thing of the past, which would mean a large saving to the city and a revenue to the operating company which alone would prove a good investment on the station so installed.

The advantage of these stations in case of fire, especially at night, is obvious With the fire-alarm boxes now in use, a person wishing to send in an alarm, has to awaken his neighbor to get the key and during all this time the fire is making headway. With the street telephone it would be possible to call fire headquarters direct, and inform them of the location of the fire.

These stations should prove convenient in the residential section of any city where there are no stores, and in the public parks where a person out driving can get in touch with the centre of the city at any time. To Bridgeport, Ct., is given the credit of being the first to install stations of this type, it having had the same in use for over three years, these being the first stations installed in the United States if not in the world. The receipts have been satisfactory from the start. During the past few months, however, several of the larger telephone companies throughout the country have placed orders for these instruments and indications point to a large demand in the near future.

These stations are keyless and by turning the handle the door can be opened. Inside is to be found a standard pay station of gravity principle, which means the user has no buttons to push or levers to pull. The user calls central and if the desired connection can be had the operator requests the deposit of a coin of the proper denomination for said call. The door of this station is also of the gravity type and is self-closing and on the inside of it is to be found a directory.

No special wiring is required for these stations and they can be placed on the iron post which is hollow to allow for underground wires, or they can be placed on the regular telephone pole. The maintenance is said to be very light.

They are finished in aluminum which will stand the weather well and will always look neat and attractive in appearance. They should also afford the telephone companies a profitable means of advertising.

Reynolds-Corliss Engines.

The Allis-Chalmers Company, Milwaukee, Wis., in catalogue No. 120, describes Reynolds-Corliss engines. In addition to the descriptive matter and tables of sizes there are numerous fine illustrations of different types of Reynolds-Corliss steam engines. The descriptive matter and illustrations include heavy duty engines, Reliance-Corliss engines, girder frame engines, vertical engines, horizontal-vertical engines, compound engines, direct-connected engines, rolling-mill engines, blowing engines and air-compressors.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

PORTO RICAN RAILROAD FAILS—It is announced that the executive council of San Juan, Porto Rico, has annulled the franchise granted on March 3, 1903, to the Vandegrift Construction Company, of Philadelphia, Pa., to build a $3,000,000 electric railroad from San Juan to Ponce.

NEW ORLEANS, LA., TELEPHONES—It has been reported that steps are being taken for the establishment of an independent people's telephone company in New Orleans, La. It is stated that the company will be made up entirely of small stockholders, no one interest to hold more than ten per cent of the capital stock. The plans are for a corporation with a capitalization of about $1,000,000, with a modern working plant.

CHICAGO CITY RAILWAY POWER-HOUSE—Plans for the erection of a large new power-house for the Chicago City Railway Company, to cost about $5,000,000, are being prepared by the engineering department of the company. The power-house will probably be built near the south branch of the Chicago river, and north of Twenty-second street. It is said that construction will begin as soon as T. E. Mitten, the newly elected operating head of the road, assumes charge.

NORTH AMERICAN COMPANY TO INCREASE ITS CAPITAL—The directors of the North American Company, St. Louis, Mo., have recommended an increase of capital from $17,000,000 to $30,000,000. The company has recently decided to purchase all the stock of the Laclede Gas Light Company and the Union Electric Light and Power Company, of St. Louis, Mo. An additional contract has been entered into, providing for the purchase of a large interest in the United Railways Company, of St. Louis.

GREAT BRITAIN TO BUY UP THE TELEPHONE TRUST—It is announced that the British postmaster-general has made an agreement with the National Telephone Company to take over its business and buy its plant after December 31, 1911. The price to be paid for the business is to be settled by arbitration. Three-quarters of the whole purchase money may, at the option of the government, be paid by means of an annuity for a term not exceeding twenty years. The postmaster-general also retains certain powers, enabling him to reject the purchase of any plant unsuitable for the carrying on of the business.

NEW JERSEY TELEPHONE MERGER—Papers merging the Delaware & Atlantic Telegraph and Telephone Company, the Trenton Telephone Company, the South Jersey Telephone Company, the Hopewell Telephone and Construction Company and the Bay Shore Telephone Company, have been filed at Trenton, N. J. A charter of incorporation has been granted to the consolidated company, which will operate under the name of the Delaware & Atlantic Telephone Company, with a capitalization of $400,000. The officers and directors are: president, Union N. Bethell; secretary and treasurer, Winfield A. Piersall, and James E. Mitchell, Theodore Spencer, William T. Westbrook and H. S. Huidekoper.

EXTENSIVE SUBWAY PLANS RECOMMENDED—The committee on plans and contracts of the Rapid Transit Commission, New York city, has formulated plans for more than a dozen new subway and elevated lines, with a number of alternate routes, in and around the city of New York. The proposed routes tap the Bronx, Westchester, Williamsburg, East New York and Staten Island, besides providing for underground rapid transit on the east side of Manhattan borough and across town. To build all of these lines would cost approximately $250,000,000. It is expected that the tunnel construction along the routes finally to be chosen from the tentative plans will cost about $120,000,000.

AN EXTENSIVE ELECTRIC POWER PLANT FOR NORTHERN INDIA—A power plant is to be established at Rampur, India, on the Jhelum river. With the use of a six-mile feeder channel it has been found that it is possible to get a fall of 450 feet at this point. With the minimum flow in the Jhelum river it will be possible to obtain 100,000 horse-power. When the installation of the power station is completed it will be possible to operate the Kashmir Railway electrically along its whole length of 180 miles, and also provide power for industrial purposes in Srinagar, Abbottabad, Murree and Rawalpindi. An even more important use, however, will be the utilization of the power in operating electrical dredges for the purpose of deepening the river in the Kashmir valley. This application will tend to minimize the effects of floods, which under the present conditions devastate the country periodically. It will allow of the reclaiming of a large tract of land, and will also permit storage of water in the Woolar lake, for sale to the Punjab irrigation department.

EXTENSIVE IMPROVEMENTS TO LONG ISLAND RAILROAD SERVICE—It is stated that approximately $90,000,000 will be spent by the Long Island Railroad Company, the Pennsylvania Railroad Company and the connecting railroad companies, for the betterment of transit facilities for passengers and freight to and from Long Island. The tunnel from Jersey City to Long Island City will cost $40,000,000. The contemplated improvements in the Long Island Railroad will cost $40,000,000, and $10,000,000 will be spent in building a connecting railroad by way of a bridge over Hell Gate and Ward's Island, for the joint use of the Pennsylvania, the Long Island and the New York, New Haven & Hartford railroads. The Long Island Railroad Company is hastening the work of electrification, and expects by June 1 to operate over forty-five miles of its length. The company is having built 122 steel motor cars, similar to those used in the rapid transit subway in Manhattan. Two portable substations, constituting an interesting development in railroad engineering, will be experimented with. These portable substations will be used to reenforce any permanent substation in an emergency caused by a rush of traffic in any particular section. They will increase from two to six times the capacity of any station. Each of the portable substations consists of one 1,500-kilowatt rotary converter with three transformers and a blower, and complete switching apparatus, all carried in a fireproof steel car.

ENGINEERING SOCIETIES.

NEW YORK ELECTRICAL SOCIETY—The next regular meeting of the New York Electrical Society will be held on Wednesday, March 15. Dr. E. F. Roeber will lecture on "Recent Developments in the Electrometallurgy of Iron and Steel," and the well-known authority, Dr. Paul L. T. Héroult, of La Praz, France, will lecture on "Making and Refining of Steel in the Electric Furnace."

ELECTRICAL SOCIETY OF PENNSYLVANIA STATE COLLEGE—The Electrical Society of Pennsylvania State College met on Wednesday evening, March 1. A paper on "The New York Central Electric Locomotives" was read by C. N. Goodman. A paper entitled "Currents in Telephone Receivers" was read by C. E. Govier. P. M. Jordan described Westinghouse direct-current motors, and an article on "Air in Electric Subways" was presented by B. W. Kline.

MADISON BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—On Thursday evening, March 2, the Madison, Wis., branch of the American Institute of Electrical Engineers took up for discussion the papers presented at the New York meeting of the Institute in January. The paper on acyclic generators was carefully abstracted by O. M. Jorstad, a graduate student at the University of Wisconsin. He also read an abstract of the New York discussion. A. Kellar discussed this subject from the standpoint of the manufacturer, as well as the operator. He compared the homopolar dynamo with the commutator type for different voltages and capacities, showing by curves the relation of the probable costs in each case. Mr. Moultrop's paper on central station design was abstracted by C. A. Hoefer, and the discussion opened by R. F. Robinson.

Digitized by Google

TELEPHONE AND TELEGRAPH.

PEKIN, ILL.—The Pekin Telephone Company will build a toll line from Havana to Lewiston, and from Atterbury to Virginia.

WHEELING, W. VA.—The Pultney Telephone Company, located at Shadyside, has been acquired by the Belmont Telephone Company.

DETROIT, MICH.—The Michigan State Telephone Company will soon begin erecting a rural telephone line through Armada.

BEATRICE, NEB.—The Nebraska Telephone Company has completed a new telephone line, running five miles east of Beatrice.

HUNTINGTON, IND.—The Central Union Telephone Company has made known its intention of establishing an exchange at Huntington.

EDWARDSVILLE, ILL.—The Central Union Telephone Company has erected another country line on the Springfield and Bethalto roads.

GADSDEN, ALA.—The work of putting in a new telephone exchange at Boaz is almost complete, and the line from Albertsville will be rebuilt at once.

ANN ARBOR, MICH.—The Washtenaw Home Telephone Company has increased its capital stock from $250,000 to $300,000. It is building an exchange at Ypsilanti.

ASHLAND, KY.—The Southern Bell Company will build a line from Wayne, W. Va., to Fort Gay, and up Tug river to Matewan. The line will cross the river at Ashland, and connect with Louisa.

ATLANTIC, IOWA—A number of farmers north of Atlantic, among them being William Lamb, A. Pellett, D. E. Milford, Charles Bartley and O. M. Becker, have organized the Atlantic Mutual Telephone Company.

BURLINGTON, IOWA—Two hundred thousand dollars will be expended by the Mississippi Valley Telephone Company in rebuilding lines and for new equipment at Burlington, Keokuk, Fort Madison, Wapello and Muscatine.

ABERDEEN, S. D.—The Dakota Central Telephone Company will extend its line to Pierre from Gettysburg. It will then have a copper metallic circuit from Bowdle to Pierre. A new line will also be built from Ipswich to Faulkton and Miller.

DUQUOIN, ILL.—The Duquoin Telephone Company has elected the following officers: president, Harry C. Miller; vice-president, Mark C. Brookings; secretary-treasurer, R. O. Lehn; manager, E. J. B. Aldridge; directors, R. O. Lehn, H. C. Miller, Mark C. Brookings, E. J. B. Aldridge.

FORT SCOTT, KAN.—The Bell Telephone Company, which some time ago secured a controlling interest in the Mutual Telephone Company, of Fort Scott, has arranged a settlement with the minority stockholders of that company and will consolidate the two plants. A new exchange will be put in at a cost of $75,000, and connections arranged with local rural lines.

ANDERSON, IND.—The stockholders of the Delaware & Madison County Telephone Company have elected directors, the board organizing with A. L. Johnson, Muncie, president; J. J. Netterville, Anderson, vice-president; Thomas Bromley, Muncie, secretary and general manager. The company has 4,243 telephones operating in Muncie, Anderson, Elwood and Alexandria.

REDLANDS, CAL.—Work has been commenced by the Sunset Telegraph and Telephone Company on its new line to Yuma, where connections will be made with a line to be built by the Consolidated Telegraph, Telephone and Electric Company, with headquarters at Phœnix. The two companies have arranged to connect with the Southwestern Company, operating in Texas.

NEW ALBANY, IND.—The Mohawk Valley Independent Telephone Company has been organized by the farmers residing between Fredericksburg and Palmyra, on the Paoli pike, north of New Albany. The line will probably be connected with the telephone system in New Albany. The officers are as follows: president, Jonathan Boston; secretary, A. L. Rudolph; treasurer, Clint Fouts.

SALT LAKE CITY, UTAH—The Grand Valley & La Sal Telephone Company has started work on a line from Cisco, *via* Richardson, Castleton, Basin, and to Gold Basin, a distance of about fifteen miles. It is proposed to have this line completed and in operation for spring business. It is also proposed to extend it from Miners' Basin into Beaver Basin, and from Gold Basin to the Paradox-La Sal mines.

FREMONT, OHIO—The annual meeting of the Fremont Home Telephone Company was held recently, and these directors were elected: S. Brinkerhoff, C. M. Russell, Joseph Horn, James Hunt, A. W. Overmyer, T. M. Brush, A. E. Lord. The directors elected: president, S. Brinkerhoff; vice-president, C. M. Russell; secretary, Joseph Horn; treasurer, J. M. Sherman. The company added 357 new telephones during the year, and now has 1,300 connected.

MONMOUTH, ORE.—The annual meeting of the Luckiamute Rural Telephone Company stockholders resulted in the election of the following officers: J. H. Hawley, president; James Helmich, vice-president; J. J. Thurston, secretary; J. H. Hawley, J. A. Withrow, J. J. Thurston, W. E. Williams and James Helmich were elected a board of directors. The wire and poles from Monmouth into the Luckiamute country are the property of this company, and are used by both the Independent and Pacific States systems.

YOUNGSTOWN, OHIO—At a meeting of the directors of the Youngstown Telephone Company, at Cleveland, two Youngstown men were reelected directors. They were C. Y. McVey and George G. King. The directors elected Mr. McVey vice-president. Mr. King is the local manager. The other directors elected were F. S. Dickson, who was elected president; J. B. Hogue, elected secretary; R. W. Judd, elected treasurer, and W. L. Carey, Jr., and M. B. Overley. A dividend of four per cent was ordered on the common stock at the rate of one per cent quarterly.

ANOKA, MINN.—At the annual meeting of the stockholders of the Rural Telephone Company, of Hennepin County, held at Osseo, the company was reported to have 102 patrons, ninety miles of wire, and six toll lines. The exchange is in Osseo, and lines run into Corcoran, Hassan, Maple Glove, Brooklyn, Champlin, Osseo, Rogers and St. Michaels. The stockholders chose as directors for one year O. S. Miller, P. Heckleman and G. H. Smith; for two years, A. P. Hechtman, B. V. Dibb and Edam Schmidt; for three years, Elmer Owen, H. E. Punt and Henry Berning.

BALTIMORE, MD.—The Delmarvia Telephone Company, of Wilmington, Del., is projecting two lines, one covering the eastern shore of Maryland and the other the state of Delaware. The objective point of both lines is Salisbury. At this point these lines will connect with the Pocomoke Telephone Company, which operates below Salisbury, and the two will give a complete local service on the whole peninsula, and will as well have a long-distance service between Wilmington, Philadelphia and Baltimore. The new lines will operate in connection with the Maryland Telephone Company.

DENVER, COL.—Extensions and improvements for the Colorado Telephone Company were ratified at a recent meeting of the stockholders and directors. The sale of $1,200,000 of treasury stock authorized at a special meeting in January for the purpose of improvements was indorsed, and it was agreed that $200,000 of this money should be used for extending the Colorado line into New Mexico. Officers elected were: E. B. Field, president; Alonzo Burt, of Milwaukee, vice-president; H. W. Bellard, secretary and auditor; E. B. Field, Jr., treasurer. The following directors were elected: E. B. Field, A. V. Hunter, of Leadville; W. L. Graham, of Pueblo; F. P. Fish, of Boston; E. S. Kassler, Crawford Hill, Joel F. Vaile and Philip Feldhauser.

COOPERSTOWN, N. Y.—The Otsego Home Telephone Company has purchased the Winfield Telephone Company and the Wharton Valley Telephone Company. The first named is a small company operating between Richfield Springs and Winfield. The Wharton Valley company is one operating lines in the northern part of Otsego County, through the towns of Edmeston, South Edmeston, West Edmeston, North Edmeston, Burlington, West Burlington, Burlington Flats and Garratsville. The purchase of the two companies practically completes the Otsego Home Telephone Company's connections throughout the northern part of Otsego County and the southern part of Herkimer County, and gives it about one hundred and sixty additional telephones, with about sixty additional miles of toll lines.

Digitized by Google

LEGAL NOTES.

COURT AND COUNCIL DENIED RIGHT TO FIX TELEPHONE RATES—The Supreme Court of Ohio has rendered a decision in the case of the state against the Toledo Home Telephone Company, holding that, in granting franchises, there is no power either in the probate court or the city council to fix the rate which the telephone companies may charge for service. The decision of the court is that the demurrer to the answer is overruled, and the petition is dismissed.

CINCINNATI STREET RAILWAY FRANCHISE UPHELD—The Supreme Court of Ohio has handed down a decision which sustains the validity of the franchises under which the Cincinnati Street Railway Company operates. The franchises rest upon the so-called Regers fifty-year franchise act, which was passed eight years ago, and repealed by the next legislature. The court, in its decision, reversed the decision of the lower courts against the railway company, and dismissed the petition. This brings to an end, in favor of the railway company, the long litigation over the franchises purchased by Theodore Horstman.

FEDERAL COURT ENJOINS NATIONAL COMPANY IN ERBEN PATENT SUIT—Judge Seaman, in the United States Circuit Court for the Eastern District of Wisconsin, in an opinion handed down on February 24, after a preliminary hearing, granted an injunction against the National Electric Company in the suit brought by the General Electric Company, alleging infringement of the Erben brush-holder patent No. 705,055, in the manufacture by the defendant company of brush-holders for generators and motors. The Westinghouse Electric and Manufacturing Company was interested in the suit as licensee under the Erben patents.

HALF-FARE LAW FOR SCHOOL CHILDREN DECLARED CONSTITUTIONAL IN MASSACHUSETTS—The Massachusetts Supreme Court has handed down a decision declaring constitutional the legislation under which street railway companies are required to carry pupils of the public schools to and from school at half the regular fare. The decision was in the case of the commonwealth against the Interstate Consolidated Street Railway Company. The railway company contended that the statute was unconstitutional, as it did not apply to all pupils of all schools, but only to those of the public schools. The court held that the legislature has the power to concern itself with the transportation of children to the public schools in the interests of popular education, as it provides the children with books and other necessaries.

DECISION IN TESLA PATENT SUIT—Judge Buffington, in the United States Circuit Court for the Western District of Pennsylvania, on February 24, handed down a decision dismissing the plea of estoppel interposed by the Diamond Meter Company, of Peoria, in the suit brought by the Westinghouse Electric and Manufacturing Company against the Jefferson Electric Light, Heat and Power Company, of Punxsutawney, for infringement of the Tesla split-phase patents Nos. 511,559 and 511,560, in the use of Scheefer induction meters for alternating currents manufactured by the Diamond company. An injunction was granted on the following day restraining the Jefferson company from the further use of these meters. The Diamond Meter Company undertook the defence of the case against the Jefferson company on the plea that it had been a party to the defence in a similar suit brought some years ago by the Westinghouse company against the Catskill Illuminating Company, in which Judge Lacombe's decision sustaining the complainant was reversed by the Court of Appeals, which held that the validity of the patents in question had not clearly been established in the hearing in the lower court. The validity of the patents has since been established in a number of actions in different states. The defence in the suit against the Jefferson company rested on the plea of estoppel entered by the Diamond company, and Judge Buffington, in holding after a final hearing that the Diamond company had not appeared openly as a party to the defence in the Catskill case, ordered that a decree of infringement be entered against the Jefferson company.

NEW PUBLICATIONS.

THE EFFICIENCY AND PRACTICAL APPLICATION OF USEFUL ILLUMINANTS—Dr. W. Wedding, professor at the Technical High School, Berlin, has issued, in pamphlet form, his recent paper on the efficiency and use of illuminants, which appeared in the *Journal fur Gasbeleuchtung und Wasserversorgung* during January.

THE WORK OF THE INTERSTATE COMMERCE COMMISSION—This book, by H. T. Newcomb, has been printed, together with reprints of certain editorial and other articles which throw light upon the proposed amendment to the interstate commerce law. The articles have been taken from the *Railway Age*, the *Railroad Gazette* and the *Commercial and Financial Chronicle.*

INTERSTATE COMMERCE BRIEF AS TO PROPOSED NEW LEGISLATION—This is a brief prepared by Samuel Spencer and David Wilcox, and filed with the Committee of Interstate and Foreign Commerce of the House of Representatives, January, 1905. It takes up the propaganda for further legislation, past and present proposed changes in the law, and discusses these proposed changes.

OFFICERS, DIRECTORS, COMMITTEES, MEMBERS, ETC., OF THE MERCHANTS' ASSOCIATION OF NEW YORK—The Merchants' Association of New York has issued a booklet giving the officers, directors, committees, members, annual reports, by-laws, etc., of this association. The book contains eighty pages, and tells the purposes of the association and the work done during the past year.

WATER SUPPLY AND STATISTICS OF THE UNITED STATES GEOLOGICAL SURVEY—The Department of the Interior, Washington, D. C., has issued five papers dealing with the water supplies of the United States, as follows: "Water Powers of the State of Maine," by H. A. Pressey; "Normal and Polluted Waters in Northeastern United States," by M. O. Leighton; "Report of Progress of Stream Measurements for 1902," by F. H. Newell; "Report of Progress of Stream Measurements for 1903," by J. C. Hoyt; "Contributions to the Hydrology of Eastern United States," by Myron L. Fuller and others.

PROCEEDINGS OF THE TENTH ANNUAL MEETING OF THE OHIO ELECTRIC LIGHT ASSOCIATION—This book gives the proceedings of the tenth annual meeting of the Ohio Electric Light Association, which was held at Sandusky, Ohio, August 16 to 18, inclusive, 1904. It gives the officers and members of the association, and also the papers read at the meeting, together with the president's address. The papers presented were "The Day Load as a Factor in Central Station Earning Capacity," by L. B. Hoit; "Transformer Testing for Central Stations," S. E. Johannesen; "Relation of the Supply House to the Central Station," P. R. Boole; "Relation of Electric Heating Devices to Central Stations." H. W. Hillman; "The New Luminous Arc Street Lighting System," H. W. Hillman; "Notes on Incandescent Street Lighting," K. C. Randall; "Notes on the Incandescent Lamp," E. H. Haughton; "The Steam Turbine and Its Use," E. C. Crocker; "The Instrument Equipment of a Testing Department," F. Conrad; "Graded Costs of Electric Supply," M. E. Turner; "Points for Consideration When Purchasing Series Alternating-Current Lamps," G. Brewer Griffin; "Unaccounted-for Current," W. E. Richards; "Joint Use of Poles by Public Service Corporations," G. S. Gaskill.

AUTOMOBILE NOTE.

THE AUTOMOBILE AND THE LAW—On Tuesday evening, March 7, at nine o'clock, Mr. W. W. Niles addressed the Automobile Club of America on the "Automobile and the Law," setting forth the rights, duties and liabilities of the automobilist.

Digitized by Google

ELECTRIC RAILWAYS.

VISALIA, CAL.—The contract for the construction of the electric road from Exeter to Lemon Cove by the Visalia Electric Railroad Company has been let.

ATHENS, GA.—The Athens Electric Street Railway Company will at once install a large steam plant, to be used when the water of Middle river is not available.

PERU, IND.—Peru township has voted $20,000, and Richland township $10,000 subsidies for the Peru & Warsaw interurban line, promoted by Solomon C. Dickey, of Indianapolis.

MILWAUKEE, WIS.—A franchise has been obtained for the construction of an electric road from Genesee, Waukesha County, to Waukesha for both freight and passenger traffic. Work will begin soon.

MEMPHIS, TENN.—An extension of its franchise has been granted to the Memphis Street Railroad Company, and $1,000,000 will be spent in extending the lines, the work to be completed by December 1.

NEW ORLEANS, LA.—The franchise for an electric street railway, to be operated in Jefferson parish, from the Orleans parish line to the Texas Pacific Railroad depot in Gretna, has been sold to Leigh Carroll and James Dickins.

ATTICA, IND.—Logan has voted a subsidy of $33,000 to the proposed interurban line from Tipton, through Frankfort, to Attica, by a majority of 264. The same proposition was defeated more than a year ago by a majority of ninety-six.

ELKHART LAKE, WIS.—The power plant for the Sheboygan-Elkhart Lake Railway and Electric Company has been completed. The cost of the plant was $200,000. As soon as the winter is over construction work will be begun. The grading has been completed between Elkhart Lake and Plymouth.

CANON CITY, COL.—At a special meeting of the Canon City city council a franchise was granted to J. W. Baumhoff, of St. Louis, to build, equip and maintain an electric railway system, the franchise to extend over a period of twenty-five years. The concession carries with it the privilege of conveying freight cars over the lines within the city limits.

MAHANOY CITY, PA.—Mahanoy City, Shenandoah, Ashland and Frackville capitalists are forming a company to purchase the Lakeside & Schuylkill trolley lines, operating between Mahanoy City and Shenandoah, and Mahanoy City and Locustdale. The Lakeside line will be extended to Tamaqua, thus connecting Mauch Chunk with Shamokin by trolley.

SALISBURY, N. C.—The Salisbury & Spencer Railway Company has sold an interest in its system to the American Gas and Electric Company, of Providence, R. I., for $150,000, and it is stated that the line now under construction between Salisbury and Spencer will be completed and put into operation at once, and an electric light system will also be installed in Spencer.

BOWLING GREEN, OHIO—By the completion of the eastern extension of the Lake Erie, Bowling Green & Napoleon Electric Railroad from Pemberville to Woodville, through passenger traffic is established between Bowling Green, Cleveland and other eastern points by trolley lines. Connection is also made with cars for Toledo and Findlay over the Toledo, Urban & Interurban Electric line.

BENTON HARBOR, MICH.—The St. Joe River Traction Company, originally formed to connect Benton Harbor, Niles and Dowagiac, will be extended north from Benton Harbor to Kalamazoo, with a spur to Sister Lakes. Immediate steps will be taken to secure a right of way. The line to Kalamazoo will be fifty miles long, and will tap a rich farming country heretofore untouched by a railway line.

MIDDLETOWN, N. Y.—The Middletown-Goshen Traction Company was sold recently at foreclosure in the action entitled the Farmers' Loan and Trust Company, as trustee, plaintiff, against the Middletown-Goshen Traction Company. It was bid in by Edward R. Sponsler and William H. Sponsler, of Philadelphia, for $150,000. The same parties also purchased the Middletown-Bloominburgh Electric Railway.

PHILADELPHIA, PA.—Judge McPherson, in a decree handed down in the United States Circuit Court, of Philadelphia, has ordered the sale of the West Chester, Kennett Square & Wilmington Electric Railway Company's line at public auction by Bayard Henry, the receiver. Under this order the entire line will be sold, including rights, rolling stock, power-house, car barn, tracks, poles and wires.

BOSTON, MASS.—Boston and Worcester stockholders have authorized the issue of 1,000 shares of preferred and 1,500 shares of common, the proceeds to be used to retire floating debt incurred for the purchase of stocks of the operating companies. The report for the quarter ended December 31 shows an increase of $12,683 in gross, and an increase of $7,118 in balance for dividends. Earnings since January 1 have increased heavily.

YORK, PA.—A meeting of residents of Fawn township and near-by towns was held at Centre recently to organize the New Park & Fawn Grove Railroad Company, whose proposed line will be nine miles in length. It will extend from Stewartstown to New Park and Fawn Grove. The capital is placed at $90,000. The new road is to be operated by the Stewartstown Railroad Company. John C. Wiley was chosen temporary president.

SPRINGFIELD, OHIO—President John L. Plummer, of the Commercial Club, D. King Gotwald and others have interested New York capitalists in an electric line to be built from Yellow Springs to Clifton, thence to Cedarville and Jamestown, and eventually to Wilmington. Entrance to Springfield will be made by connecting with the Springfield & Xenia road at Yellow Springs. Work of constructing the new road will be started this spring.

WILLIAMSPORT, MD.—At the annual meeting of the stockholders of the Hagerstown Street Railroad Company the following officers were elected to serve for the ensuing year; president, Christian W. Lynch; vice-president, Donald C. Haldeman; treasurer, William Jennings; secretary and superintendent, W. C. Hepperle; directors, Christian W. Lynch, William Jennings, J. Clarence Lane, W. C. Hepperle, J. I. Bitner, H. H. Keedy, Jr., and Edward W. Mealey.

SCRANTON, PA.—Work has been begun at Factoryville on the trolley road, to be constructed from Scranton to Tunkhannock. The company is partly made up of Scranton capitalists, among whom are J. Seldon Swisher, Lewis B. Carter, James P. Dickson, Frederick E. Scott and C. W. Seeley. The contract for the construction of the road has been awarded to the American Lime, Stone and Cement Company, of Berwick, Pa. The road will be built for high-speed travel.

TOLEDO, OHIO—Negotiations have been closed for the electrical equipment for the new Toledo, Port Clinton & Lakeside permanent power plant, to be located at Port Clinton or Oakharbor. The contract was secured by the Allis-Chalmers Company, the plant complete to be turned over to the railway company on or before July 1. Plans have also been perfected for the purchase of ties and other equipment to complete the road to Marblehead, and cars will be in operation between Toledo and Marblehead by July 1.

MATTOON, WIS.—Surveys for the new electric passenger and freight road, between Clintonville, Mattoon and Antigo, to be known as the Red River Valley Electric Railway, will be completed in April, and it is expected that cars will be running over the line by July 1. The road will begin at Clintonville, run thence to Eland Junction, thence to Mattoon, thence to Phlox, and thence to Antigo. The line is being surveyed for a double track, and it is said it may be extended to the Republic, Mich., iron mines.

JOHNSTOWN, PA.—The Northern Cambria Street Railway Company, which has projected a trolley line from Patton to St. Boniface, Hastings, Barnesboro, Spangler, St. Benedict and Carrolltown, has elected the following directors: Rembrant Peale, S. R. Jackman, Thomas Barnes, George W. Hoover, James H. Allport, F. H. Bigler, W. D. Bigler, W. H. Denlinger, George M. Wertz, F. H. Parker, F. O. Botts and R. A. Shillingford. The directors have elected as officers W. H. Denlinger, president; Rembrant Peale, vice-president, and James H. Allport, secretary.

Digitized by Google

PERSONAL MENTION.

MR. H. T. PAISTE, of Philadelphia, was among the pioneer electrical manufacturers who spent several days in New York recently.

MR. H. O. PHILLIPS, of Pawtucket, R. I., the well-known manufacturer of insulated and copper wire, was a New York visitor last week.

MR. CHARLES F. MUNDER, president and treasurer of the Munder Electric Company, Springfield, Mass., was a visitor in Chicago during the past week.

MR. CHARLES E. BROWN, of the Central Electric Company, and Mr. W. W. Low, of the Electric Appliance Company, were among the electrical visitors from Chicago in New York city during the past week.

MR. H. R. MASON, manager of the local Bell telephone exchange at Ann Arbor, Mich., has been made superintendent of the Saginaw district. He will be succeeded at Ann Arbor by Mr. Thomas Harbaugh, of Detroit.

MR. ARTHUR WARREN, manager of publicity for the Allis-Chalmers Company, delivered his very interesting address, entitled "A Plain Talk on Trade Journals," before the Chicago Trade Press Association February 28.

MR. A. A. THRESHER, of the Thresher Electric Company, of Dayton, Ohio, has been confined to his room at the Waldorf-Astoria, in this city, for ten days past with a badly sprained ankle. He was able to be out Monday of this week.

MR. FRED F. CLARK, manager of the Clark Electric Specialty Manufacturing Company, Minneapolis, Minn., made a visit to Chicago during the past week. Mr. Clark reports that the electrical specialty business is at its best at the present time.

MR. B. A. SCHRODER, for some time attached to the St. Louis office of the Crocker-Wheeler Company, has been placed in charge of the New Orleans office of the company. Mr. Schroder succeeds Mr. W. P. Field, who has been transferred to the Boston office.

MR. W. S. SISSON, of Providence, secretary of the D. & W. Fuse Company, spent several days at the Hotel Imperial last week. Mr. Sisson's company is moving to its enlarged and modern factory, where facilities for turning out its product have been greatly increased.

MR. F. S. PALMER, formerly electrical engineer for the Consolidated Engine-Stop Company, New York city, has associated himself with the Locke Regulator Company, Salem, Mass. This company is the manufacturer of an automatic engine-stop and speed-limit system.

MR. E. P. SIMMONS has resigned his post with the Interstate Electrical Company, Atlanta, Ga., to become secretary and treasurer of the P. E. Allison Company, of Atlanta. This company has recently been reorganized and reincorporated under the name of the Allison-Simmons Company. Mr. P. E. Allison is the president.

MR. M. W. WOOD, for the past three years an electrical engineer with the General Electric Company, Schenectady, N. Y., will shortly engage in consulting engineering in Chicago, Ill. Mr. Wood was district engineer for the Edison Illuminating Company, at Portland, Ore., prior to the consolidation of the Edison and Thomson-Houston companies.

MR. E. B. GUNN, formerly superintendent of the Richmond, Ind., Street Railway Company, has been appointed manager of the Springfield, South Charleston, Washington Court House & Chillicothe Electric Railway Company. Mr. Gunn was superintendent of the Dayton, Springfield & Urbana Railway Company prior to his appointment with the Richmond company.

MR. ARTHUR C. RALPH, for several years in charge of the Marlboro street railway system as superintendent, and formerly general superintendent of the Boston & Worcester system, has been appointed general manager of the Taunton & Pawtucket and the Middleboro, Wareham & Buzzard's Bay street railway systems.

MR. ARTHUR WILLIAMS has been appointed by President Davis to report on municipal ownership at the twenty-eighth convention of the National Electric Light Association. This convention will be held at Denver and Colorado Springs, Col., June 6 to 11. Mr. Williams has already in hand a large amount of statistics regarding municipal ownership of plants, both in this country and abroad. His report on decorative and sign lighting has attracted a great deal of attention wherever electric light has been used, and there is no doubt that the coming report on municipal plants will be of equal value and interest.

MR. FREDERICK P. FISH, president of the American Telephone and Telegraph Company, addressed the members of the Beacon Society at the Algonquin club-house, Boston, Mass., on the evening of February 28. Mr. Fish was the chief guest and only speaker of the evening. He paid a tribute to the three great inventors of the last one hundred years—Eli Whitney, the inventor of the cotton gin; Robert Fulton, who developed the steamboat, and Alexander Graham Bell, who produced the telephone Apropos the future of the telephone service, Mr. Fish remarked that the number of subscribers in New England had more than doubled in the last three years over the total of the previous twenty-four years. He was confident that the next three years would see the present number more than doubled.

MR. FRANK B. KNIGHT, of Dallas, Tex., will hereafter be an official of the Southwestern Telephone and Telegraph Company, resigning as special agent of the American Telephone and Telegraph Company. Mr. Knight has been identified with the Bell telephone interests since 1880. The Dallas *Morning News* says: "Mr. Knight was assigned to duty in the Southwest in 1886, having jurisdiction over the states of Arkansas, Texas, Louisiana and Mississippi and Oklahoma and Indian Territories, with headquarters in Austin, Tex., from which place he removed to Dallas in the early part of 1902. Mr. Knight has always entertained an abiding faith in the possibilities of the telephone business throughout this section of the country, and has lent his aid in furthering every project that had for its object increased facilities or the more efficient working of the system, and he has the satisfaction of knowing that in no part of the United States has a higher degree of excellence been attained in telephone operation than is to be found in the territory with which he has so long been connected."

OBITUARY NOTICES.

MR. WILLIAM WALTER FAGIN, chief canvasser of the Colorado Telephone Company, Denver, Col., died on the evening of February 23, in Denver. He had been in the employ of the company for over three years, and was one of its most popular and efficient men.

MR. FRANK SCHIFFHAUER, superintendent in charge of construction work of the Mexican Light and Power Company, Mexico City, Mexico, died on the morning of February 18, as the result of injuries which he received during the fire at the company's power-house.

MR. FRED A. LA ROCHE, proprietor of the F. A. La Roche Company, New York city, died on Saturday, March 4. Mr. La Roche was widely known throughout the electrical fraternity. He was an enthusiastic automobilist. He was buried on Thursday afternoon from Germantown, Philadelphia.

MR. RICHARD SOMERS HAYES died on Thursday, March 2, in New York city. Mr. Hayes was formerly president of the St. Paul & Duluth Railroad and the New York & Northern, and vice-president of the Missouri Pacific Railroad Company. He built the Texas & Pacific, and was receiver of the Texas International. He was a director of the Brooklyn Rapid Transit Company, the Acheson, Delaware & Hudson, Long Island and other railroads.

MR. DUDLEY B. WICK, JR., chief of the engineering department of the North Electric Company, Cleveland, Ohio, died on the morning of March 1. He had been ill for about a week with a severe attack of the grippe, and this brought about a brain complication which caused his death. He was a student of the university and high schools of Cleveland, Ohio, and graduated from Cascadilla in 1898. He took special courses, preparatory to his entering upon the profession of electrical engineer, at both the Case School of Applied Science and Cornell University. He became connected with the North Electric Company a few years ago, and by tireless energy speedily rose from a subordinate position to that of chief of the engineering department. This responsible position he filled with great success, and he had won a high place for himself among his business associates.

Digitized by Google

ELECTRIC LIGHTING.

ROCKFORD, ILL.—The Rockford Edison Company will make extensive improvements to its system.

HOPKINS STATION, MICH.—W. F. Nicoli will establish an electric light plant at Hopkins Station.

ELGIN, ILL.—Elgin has leased its electric plant to the local traction company, from which it will purchase current.

FORT VALLEY, GA.—Fort Valley has voted for a municipal electric light plant. Bonds to the amount of $12,000 will be issued.

LEAVENWORTH, KAN.—Local capitalists have completed arrangements for the building of a $5,000 electric light plant at Onaga.

STILLWATER, MINN.—Fire recently partially destroyed the Stillwater electric light plant, which cost $18,000. The loss will reach $5,000.

ALBANY, N. Y.—Governor Higgins has signed the bill authorizing Ilion to raise $25,000 for the establishment of an electric lighting plant.

MEXICO, MO.—The Mexico electric light plant has been granted a twenty-year franchise, and a contract for extensive street lighting will be made.

WILMINGTON, DEL.—The Colonial Beach Electric Light and Power Company has received a twenty-year franchise for a plant in Colonial Beach, Va.

FENELON FALLS, ONTARIO—The new electric lighting and power plant, built by the town of Fenelon Falls at a cost of $30,000, is now in running order.

JEFFERSON CITY, TENN.—The Jefferson City Electric Light Company has purchased the Forche tannery property, and will erect an electric light plant.

CHICAGO, ILL.—By a vote of five to one the village board of La Grange decided to sell the village waterworks and lighting plant to a private corporation.

NEWTON, N. J.—The Newton Gas and Electric Company has given a mortgage to the Hobart Trust Company, of Passaic, to cover an issue of $200,000 bonds.

MARION, S. D.—The Marion town council has awarded to J. A. Heeren and other business men a franchise for the installation and operation of a lighting system.

SODUS, N. Y.—The electric lighting franchise granted citizens of Sodus, about one year ago by the town board, has been transferred to other business men of the place.

SALEM, S. D.—Mark Donahue and P. G. Williams, of Montrose, are at work organizing a company at that place for the purpose of installing an electric lighting plant.

MANDAN, S. D.—George Horn has sold out his interest in the Cavalier electric light plant to James Lang, who is now the sole owner. The plant will be enlarged and improved.

SOUTH BEND, WASH.—J. M. Etnier has been granted a forty-five-year franchise for furnishing electric power and lights to South Bend. Local capital is back of the new enterprise.

COLUMBUS, OHIO—The contract for the electric lighting in the state house, for the ensuing year, has been awarded to the Public Service Company. The bid was three cents per kilowatt.

NASHVILLE, TENN.—The mayor and board of aldermen of Huntington have closed a deal with W. J. Holman, by which he takes charge of the city's electric light and water plant on a five-year lease.

SYDNEY, CAPE BRETON—A resolution has been passed by the Sydney city council appointing a committee to secure legislation necessary for the purpose of installing an electric light plant to be owned by the city.

RENO, NEV.—The Southern Pacific Company is constructing an electric light plant at Carlin, Nev., which will be used in lighting switches and station houses at many little stations in that portion of the state.

HANNIBAL, MO.—The new electric plant of the city of Hannibal was put into operation recently. The plant cost $100,000, and is up to date in every respect. The street railway company has arranged to receive its motive power from the plant.

HACKENSACK, N. J.—As a result of a meeting of the directors of the Gas and Electric Company, of Bergen County, and a session of the stockholders of the concern the plan to lease the plant to the Public Service Corporation for 999 years was ratified.

LOUISVILLE, KY.—At the annual meeting of the Evansville Gas and Electric Company, the following officers were elected: president, E. B. Lewis, of Chicago, Ill.; vice-president, F. J. Reitz; secretary, W. B. McDonald; treasurer and auditor, James H. Foster.

WILKESBARRE, PA.—Contracts for new machinery and engines have been let by the Wyoming Valley Gas and Electric Company as a step toward the improvements the company is promising to residents of the West Side. The contracts call for the expenditure of about $50,000.

TORRINGTON, CT.—The annual meeting of the Torrington Electric Light Company was held recently. The directors were reelected as follows: George D. Workman, Henry J. Hendey, Gideon H. Welch, James A. Doughty, Frank Travis, John Workman and Frederick F. Fuessenich.

WHEELING, W. VA.—The newly organized Ohio Valley Electric Light Company, of Benwood, has elected the following officers: general superintendent, William H. Snider; president, Thomas P. Deegan; vice-president, Charles P. Kinney; secretary, William Leach, Jr.; treasurer, Charles Schad.

SYLACAUGA, ALA.—At a recent meeting of the Sylacauga city council the sale of $24,000 of city bonds was confirmed. The bonds were sold to H. L. McEldry, of Talladega, Ala. The proceeds will be used solely for the purpose of erecting an electric light and waterworks plant in Sylacauga.

CARLISLE, KY.—The plant of the Citizens' Electric Light Company was entirely destroyed by fire on February 18, causing a loss of $8,000, with insurance of $2,000. The destruction of the plant will leave the city in darkness until temporary arrangements can be made to supply illumination.

STILLWATER, MINN.—A trust deed for $500,000 has been filed by the Stillwater Gas and Electric Company in favor of the American Loan and Savings Company, of Chicago. The deed is to cover bonds issued by the company, with the proceeds of which extensive improvements are to be made.

DILLON, COL.—W. H. Foster, who last fall purchased the old Ora Grande placer workings, a half mile north of Dillon, has interested New York capital, and will shortly begin the construction of a large electric power plant on the property. The ditch from which the water power will be obtained is nine miles long.

OTTAWA, ILL.—The McKinley syndicate, controlling and operating the interurban electric lines of the Illinois Central Traction Company, the St. Louis & Springfield Electric Railway Company, and the St. Louis & Northeastern Railway Company, has purchased the power plant of the Edwardsville Electric Light and Power Company.

MALONE, N. Y.—The Paul Smith Hotel Company has bought the Saranac Lake Light, Heat and Power Company, the capital of which is $100,000. The power will also be used in running the electric trolley line now in course of construction between Lake Clear Junction and the Paul Smith hotel, located on St. Regis lake.

ONEIDA, N. Y.—The Oneida board of public works has ordered the Madison County Gas and Electric Company to remove its high-tension wires running through Madison street to furnish power for the village of Canastota. Hereafter the board of public works will oversee the erection of wires to carry high-power electric currents in this city.

BOSTON, MASS.—A petition has been received by the gas and electric light commissioners from the Lynn Gas and Electric Light Company, asking for authority to issue additional stock to the

Digitized by Google

amount of $230,000, the proceeds of which are to be devoted to funding floating indebtedness and for the payment of expenses incurred by the company.

KEWANEE, ILL.—At the annual meeting of the Kewanee Light and Power Company, Xenophon Caverno, James K. Blish and B. C. Parkinson were elected directors for the coming year. The directors chose officers as follows: president and general manager, Xenophon Caverno; vice-president, James K. Blish; secretary, B. C. Parkinson.

OROVILLE, CAL.—E. W. Sutcliffe, for the Northern California Electric and Navigation Company, has been granted a franchise for one year and eleven months for a pole line to transmit electricity over the streets and highways of Butte County. The object of this two-year franchise is to allow the company to immediately construct its line.

HAMILTON, OHIO—The Hamilton Gas and Electric Company has filed a mortgage for $1,000,000 in favor of the Union Savings Bank and Trust Company, of Cincinnati. The mortgage covers the entire assets of the company, and includes, in addition, a bonded debt of $540,000 of the Hamilton Otto Coke Company, which is absorbed in the new corporation.

ST. LOUIS, MO.—The following officers were elected at the annual directors' meeting of the Union Electric Light and Power Company: John I. Beggs, of Milwaukee, president; Julius S. Walsh, first vice-president; Charles W. Wetmore, second vice-president; Breckinridge Jones, treasurer; Harold P. G. Coates, secretary, and W. V. N. Powelson, general manager.

DES MOINES, IOWA—The Valley Junction electric light and water plant, which has been in the hands of eastern capitalists, has been sold to four citizens of the home town, who will incorporate under the laws of Iowa and form a stock company. The title will be transferred to John Fisher, A. H. Dyke, J. T. and Charles Ashworth, of Valley Junction.

ALBANY, GA.—The contract for the erection of the dam and power-house of the Albany Power and Manufacturing Company has been awarded to B. H. Hardaway, of Columbus. The terms of the contract call for the completion of the dam and power-house by the first of September. The work involves an amount in excess of $100,000. Construction will begin at once.

ST. PAUL, MINN.—The redraughted form of the ordinance permitting the Union Manufacturing Company to extend its electric lighting system in the western portion of St. Paul has been approved by the board of aldermen. The measure now provides for a bond of $25,000, and allows other public service corporations to use the poles on the payment of a proportion of their cost.

TROY, N. Y.—A petition for the renewal of the charter of the Hoosac Electric Power Company has been presented to the legislature by W. S. Kelly, of North Adams, Mass. The charter was granted some time ago, but was dissolved shortly after. An immense power plant at Howe's pond has been planned by the company to supply power to Adams, North Adams and surrounding places.

UNIONTOWN, PA.—The agreement of merger and consolidation whereby eleven electric light companies have been consolidated, forming the Western Pennsylvania Electric Company, has been recorded. The capital stock is $337,500. The officers are William S. Kuhn, president; Jacob Van Wagener, vice-president; Jesse H. Purdy, secretary, and John F. Cockburn, treasurer, all of Pittsburg.

EAST HADDAM, CT.—The firm of Ransom & Hoadley, of Providence, has bought the stock and entire rights of the Salmon River Power Company, which is controlled by the Connecticut River Banking Company, of Hartford, and expects to enlarge the plant at Leedsville, and spend about $300,000 in improvements. The Salmon River Power Company has furnished power for the East Haddam Electric Light Company at Leedsville.

PITTSBURG, PA.—Homestead is to have an independent electric light company, with George S. Debolt and W. S. B. Hays as its promoters. Announcement of the formation of a stock company was made recently, and it was stated that work on the erection of the plant would be commenced within a short time. Light and power will be sold in Homestead and surrounding boroughs, and power furnished to the Homestead & Mifflin Street Railway Company.

AGUILAR, COL.—A mass meeting of Aguilar citizens was held recently, at which definite steps were taken toward securing a municipal electric light plant for Aguilar. A stock company will be formed and a $10,000 system installed. At the end of five years the city will have the option of purchasing the plant. A site has been secured, and the erection of the plant will be begun soon. Among the leading stockholders are A. R. Lindsey, Morris Pitti, H. Pinamonti and B. Harbison.

ALPENA, MICH.—The incorporation of the Alpena Power Company has been completed. The capital stock is $99,000 and the officers are F. W. Gilchrist, Alpena, chairman; Russell A. Alger, Detroit, vice-chairman; George P. Smith, recently of Ann Arbor, secretary; Frank W. Fletcher, Alpena, treasurer. The company has absorbed the local water and electric light companies, and secured control and right of way along the Thunder Bay river, preparatory to the erection of a large power plant.

CHESTERTOWN, MD.—The board of town commissioners of Chestertown, Md., has granted a franchise for the erection of poles, wires, etc., for the installation of a modern and thoroughly equipped electric light plant. The franchise covers a period of forty years, and a lot has been leased for ninety-nine years for the erection of a plant. The machinery is to be in place and the wires ready for operation by April 1. Two dynamos will be installed, capable of generating a current that will furnish light, not only to Chestertown, but to near-by towns, such as Church Hill, Centreville, Millington, Still Pond, Rock Hall, Kennedyville, Galena and Betterton.

BANGOR, ME.—The Maine & New Brunswick Electric Power Company will, in the early spring, begin the development of its property at Aroostook Falls, and before the end of the year is to have in operation a plant to supply electric light and power to a number of towns in Maine and New Brunswick. Arthur R. Gould, of Presque Isle, is a leader in the enterprise. About one hundred acres of land have been purchased adjacent to the falls, and preparations are now being made for the erection of the buildings. The falls afford, in a fall of seventy-five feet, about 4,000 horse-power. At the beginning the company will install five pairs of water-wheels of 400 horse-power each, sufficient for the lighting of the principal towns of Aroostook County and the towns of Perth and Andover in New Brunswick.

DIXON, ILL.—The Lee County Lighting Company—John I. Beggs, of Milwaukee, president; H. C. Higgins, of Dixon, vice-president and general manager, and J. H. Vandyke, Jr., of Milwaukee, treasurer—has closed a deal for the purchase of the interests of the Dixon Power and Lighting Company, including the local electric light and gas plants and the company's three-fourths interest in the Rock river dam, completed last September. Two hundred thousand dollars is involved in the transaction. The purchasers own an extensive gas plant here and the Sterling, Dixon & Eastern electric railway, which has been in operation the last six months. The capital stock of the Dixon company is $100,000, with $50,000 in bonds, and another $50,000 in floating indebtedness. The Lee County corporation has an authorized capital of $1,000,000, and a bond issue of $1,000,000.

SCRANTON, PA.—The stockholders of the Suburban Electric Light Company have elected officers and directors as follows: president, A. L. Snowden; vice-president, G. M. Hallstead; secretary and treasurer, E. M. Stack; F. E. Platt, W. F. Hallstead, M. W. Collins, F. B. Bull, B. Moses and A. L. Francois. The old board was reelected. The Dunmore Light, Heat and Power Company has organized by electing the following officers and directors: president, A. L. Snowden; secretary and treasurer, E. M. Stack; G. M. Hallstead, F. B. Bull, H. H. Knapp, M. J. Murray, R. D. Manley, John Carney and M. B. Freedman. The Scranton Illuminating, Light, Heat and Power Company has organized by the election of the following officers and directors: president, A. L. Snowden; vice-president, G. M. Hallstead; secretary and treasurer, E. M. Stack; W. F. Hallstead, M. W. Collins, Theodore G. Wolfe, Franklin Howell.

Digitized by Google

NEW INCORPORATIONS.

CONCORD, N. H.—Citizens' Telephone Company. $100,000.

WIGGINS, ALA.—Wiggins Electric Light Company. $10,000.

DES MOINES, IOWA—Maquoketa Light and Heat Company. $12,500.

AMELIA, NEB.—South Fork Independent Telephone Company. $2,000.

FRANKLIN, N. H.—The Canterbury & Boscawen Telephone Company. $1,500.

WABASH, IND.—Home Telephone Company. Increased from $20,000 to $50,000.

SPOKANE, WASH.—Spokane Southern Traction Company. Increased to $2,000,000.

EATON RAPIDS, MICH.—Eaton Rapids & West Aurelius Telephone Company. $3,000.

SOLSVILLE, N. Y.—Madison Mutual Telephone Company. Increased from $1,000 to $5,000.

NEWARK, N. J.—Milwaukee Light and Power Company. Increased from $500,000 to $1,000,000.

COLUMBUS, OHIO—Washington Gas and Electric Company. Increased from $100,000 to $150,000.

AUGUSTA, ME.—Home Light and Heat Company. $300,000. President, M. H. Simmons; treasurer, E. F. Whittum.

SCRANTON, IOWA—Scranton Independent Mutual Telephone Company. $5,000. Incorporators: R. S. Lowe, and others.

LA CROSSE, WASH.—Farmers' Rural Telephone Company. $1,000. Incorporators: W. J. Sharp, W. C. Fudge, A. E. Benner.

DES MOINES, IOWA—Harmony & Kendallville Farmers' Telephone Company. $600. Incorporators: Emmet Benson and others.

PAWNEE, ILL.—Sangamon County Telephone Company. $20,000. Incorporators: H. E. Farnam, E. L. Farnam and H. M. Farnam

LEXINGTON, ILL.—Prairie Hall Telephone Company. $4,000. Incorporators: Gilson H. Elder, John A. Moon and George C. Elder.

LINCOLN, NEB.—Ogalalla & Big Springs Telephone Company. $55,000. Incorporators: James Gray, E. D. Harrison and W. J. Harris.

EAST ST. LOUIS, ILL.—St. Clair Light and Power Company. $75,000. Incorporators: C. L. Gray, H. C. Barnard and R. W. Sikking.

CHICAGO, ILL.—Blue Island, Riverside & Hammond Railway Company. Changed to Chicago & Interurban Electric Railway Company.

BAKER CITY, ORE.—Farmers' Mutual Telephone Company. $2,000. Incorporators: George Ebell, Lee Stewart and E. M. Chandler.

MADISON, N. J.—The Western Water and Electric Company. $100,000. Incorporators: Charles E. W. Smith, George M. Ward, John H. Gindrat.

WALLA WALLA, WASH.—Walla Walla Railway Company. $500,000. Incorporators: E. S. Isaacs, F. E. Smith, Grant Copeland, William O'Donnell.

GUTHRIE, OKLA.—German-American Telephone Company. $5,000. Incorporators: H. C. Arnold, E. E. Cowman and D. L. Kinnewan, all of Orlando.

BICKNELL, IND.—Bicknell Light and Power Company. $10,000. Directors: A. L. Brocksmith, B. P. Barnes, J. G. Welton, J. H. Welton and E. G. Barnes.

TYLER, TEX.—White Telephone and Telegraph Company. $10 000. Incorporators: Charles N. White, N. W. White and W. Frank Know, all of Tyler.

GREENVILLE, ME.—Greenville & Kennebec Telegraph and Telephone Company. $10,000. President, C. D. Shaw; treasurer, H. M. Shaw, both of Greenville.

ALBANY, N. Y.—Frankfort, East & West Schuyler Mutual Telephone Company. $1,000. Incorporators: A. Eaton, Elmer J. Ladd and W. Klock, all of Frankfort, N. Y.

HELENA, MONT.—Fort Benton Electric Light Company. $15,000. Incorporators: W. K. Harber, John Harris, Charles Lepley, Jr., James Townsend and L. D. Sharp.

ALBANY, N. Y.—The East Pembroke Telephone Company. $3,000. Incorporators: E. Chapin Richardson, C. K. Durham and C. C. Day, all of East Pembroke, N. Y.

PORTLAND, ORE.—Estacada Telephone and Telegraph Company. $10,000. Incorporators: M. C. Adkins, B. O. Boswell, John B. Haviland, J. W. Reed and R. A. Stratton.

AUGUSTA, ME.—Lorimer Automatic Telephone Company. To operate telephone lines. $10,000,000. President, G. R. Hadlock, Augusta; treasurer, E. F. Whittum, Augusta.

EAST ST. LOUIS, ILL.—East St. Louis Consumers' Electric Light, Power and Heat Company. $75,000. Incorporators: H. J. Dehaan, Fred W. Zegenheim and Charles O. Clark.

PORTLAND, ORE.—American Telegraph and Telephone Company. To construct telegraph and telephone lines, etc. $10,000. President and treasurer, C. H. Adams, Boston, Mass.

ALBUQUERQUE, N. M.—Las Cruces Electric Light and Ice Company. $5,000. Incorporators: B. L. Berkley, Theodore Honault, Henry D. Bowman and Herbert B. Holt, of Las Cruces.

GULFPORT, LA.—West Gulfport & Race Track Street Railway Company. $25,000. Incorporators: Phil. A. Dolan, J. R. Hill, J. R. Pratt, S. P. Moorman, E. S. Burrill, W. R. Bachellor, J. T. Richardson and P. H. M. Tippin.

GUTHRIE, OKLA.—Byron Rural 'Phone Company. To construct a telephone line between Mendon and Byron. $1,000. Incorporators: H. B. Holderby, M. Sluder and W. M. McRay, all of Byron, Okla.

BAIRD, TEX.—Home Telephone and Electric Company. $25,000. Incorporators: I. N. Jackson, S. L. Driskell, T. E. Powell, S. H. Ramsey, Bennie Richardson, all of Baird, and J. M. Estes, of Clyde, Tex.

PIERRE, S. D.—Watertown Transportation Company. Formed for the purpose of constructing a ten-mile line to lake Kampeska. $100,000. Incorporators: Charles Hamilton, of Chicago; Percy Cocks, of Brooklyn; O. C. Berg, of Redfield, and Alfred L. Rowe and William D. Rowe, of Watertown.

DENVER, COL.—Elk Mountain Mutual Telephone Company. To supply telephone service to Roult, Western Lorimer, Rio Blanco, Eagle and Grand counties. $37,500. Directors: James B. Male, Fred S. Follett, William W. Adair, William M. Hitchens, William H. Dingfield, Charles Blackburn and Patrick Cullen.

NIAGARA FALLS, N. Y.—Niagara Falls Electrical Transmission Company. To manufacture and supply gas and electricity for lighting, domestic and manufacturing purposes in cities, villages and towns of Niagara, Erie, Orleans, Genessee and Monroe counties. $100,000. Directors: Harry Highland, Frank A. Fudley, Niagara Falls; Frederick Nicholls, W. R. Wood and D. E. Thomson, Toronto, Ontario.

ALBANY, N. Y.—Hornellsville, Bath & Lake Keuka Railroad Company. To construct an electric railroad from Kinona to Bath, Steuben County, a distance of five miles. $50,000. Directors: Linn D. Nasson, J. Seymour Hubba, J. F. Turk, Hammondsport; Thomas Shannon, Bath; Leslie D. Whiting, Canisteo; W. H. P. Gilmore, Turner's Falls, Mass.; Sayward Hilbraith, Springfield, Mass.; Frederick Gailbraith, Cincinnati; Walter H. Miller, East Orange, N. J.

ALBANY, N. Y.—New York Independent Telephone Company. To operate a telephone system in New York city, and thence to Albany and Boston, connecting intermediate cities in New York, Massachusetts, Rhode Island and Connecticut, and also through New Jersey and Pennsylvania to Jersey City, Philadelphia and other places. $50,000. Directors: S. Lee, Jr., James M. Woods, B. S. Mantz and Horace S. Gould, of New York city; H. O. Coughlan, of Brooklyn; J. R. Turner, of Basking Ridge, N. J., and Kenneth K. McLaren, of Jersey City.

Digitized by Google

ELECTRICAL SECURITIES.

For the first time since the beginning of the year a really buoyant feeling seems to pervade all business enterprises. The market continues to show high security values and the most conservative opinions point to a condition of stability not often concurrent with a high-priced market. Holdings seem to be in strong hands, and the present way of looking at industrials is not so much on the side of their immediate dividend-paying values as on the side of their investment value some time hence. In all directions there is a noticeable demand for manufactured products, and in the iron and steel trade practically all the companies are enjoying a very fair amount of business. Not only in these large interests is there an awakened activity, but in smaller lines, and particularly in construction specialties is there a brisk and improving trade. Railroad earnings are not as favorable as usual, but this is probably due to restrictions from bad weather. That large expansions are contemplated is evident from the new work going on on every system, and the recent large orders for additional equipment.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 4.

New York:	*Closing.*
Brooklyn Rapid Transit	66½
Consolidated Gas	212
General Electric	188
Interborough Rapid Transit	206
Kings County Electric	200
Manhattan Elevated	170⅜
Metropolitan Street Railway	123⅜
New York & New Jersey Telephone	172
Western Telephone and Telegraph preferred	192

The following were elected directors of the Kings County Electric Light and Power Company for the ensuing year, at a meeting held February 27: A. N. Brady, N. F. Brady, William Berri, Horace C. Duval, Walton Ferguson, W. W. Freeman, Bernard Gallagher, Hugh J. Grant, Seth L. Kenney, Edward A. Leslie, Thomas E. Murray, W. F. Sheehan and A. M. Young.

The quarterly statement of the New York City Railway Company for the quarter ended December 31, 1904, is as follows: gross, $4,286,275; expenses, $2,354,407; net, $1,931,868; other income, $318,731, a total of $2,250,599; charges, $2,791,543, leaving a deficit of $540,944.

Boston:	*Closing.*
American Telephone and Telegraph	146
Edison Electric Illuminating	250
Massachusetts Electric	62
New England Telephone	137
Western Telephone and Telegraph preferred	102

Boston Elevated stockholders have approved an issue of $11,000,000 bonds for construction and funding floating debt.

The American Telephone and Telegraph Company received bids for $25,000,000 4 per cent collateral trust bonds, due in 1929. The bonds were awarded to Kidder, Peabody & Company and Baring Brothers.

Both gross and net earnings of the Massachusetts Electric Companies are making very good gains over last year. For the first two months of 1905 gross earnings have increased over $1,000 per day, amounting to about $70,000, which is $25,000 in excess of the increase in gross earnings on the entire system for the year ended September 30, 1904. New stock to the amount of $2,461,512 is to be used by the Old Colony Street Railway Company and the Boston & Northern Street Railway Company (controlled by the Massachusetts Electric Companies) for the purpose of improving the systems.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	87
Electric Storage Battery preferred	87
Philadelphia Electric	10¾
Philadelphia Rapid Transit	29⅝
United Gas Improvement	116¼

The directors of the Philadelphia Traction Company (controlled by the Philadelphia Rapid Transit Company) have declared a dividend of $2 per share, payable April 1.

Chicago:	*Closing.*
Chicago Telephone	143
Chicago Edison Light	170
Metropolitan Elevated preferred	61
National Carbon common	43
National Carbon preferred	114
Union Traction common	12
Union Traction preferred	50

Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent, payable March 31. Books close March 27 and reopen April 1.

The National Carbon Company has issued its report for the year ended January 31, 1905, as follows: net earnings, $846,307; preferred dividends, $315,000, leaving a balance of $531,307; charged off, depreciation, etc., $383,336, and common dividend, $82,500, leaving a surplus of $65,471, as compared with $141,012 for the preceding year.

For the fiscal year ended February 28 Metropolitan Elevated carried 115,700 passengers daily, against 113,000 for the previous year.

INDUSTRIAL ITEMS.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., announces that it has received an order from the Northern Electrical Manufacturing Company, of Madison, Wis., for 135 of the new type of C. H. machine tool controllers, equipped with fuses and switch in conformity to the United States Navy specifications. All of these controllers will be installed in the plant of the Winchester Repeating Arms Company. Although this controller has been on the market but a few months, its sales have far exceeded the most sanguine expectations of the Cutler-Hammer Manufacturing Company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is exhibiting its mercury arc rectifier at the Motor-Boat and Sportmen's Show, in Madison Square Garden, New York city. In the exhibit of the Electric Launch Company is shown one of the mercury arc rectifiers in full operation. It is used to charge forty-four cells of battery in the electric launch "Rest-Awhile," the current being thirty amperes at 110 volts, direct current; the alternating current used is 220 volts, sixty cycles. This presents an interesting field for the use of mercury arc rectifiers, and it is probable that the use of electric launches may be materially increased because of the simplicity of the charging outfit now offered.

THE HYDREX FELT AND ENGINEERING COMPANY has just commenced business at 120 Liberty street, New York city, and devotes its energies exclusively to the subject of waterproofing. This is a branch of engineering which has hitherto been comparatively neglected, but with the great activity in tunnel building and in structural work requiring deep foundations, the importance of the subject now warrants the attention of specialists. This company states that it is the first company which, besides offering waterproofing material, also draws up plans and specifications and attends to the engineering details of this class of work. The manager of the new company is Edward W. DeKnight, who has taken a prominent part in preparing the plans for waterproofing a number of great engineering enterprises. The new company is an off-shoot of the old-established concern of F. W. Bird & Son, East Walpole, Mass., and starts business under favorable auspices, as "Hydrex" felt has been specified for the Pennsylvania tunnel under New York city, the B. & O.-Pennsylvania improvements at Washington and other important projects.

H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York, announces that "Kearsarge" gasket tubing is a recent addition to the well-known list of "Kearsarge" packings, manufactured by it. Gasket tubing is especially desirable for certain conditions, is easy of application, efficient and an article in which all engineers should be interested. The same company is also furnishing Kearsarge ring packing, a new form of its well-known coil packing. These rings can be furnished in any size and quantity, and the high standard of efficiency of its entire line of packings is maintained in this new product. Samples and printed matter may be

Digitized by Google

obtained from the company's offices in New York, Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland and New Orleans.

THE POPE MANUFACTURING COMPANY, Hartford, Ct., has issued its annual catalogue descriptive of Columbia and Hartford bicycles.

THE NEWTON MACHINE TOOL WORKS, INCORPORATED, Philadelphia, Pa., has issued a catalogue describing the Newton vertical milling machine.

THE TURNERS FALLS MACHINE COMPANY, Turners Falls, Mass., has published a large catalogue descriptive of the Crocker triple-diameter-pattern turbine.

THE REMINGTON TYPEWRITER COMPANY, 327 Broadway, New York city, is issuing a pamphlet describing the use of the Remington typewriter for card indexing.

THE WASHBURN SHOPS OF THE WORCESTER POLYTECHNIC INSTITUTE, Worcester, Mass., has issued catalogue C, describing the drill grinders which it manufactures.

THE WESCO SUPPLY COMPANY, Seventh street and Clark avenue, St. Louis, Mo., will be pleased to send its bulletins No. 61 and No. 63, describing the product of its telephone factory.

A. L. IDE & SONS, Springfield, Ill., are distributing a partial list of purchasers of "Ideal" engines. This list is classified and gives a good idea of the extent and variety of service into which these engines enter.

THE NERNST LAMP COMPANY, Pittsburg, Pa., is mailing an attractive folder descriptive of the Nernst street lighting system at Sewickley, Pa. This is reprinted from the ELECTRICAL REVIEW of January 21.

C. H. THORDARSON, Chicago, Ill., has printed a new catalogue descriptive of electrical experimental apparatus, including high-potential transformers, impedance coils, spark coils, permeameters, special apparatus and instruments.

THE GOLD CAR HEATING AND LIGHTING COMPANY, 17 Battery place, New York city, has issued a catalogue describing improved electric heaters and other apparatus for warming elevated, underground, suburban or street railway cars.

THE CONTROLLER COMPANY OF AMERICA, Chicago and St. Louis, is issuing a calendar bearing a picture about ten inches high entitled "The Spirit of the Telephone." On the back are given a number of advantages of telephone service.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, Ill., is distributing a new catalogue describing and illustrating telephone protective apparatus. American self-soldering protectors are listed and described in a separate catalogue. Either of these will be sent upon request.

THE HOWARD MINIATURE LAMP COMPANY, New York, has recently moved into new and enlarged quarters and hereafter will be located at 58-60 Reade street. Mr. H. W. Harper, formerly of the lamp department of the General Electric Company, is president and H. E. Plass secretary.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., is placing on the market a compact, self-contained type of electric forge blower for metal-working shops. Leaflet No. 145 shows the general types and sizes supplied, and will be sent by the company upon request.

THE GOHEEN MANUFACTURING COMPANY, Canton, Ohio, is issuing two catalogues calling attention to various brands of paint manufactured by the company. One of the catalogues tells of "Galvanum," which the company claims is the only paint that will adhere firmly to galvanized iron.

RUSSELL HOWLAND, 120 Liberty street, New York city, has secured the New York sales agency for the Motsinger Device Manufacturing Company, of Pendleton, Ind. A very interesting booklet is being distributed by the company, describing its autosparker. This booklet will be mailed upon request.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., are distributing some attractive advertising literature, calling attention to their national code fuseless attachment plugs, and the P. & S. china wiring tubes. Pass & Seymour pack these tubes in boxes containing 100. In this way the danger of breakage is eliminated.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is distributing an attractive and instructive folder entitled "Wattmeters and How to Read Them." Typical illustrations are shown, and there is added a meter sheet showing a method of marking up meter readings for ready comprehension.

JONATHAN A. RAWSON, JR., 130 Pearl street, New York city, is making a specialty of time-saving devices for offices. A booklet, recently issued, entitled "Doing Things Easily and Quickly in the Office," explains the advantages of a number of pieces of apparatus for office work. Mr. Rawson will correspond with any one interested in the subject.

THE MESTA MACHINE COMPANY, Pittsburg, Pa., has issued catalogue B. This is a handsome book, nine by twelve inches, bound in cloth, and describes the company's shops and the work done by it. The book contains 127 pages, and is well printed and splendidly illustrated by half-tone engravings. In the back of the book are a few pages of very useful tables.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., will be pleased to send its bulletin No. 22, descriptive of the operation and maintenance of the automatic Union electric semaphore signal. A new edition of section eleven—electric locks, electric slots, hand releases and time locks—of the catalogue of interlocking and signaling devices has also been issued.

GEORGE H. BUCKMINSTER & COMPANY, 155 Milk street, Boston, Mass., will be pleased to mail, upon application, a list of the specialties which they carry. Among these specialties are "Munder" lamps, "Hill" specialties, "I. X. L." wire products, Dale portables and specialties, Chase-Shawmut new code fuses and cut-outs, Crescent specialties, Lundin high-tension specialties, and Roche U. S. N. standard dry batteries.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y. is distributing a number of bulletins descriptive of new apparatus. Bulletin No. 4398 illustrates and describes remote-control field rheostats for railway generators and rotary converters; No. 4399, direct-connected generating sets; No. 4400, type H subway transformers; No. 4401, type UP motor-starting rheostats with switches and fuses; No. 4402, complete charging equipments for electric vehicles.

THE KUSEL & KUSEL COMPANY, Chicago, Ill., has closed contracts for automatic systems with the Chicago & Northwestern Railway Company at Chicago, Ill., at New Holstein, Wis., Kiel, Wis., and for the Eastern Wisconsin Telephone Company. The company states that a number of telephone companies are interested in this apparatus, and it is expected that some large contracts will be closed before spring. A new catalogue is now being distributed, describing this automatic apparatus. The company will be pleased to send descriptive data to any one interested.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has placed on the market a new type of magnet for handling pig iron, small billets, scrap iron or steel, small steel or iron castings, bolts, rivets, etc., in bulk. This magnet is the result of long experience and persistent experimenting to get the most efficient design. It is adapted to be carried on the hook of a crane, and controlled by the crane man who can thus perform the entire operation of loading or unloading a car, or loading melting stock into charging boxes with no ground helpers. The design of this magnet is radically new, and is covered by letters-patent.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing a pamphlet entitled "Answers to Some Central Station Questions About Single-Phase Motors." The pamphlet is in two parts, the first part being a paper bearing the above title, presented at the October (1904) meeting of the Kansas Gas, Water and Electric Light Association by Mr. G. Percy Cole. The paper takes up the question of installation of polyphase generators and motor service, and discusses the proper number of cycles to use in alternating-current work, and a number of other very interesting questions. Part two is devoted to illustrations of the Wagner Electric Manufacturing Company's machinery.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 11. NEW YORK, SATURDAY, MARCH 18, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada	$3.00
One Year, Foreign Countries	5.00
Single Copies, each	.10
Copies supplied for only one year back, each	.25

CONTENTS.

EDITORIAL:
Polarization of X-Rays ... 445
The Telephone in War ... 445
Precautions in the Use of Acetylene ... 446
Starting Resistance for Induction Motors ... 446
Responsibility in Strikes ... 447
Oil-Insulated Transformers ... 447
The Commercial Aspect of Engineering, by Charles A. S. Howlett ... 448
The Philadelphia Bell Telephone Company ... 448
Oil-Insulated *versus* Air-Blast Transformers, by M. A. Sammett ... 449
Scope and Effect of Competition on Telephone Development ... 452
On a New System of Wireless Telegraphy ... 452
Polarized Rœntgen Radiation, by Dr. Charles G. Barkla ... 452
German Electrical Developments ... 452
Safety Devices for Preventing Excessive Pressure Rise in Alternating-Current Systems ... 453
National Electric Light Association ... 453
Power-House and Single-Phase Car Equipment of the Indianapolis & Cincinnati Traction Company ... 454
Power-House Fuel Supply ... 458
BOOK REVIEWS ... 460
Single-Phase Repulsion Motor Driving a Pump ... 461
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 462
ELECTRICAL PATENTS ... 464
The Cunard Twin-Screw Steamship Caronia ... 465
The World's Production of Coal ... 466
Financial Statement of the United States Telephone Company ... 466
The Osmium Lamp ... 467
Special Report on Street and Electric Railways ... 468
The Annual Meeting of the Iowa Telephone Association ... 469
Oil for Insulating Purposes ... 470
Protective Apparatus ... 472
A Change in the United Telpherage Company ... 472
Meeting of the American Institute of Electrical Engineers ... 472
Electricity for Rio ... 472
INDUSTRIAL SECTION:
The Queen Standard Potentiometer ... 473
Flexible Steel-Armored Hose ... 473
Small Multipolar Motors ... 474
An Electric Derrick Winch ... 475
The "Vitæ" Stirrup ... 475
Apparatus for the New Power-House of the Ohio Street Railway System ... 475
A New Type of Combination Fan ... 476
Fast Railway Service as a Business Aid ... 476
Belt Type Alternating-Current Generators ... 477
The Svea Caloric Engine, by G. Emil Hesse ... 478
The Use of the Wright Demand Meter ... 478
Small Electric Light Equipments ... 478
CURRENT ELECTRICAL NEWS ... 479

POLARIZATION OF X-RAYS.

In a recent paper read before the Royal Society, of London, Dr. C. G. Barkla describes a method by which polarization of X-rays may be demonstrated experimentally. This is an important matter, since proof that X-rays can be polarized would be pretty conclusive proof that they are propagated by transverse, and not by longitudinal, vibrations of the ether, a conclusion which would settle finally the controversy which arose as soon as the discovery of the X-rays was announced by Dr. Rœntgen.

It is interesting to note that it was while searching for proof that the X-rays could be polarized that Blondlot discovered his so-called and now famous N-rays, a discovery which led him far away from the object of his original research. Blondlot did secure some results which indicate that polarization could be brought about, and it is to his credit to note that his preliminary results agree with the final results of Dr. Barkla.

THE TELEPHONE IN WAR.

Among many things which the Japanese have done during the war which they are now waging, and which have attracted the attention of the world, their use of the telephone is one. When the war first broke out, and while the question of supremacy on water was undecided, they made good use of wireless telegraphy. By this means the main fleet kept in touch with its scouts, and, indeed, in the final conclusive battle of last August, in which the Russian vessels left the harbor to attack a few apparently unsupported Japanese vessels, the latter called up the main Japanese fleet, then out of sight, but in waiting, by means of wireless telegraphy. On land the Japanese have erected telegraph lines as they advanced, and kept the government at Tokio in constant communication with all of the armies, and each army in touch with the other.

But to keep the commander of a single army in constant touch with his division commanders, the telephone has been used. As each advance was made, or a trench was dug, connections were made with headquarters by telephone. Thus, not only was all important information transmitted immediately to the commander, but fighting was directed from the latter point by the same means. The commander was able to direct the fire of the guns and to order advances when the proper time arrived. The telephone in this service has taken the place of the courier, and does the work better and more quickly. By its ability to communicate instantly with many and widely separated points, not only are the army's operations directed more effectively, but one commander is enabled to control a larger force than was possible under the old system. Take the last great battle as an example. Could Field Marshal Oyama have directed the operations of 400,000 men, and have timed his strokes so exactly, had he been forced to depend upon orders carried by horse? How could he have controlled a fighting line a hundred miles long? Without the telephone the operations would have been carried on by a number of generals, each acting according to a certain plan, but depending largely upon his own judgment for what to do and when to do it. That the fight would have been carried on as bravely, none can doubt, but the telephone coordinated the actions of each division, and reduced the armies to one vast machine. Nothing was left to chance; every stroke was correctly timed, and the commander-in-chief was at once informed of its result. Even the flying columns were followed by the engineering corps, and the result of every skirmish and the taking of every village were known, within a short time, at headquarters.

Besides making each of the divisions able to act with the others offensively, the telephone enabled them to act together

Digitized by Google

for defence. As soon as any point was threatened, this was known at headquarters, and moving orders could be issued to the most available reserves for support. Truly, the telephone has become one of the most important factors in modern warfare, and it is one factor—if not the only factor—which has acted to reduce the danger to the individual. The Japanese are brave enough, but, unless we except their action in battle, they make no sacrifice that is not necessary, and, being practical, they have used the telephone, not only for such purposes as require great speed, but at times when the risk to the messenger is the chief consideration. There is no longer any necessity for exposing couriers to the fire of the enemy.

PRECAUTIONS IN THE USE OF ACETYLENE.

Some of the more obvious dangers in the use of acetylene are well recognized, and are fairly well provided for in the newer types of acetylene generators. These are the precautions which any one with common sense would take in handling and using an explosive gas. There are, however, other dangers involved which are not so well recognized. In a recent paper presented by Mr. W. D. Grier before the National Fire Protection Association, the hazards involved in the use of acetylene are discussed, and the precautions which should be taken when this illuminant is used are pointed out.

With the hazard of manufacture but few are concerned. These are, of course, the use of high-tension electric current, and in the handling and storing of the material which, when exposed to moisture, gives off an inflammable gas and evolves much heat. A factory for manufacturing such material should be of entirely non-inflammable material. It should be well ventilated, and the electrical work should be of the most approved kind.

One of the dangers which the user of acetylene should be aware of is the explosive nature of the mixture of acetylene and air. There is a greater danger here than with the use of illuminating gas, because a mixture of air and acetylene will explode, if ignited, when it consists of any proportions of acetylene between 3.3 per cent and eighty-two per cent. The corresponding figures for hydrogen are five per cent and eighty per cent, while for carbon monoxide they are thirteen and seventy-five per cent. Thus, when acetylene is allowed to escape into a room, a dangerous mixture results sooner than with other common inflammable gases. In the same way, when air is allowed to enter a vessel containing acetylene gas, the explosive mixture is reached earlier than with other gases. The pungent odor of acetylene acts is a safeguard against the former danger, for an escape of acetylene into a room should be noticed some time before the danger point is reached. As far as the poisonous character of the gas is concerned, it is said to be less dangerous than city gas, because its presence is more readily noticed, and it does not contain an active poison like carbon monoxide.

Another risk involved in the use of acetylene should be known by every one. This gas, in the presence of moisture and ammonia, acts upon metals, notably copper and silver, to form a class of bodies known as acetylides, which are more or less explosive. Ammonia is one of those materials which are to be found in every household. Nothing would be more natural than for one to make use of this substance for cleaning gas fixtures or a bicycle lamp, but it should never be used for this purpose when the illuminant is acetylene. In this same class of danger comes the use of chloride of lime for purifying the gas. Still another precaution is that the generator should be so constructed as to avoid all possibility of putting the gas under a high pressure, for it then becomes dangerous. When the pressure has reached a point where the gas is liquefied, it becomes a true explosive, and capable of detonation or ignition with terrible results.

Acetylene is one of the welcome additions to our illuminants. It gives a beautiful light when properly shaded, and when correctly handled is comparatively safe. For certain fields, such as the lighting of country places, where an electric light plant would be out of the question, it is unsurpassed; but those who use it should be aware of the dangers involved, and should observe every possible precaution against accident.

STARTING RESISTANCE FOR INDUCTION MOTORS.

A point which is frequently made to the disadvantage of the continuous-current motor, and in favor of the alternating-current induction motor, is that the former requires a starting resistance which wastes a certain amount of energy every time the motor is started; while the induction motor may be started by an autostarter with a smaller loss of energy. Viewed from the standpoint of the motor user, this is true, but from the viewpoint of the central station the method of starting an induction motor by means of an autotransformer or other similar device may be more objectionable than the use of simple resistances. As a general thing, the supply station can handle better a sudden load which has a high power-factor than a smaller load having a smaller power-factor. The first load may affect the voltage but little, and, through the more common methods of compensation, may itself correct the voltage for the additional load. Throwing an inductive load on, as is done when a motor is started by means of an autotransformer, is likely to affect the voltage of the supply more seriously, and to be harder to handle, even though the current drawn in each case may be the same. For very large motors this starting resistance is more suitably placed in the secondary circuit of the motor, but for smaller motors a simple resistance connected in series with the motor will frequently reduce the effect on the station, of starting the motor to a point where it may cause no inconvenience. When the motor is started but a few times during the day, the loss of energy in the rheostats is practically negligible; on the other hand, where many starts must be made, the frequent throwing on and off of an inductive load is anything but desirable at the station.

Digitized by Google

RESPONSIBILITY IN STRIKES.

It is probable that a valuable lesson will result from the recent strike on the New York subway and the elevated lines. Without entering upon the justice or injustice of the demands made by the strikers, it seems apparent that they did not realize their responsibilities. Of course, every man has a right to quit work if he pleases. The question, however, may be raised, whether a body of men has a right to stop work when it knows that doing so will seriously inconvenience a large number of persons who are in no way concerned in the quarrel. The strikers themselves would surely object seriously if the company, on very short warning, should dismiss them all because they refused to do more work for the same pay as they had been receiving; yet, while they had been contented with what they were getting, they made certain demands, refused to arbitrate, and all quit, hoping that the company would not be able to keep in operation a service so necessary to the city.

In operating a public service, the company acknowledges that it has certain responsibilities, and it is subject to public control, to a considerable extent. Part of this responsibility should be borne by the employés of the company. The city has been to an enormous expense to secure certain traffic facilities absolutely required. It has made a contract with the Interborough Rapid Transit Company to operate this system for a certain number of years; yet if the employés could have their way, the public would have been deprived—for no one knows how long—of all that the city has been to so much expense and so great inconvenience to secure. As it was, much loss, as well as inconvenience, was caused for several days.

Although the greater blame must be laid upon the strikers for the recent trouble, a strike brings, as well, certain responsibilities to the operating company. The latter, in deciding upon the justice or injustice of the demands of its employés, must always bear in mind the rights of the public. When a strike takes place, while it makes every effort to give its regular service, it must first of all consider the safety of its passengers. Inexperienced men must not be put in charge of cars. It would be better to reduce the service to one-half, or even one-third, and increase it as fast as the available men could be obtained, than to risk putting men not thoroughly competent in charge. It is not very difficult to operate a train equipped as the subway trains are. A cool-headed man can learn to do this in a few weeks, and, as our trains are operated to-day, there are generally a large number of men available who can handle a fully equipped electric train. We believe that the Interborough Rapid Transit Company appreciated this responsibility and lived up to it as far as it was able. The fact that but one serious accident occurred, although practically all the crews were strange to the system, however experienced they may have been in the handling of cars, shows that great care was taken in the selection of new men.

It is sincerely to be hoped that the lessons of the recent strike will be learned, and that other methods will be found for adjusting difficulties. The city of New York owns the subway, and, before many years, it probably will own an elaborate system of subways. When this day comes, there must be no possibility of having all trains stopped because a comparatively small number of men are dissatisfied.

OIL-INSULATED TRANSFORMERS.

On another page of this issue appears an interesting discussion of the merits of the oil-insulated transformer. The author, Mr. M. A. Sammett, gives the results of his personal experience with this type of transformer, his conclusion being that it is a better fire risk than the air-insulated type. One extreme case is described, in which the transformer, though very much overloaded, operated satisfactorily, even after the insulating windings on the wires had been completely charred. No other type could have operated under such adverse conditions. Here, however, although the charred material formed a conductor, this was so thoroughly permeated with the oil that there was no complete electrical path between adjacent turns of wire. The insulation then consisted only of the exceedingly thin films of oil which separated the charred surfaces, and the charred surfaces and the wire.

As a precaution, Mr. Sammett advises that means be provided for draining off the oil from the transformer case, should a fire occur, and he favors for this the method proposed by Mr. Ralph D. Mershon at a meeting of the American Institute of Electrical Engineers, held during March, 1904. In this plan the transformer is enclosed in a fireproof vault, and pipes are provided whereby water can be forced into the bottom of the case, driving out the oil through a pipe at the top. The advantage of this method is that, should the oil be burning, the water will surely put out the fire, but it involves the disadvantage of introducing water into the transformer case. It is true that, as all parts of the transformer are thoroughly saturated with oil, this may not cause any trouble, but it is certainly undesirable to fill the transformer case with water.

The oil might be drawn off by simply opening the pipe at the bottom, allowing it to flow out, but such a proceeding might be dangerous. As air is drawn in to fill the space being emptied of oil, an explosive mixture may be formed, with disastrous results. It would seem better to force the oil out at the bottom by means of some inert and harmless gas. Nitrogen, carbon dioxide or ammonia might be used. Forcing ammonia into the case would smother any fire existing there, and would enable the oil to be forced out rapidly at the bottom. The ammonia gas would itself have no deleterious effect on the transformer.

While drawing off oil from the transformer case removes from the building a material which may become inflammable, it leaves the transformer itself more exposed to injury from external heat. This objection could be got over by having the transformer room constructed so that it could be closed up air-tight. In case of a fire, this room could be filled completely with ammonia, which would prevent a fire from starting there. If the transformer vault is suitably constructed, it is hardly probable that a fire outside of the room would heat the oil sufficiently to drive off inflammable gases.

Digitized by Google

THE COMMERCIAL ASPECT OF ENGINEERING.[1]

BY CHARLES A. S. HOWLETT.

The engineer who makes a business of securing the contracts is known as a contracting or sales engineer. The presidents of our large manufacturing and engineering organizations are very good examples of successful contracting and sales engineers. They possess traits that are inborn, and others that are developed, which enable them to successfully influence others. And this definition applies equally as well to a successful lawyer or preacher and many other professional men. This distinction should be kept in mind, however. After a contracting or sales engineer has attended to the commercial side of his work he must immediately proceed to carry out the work without fault or blemish, whether it be the furnishing of engineering knowledge or machinery, or both. His ultimate success depends greatly upon a diligent attention to details, harnessed to an extended experience, which should produce successful work.

Success in the commercial phase of the work, without proper support from a purely engineering standpoint, would be more embarrassing than a thorough knowledge of the engineering features, without any commercial capacity. The success of the contracting or sales engineer depends on his salesmanship first, and his engineering ability second.

This would be disputed by some who claim that both should be equally developed. Theoretically this is correct, but practically it is not, due to the fact that from the nature of their training there are comparatively few engineers with a knowledge of salesmanship. Therefore, when several are endeavoring to secure a contract for machinery, or services as engineer, the questions discussed do not require as thorough a knowledge and familiarity with the purely engineering problems involved as the ability to secure the contract. The one most proficient in the selling art will naturally be the most successful.

The question then that comes home to us is, how can we best equip ourselves to secure a good portion of the available business; and if we are doing that now, as some of my worthy competitors will claim, how can we best increase it?

The average contracting engineer has, as a rule, two commodities to dispose of —his services or technical ability and manufactures, and sometimes both.

Eliminating the consideration of the purely engineering phase of the subject, by assuming for the moment that we all have the same capacity and experience and are equally well informed, how can we become more proficient in the commercial side of our calling?

The remedy may be divided into two parts:

1. That applicable to those now in the business, and

2. That applicable to the young engineers who are now in the technical schools.

"That applicable to those now in the business." Briefly it consists of the devotion of considerable time, in study and training, in mastering the rudiments of such subjects that have any bearing on the making of a commercially successful engineer. The principal subjects have already been mentioned. They are psychology, logic, expression and elocution.

There are a number who have given a great deal of thought to these and many more, with particular reference to their commercial bearing.

Schools of salesmanship conducted by correspondence have been organized and developed, which contain the vitals of a great many subjects of assistance in securing business. One may profitably be guided by their forms and methods.

Division 2 of the remedy has to do with the young engineers now in the technical schools.

The average college-bred engineer receives a very thorough training in all manner of studies—arranged in carefully planned courses—by learned professors. The object being to train the mind, to enable the graduate to tackle and successfully solve engineering problems. But unfortunately, the average engineer receives absolutely no training in the development of the mind or in any other way to enable him to secure the opportunity to solve the problems. If shortly after graduation, with finishing touches in some large factory, the embryo engineer starts into business, he is confronted with the very perplexing problem of how to secure the contracts for his services. He will find a number of experienced men after the same contract, and he will realize that before he can presume to have the standing of his senior competitors, he must have carried to successful completion a number of contracts. But how is he to secure them?

Many young engineers in this predicament find that it is necessary to spend considerable time, to obtain by actual experience a knowledge of the commercial phase of their profession.

Would not our engineering school training then be much more complete and a great deal more beneficial if it embraced studies that would give us the benefit of the successful commercial side of the profession, as well as the purely engineering? Why can not we be taught to take advantage of the experience of the successful salesman?

I believe we can, and would suggest the following remedy:

All professional schools, such as technical, medical, law, dental, agricultural, mining, pharmacy and the like, should incorporate in their senior year such studies as would develop the mind in a manner that would inspire in the student commercial instincts—that would help him to profit by the experience of others in securing an opportunity to perform the work that his professional training enabled him to handle.

If such studies be introduced, I believe it would materially increase the efficiency of such schools and materially improve the standing of professional men by making them the powers—in this commercial world. It is particularly noticeable that of the successful men, those with the professional training are the most powerful.

Some will say that the art of securing the contracts is a gift, and maybe it is. If so, Dame Nature was not very generous when she distributed her gifts among the professional men. I would say that salesmanship is not a gift necessarily, but the development of certain traits more or less common to all of us. Those with natural instincts will be more highly developed with the same training than those less gifted. In the same way that those with natural instincts will be more proficient musicians, with the same training than those less gifted.

[1] Abstract of a paper read before the electrical section of the Western Society of Engineers, January 18, 1905.

The Philadelphia Bell Telephone Company.

The stockholders of the Philadelphia (Pa.) Bell Telephone Company held their annual meeting on February 21. Mr. Charles F. Cutler, chairman, and the board of directors were reelected. The earnings for the year aggregated $3,756,059.79, of which $3,538,654.39 was derived from exchange and toll service. The company had 82,497 stations in service on January 1 last, an increase of 15,229 over the same time last year. It is the management's intention to increase this number by 27,000 during the present year.

Digitized by Google

Oil-Insulated Versus Air-Blast Transformers.

Practical Results Showing the Superiority of the Oil-Insulated Type.

By M. A. Sammett.

AT a recent meeting of the American Institute of Electrical Engineers, the question of relative fire risk of oil-insulated and air-blast transformers received a very thorough discussion. The profession was represented by the best men, whose opinion on this question was based on wide experience, and strange to say there was a decided division as to the relative fire risk resulting from the use of the two types of transformers. Many were very decidedly opposed to the use of oil transformers, considering them a menace to the plant of which they are only a part, and advocated the use of air-blast transformers as more safe a piece of apparatus. Others, on the contrary, strongly advocated the use of oil-insulated transformers and recommended as a further protection specific safety arrangements to be used in connection with them.

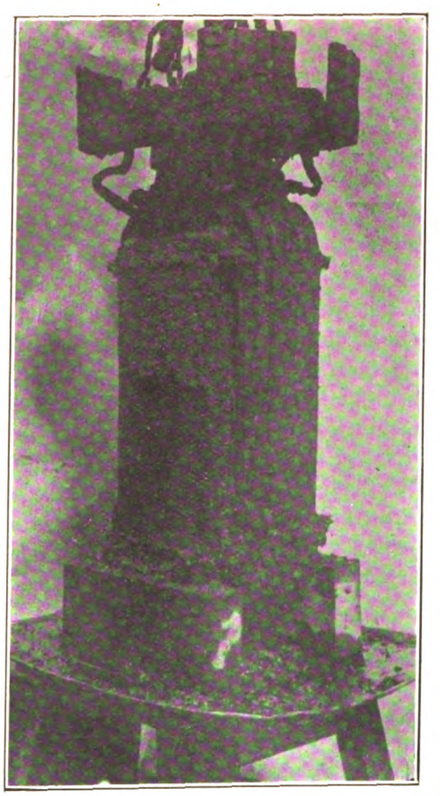
The experience of the writer has been such that he considers the oil-insulated transformer much more preferable to the air-blast type. The oil transformer is more adapted for high voltage work, will take good care of a short-circuit, extinguishing the arc, and, generally speaking, will minimize the fire risk likely to be caused by internal, inherent defects of the transformer coils. Again, the oil-insulated type will stand considerable overloads, and, as will be seen from the description given below, will safely operate under certain conditions at a temperature of 200 degrees centigrade.

This interesting case, which is described in detail below, shows the high endurance of the oil type of apparatus, and, though almost incredible, the working conditions were reproduced in the testing department of the operating company in order to check results, which were duplicated in this check test.

When the extremely high temperature was reported by the inspector, it was removed from the customer's premises, and it is interesting to note that after the transformer was cut off the circuit for sixteen hours, it registered a temperature of ninety-eight degrees centigrade in the oil. The temperature of surrounding air was twenty degrees centigrade.

In view of the extraordinary conditions of temperature under which the transformer operated, it was desirable to make a thorough test of the transformer, measure the losses, examine into the cause as to the abnormal temperature, test the oil for the flashing and burning point, as well as examine and analyze the design of the transformer.

This transformer was in operation for about five years with another transformer of same make and capacity, and while it was running quite hot, requiring on several occasions an addition of a new supply of oil, the second transformer did not have the annoying characteristics of its mate. The transformers in question were twenty-four-kilowatt, sixty-cycle, 2,000-550-volt.



TRANSFORMER REMOVED FROM TANK AFTER TEST.

They were connected at first to a two-phase circuit and were converting two-phase current to three-phase. As the secondary winding was provided only with fifty per cent taps, to secure phase transformation, the fifty per cent tap of one transformer was connected to 100 per cent lead of the second transformer, instead as it should be to 86.6 per cent, and it was the transformer originally connected with the fifty per cent tap that ran hot. About ten months prior to observing the dangerously high temperature the transformers were connected to a three-phase, 2,200-volt, distributing circuit and were converting three-phase, 2,200-volt, to three-phase, 605-volt, on an open delta connection, and it was during these ten months after the change that the abnormal rise took place.

CONNECTED LOAD.

The load on the transformers, as determined from the input of the two motors connected to them, showed the following:

Motor.	Amperes.	True Horse-Power.	Apparent Horse-Power.
1	31.0	32.2	39.1
2	6.5	7.1	10.0
..	37.5	39.3	49.1

From these data it is evident that the transformers were not overloaded, the actual load, figuring on the basis of amperes per phase, amounting only to $\frac{37.5}{45.8} = 81.7$ per cent of full load. As observed before, the mate of this transformer, of identically the same construction, ran fairly cool, the temperature of oil amounting to seventy-two degrees centigrade.

The first thought that suggested itself in explaining the cause of such high temperature was ageing of the core iron and when the core loss was measured the following was found to be the case:

605 volts; 1.64 amperes; 770 watts.

The core loss was taken at 605 instead of 550 volts, as this is the voltage corresponding to the actual primary voltage of 2,200 volts, at which it operated. The increase in the iron loss, resulting from a higher voltage, amounting to ten per cent will be increased by only $\left(\frac{2,200}{2,000}\right)$ raised to 1.6 power, which when expressed as a constant will be 1.16 times the original core loss at 2,000 volts.

From data derived in tearing down the transformer, the magnetic density in the iron figures out to be 41,800 lines of force per square inch, calling primary voltage 2,200, and from a curve giving the relation between induction in iron and watts loss per pound of iron, it is inferred that the core loss originally did not exceed 335 watts. Considering then that the transformer had to dissipate 435 watts in addition to the losses it was designed for, the cause of the abnormal temperature will become quite apparent. Adding to the 770 watts of loss in the iron 408 watts of copper loss of the primary and secondary coils, the total loss will come to 1,178 watts and no adequate means to dissipate the

Digitized by Google

heat. Besides the additional loss in the iron a heavy deposit of asphaltum-like residue all around the core prevented proper circulation of the oil. As will be seen from the photograph of the transformer, the lower portion exposes the iron, the residue of oil being removed, while the upper portion is heavily coated with a thick oily mass. It is this heavy coating and the excessive losses that are responsible for the high temperature.

Comparing the iron loss of the transformer described here and modern transformers of good design, intended to operate at the same frequency, the comparison will stand as follows:

Core loss of twenty-four kilowatts, sixty cycles, between 195 to 235 watts.

Core loss of twenty-four kilowatts, sixty cycles (described), 770 watts.

DATA DERIVED FROM TEST.

	Ohms.
Primary resistance at twenty-five degrees centigrade	1.8
Secondary resistance at twenty-five degrees centigrade	0.0123
Core loss, 605 volts, 1.64 amperes, 770 watts, sixty cycles.	

Impedance (full load current).

10.9 amperes, 880 volts, 405 watts.

Calculated copper losses.

	Watts.
Primary	214
Secondary	194
Total core loss	408
Iron loss	770
Iron and copper loss	1178

Efficiency full load, 95.32 per cent.

DESIGN DATA.

Rating twenty-four kilowatts, 2,000 to 550 volts, 60 cycles.
Iron core width, 2 inches.
Iron core height, 22 inches.
Wire space, 5¾ inches by 6¾ inches.
Induction in iron in megalines, 1.672.
Density per square inch, 38,000 (2,000 volts primary).
Cross-section of core, 44 inches.

Primary.

Total turns, 450.
Number of coils, 6.
Dimension of conductor, No. 9 square wire.
Density, 925 amperes per square inch.
Turns per layer, 6.
Number of layers per coil, 12½.

Secondary.

Total turns, 124.
Number of coils, 4.
Dimension of conductor, 0.750 inch by 0.062 inch.
Density, 935 amperes per square inch.
Weight of iron core, 399 pounds.
Weight of primary and secondary copper, 256 pounds.
Dimensions of tank, 4 feet 6 inches high by 23 inches diameter.

After the preliminary test, the transformer was connected for a heat run, first on open circuit, to get the data of heating on core loss alone, and then under conditions of full load.

As will be seen from curve of full load heat run, the temperature of the primary coils reached a maximum of 200 degrees centigrade, giving a rise of 180 degrees centigrade, with a room temperature of twenty degrees centigrade. On the customer's premises this transformer at eighty-one per cent full load had a temperature of 200 degrees centigrade, with a room temperature of forty degrees centigrade.

Having traced the cause of the abnormal heating of the transformer to ageing of the iron, it would be interesting to explain this unique phenomena. The peculiarity of iron changing its magnetic property when used in alternating-current ap-

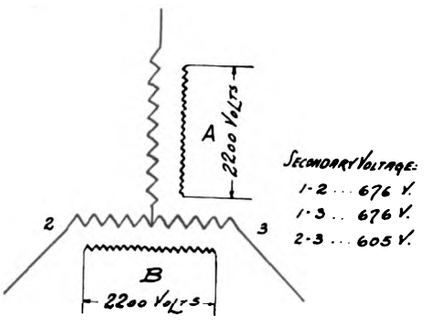


FIG. 1.—TWO-PHASE, THREE-PHASE. UNBALANCED SECONDARY VOLTAGE.

paratus was observed for the first time by G. W. Partridge, in 1894. After having made public some experimental data relative the increase of iron loss in transformers, the question received close investigation in view of its importance. Soon it was ascertained that the phenomenon is due not to any magnetic or electric causes, but was purely the effect of relatively high temperature at which the iron was maintained, on the magnetic properties of iron. The same effect was observed when transformers were placed

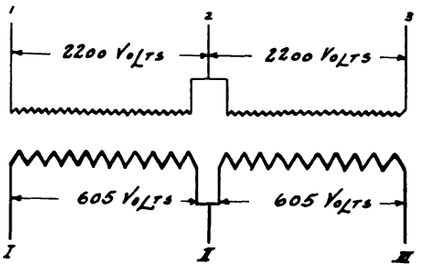


FIG. 2.—CONNECTION UNDER WHICH THE TRANSFORMER RAN HOT.

in baking ovens, where they were kept at a predetermined temperature, and after a given time the hysteresis loss increased considerably as compared with the original loss, same as it is observed with the transformer under operating conditions. It was also observed that ageing increases with the increase of temperature.

Manufacturers of electrical apparatus while working in the direction of securing a non-ageing iron had to work out designs of machines with a possible commercial minimum temperature rise. At the time the transformer discussed in this paper was built, the non-ageing iron was non-existent and the unstable quality of the iron is responsible for the increase in the iron loss and consequently for the abnormal temperature. With transformers of modern construction, when manufacturers have developed certain processes by which they are able to produce the non-ageing iron (relatively speaking) this unstable condition is done away with and the oil transformers are in no danger of attaining hazardous temperatures through this source. Cure of rise in hysteresis will show the effect of increased temperature on core loss and the tendency of larger increases at higher temperatures will be easily observed. This tendency, however, does not follow any fixed law, but is somewhat erratic and upon reaching a certain point the loss diminishes with the increase in temperature.

After all the data to be had from test were secured, the question as to the voltage necessary to break down the winding, after

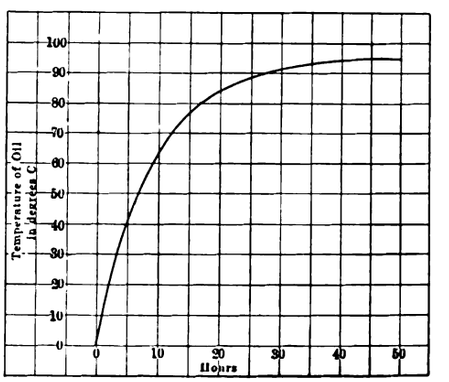


FIG. 3.—OPEN CIRCUIT HEAT RUN.

operating at such an extreme temperature, was of considerable interest. This could not be very successfully carried out on account of not having on hand an alternator of high frequency. Testing the transformer at sixty cycles only double voltage could be impressed, the iron being fully saturated at about 76,000 lines per square inch, and a further increase in voltage was impossible. The primary and secondary coils successfully withstood a ground test of 10,000 volts, thus adding further proof as to the good properties of oil-insulated transformers.

When the transformer was removed from the tank it was found to be coated with a heavy asphaltum-like residue of about one and one-half inches thick. The insulation separating the coils and insulating them from the core was so brittle that the slightest pressure of the hand made it fall to pieces or turn into a soft carbonized mass. The insulation between turns and layers was completely charred

Digitized by Google

and it was the film of oil, though impregnated with carbonized matter, that provided the effective insulation.

Were this a dry transformer it would have burned out long before it would reach a temperature of 200 degrees centigrade. The same would hold true in the case of an air-blast transformer, where the force of the draught would blow away the charred insulation and so hasten the time of the breakdown.

It is the oil, generally understood to be an easily inflammable substance, that makes this type of apparatus so objectionable to some engineers. In reality it is no easy matter to set oil on fire and, as shown by samples of the mineral seal oil used in this transformer, the flashing point of the oil gases was at 175 degrees centigrade and the oil was heated to a temperature of 235 degrees centigrade, the maximum range of the thermometer, and it did not catch fire. Under ordinary conditions a

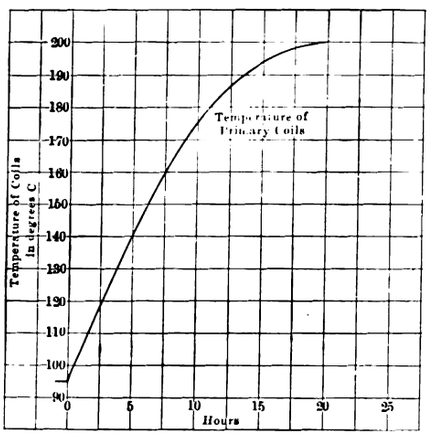


FIG. 4.—FULL LOAD HEAT RUN.

burning match or burning waste when thrown into a tank of oil will be extinguished.

The only danger of the transformer catching fire was likely to be on account of a flame getting in the neighborhood of the volatile gases, issuing from the transformer oil, but no immediate danger could be anticipated on account of the oil burning, as there was still a considerable margin, allowing a further increase of temperature. The transformer while in service was installed in a separate fireproof compartment. The cover was not completely sealing the tank and there was considerable space between the leads and porcelain bushings. The tank of this transformer was made of boiler-plate, one-quarter inch thick, riveted together, and did not show the slightest sign of oil leaking in any part of the case. It may be well to analyze further the design of the transformer in order to bring out the point of high-insulating qualities of oil. The fact that the only insulation in this transformer was the oil, since all the insulating material was carbonized, shows what a thin film of oil would do. The primary coils were wound in layers of six turns per layer, thus making the maximum difference of potential between layers of sixty volts, allowing for the double-cotton cover insulation of the wire twelve mils, and ten mils for the varnished cambric between layers, total space separating the wire between layers amounts to twenty-two mils, and the film of oil, though impregnated with the conducting carbonized insulation, withstood the voltage without difficulty. A dielectric test of a sample of oil taken from this transformer has proved it to possess a high-resisting quality, as it took 27,000 volts to break through a space of one-eighth inch, the voltage being applied to needle points.

From the various records of stations destroyed by fire the causes of fire were not the oil transformers. It originated most frequently either in a short-circuit at the switchboard or was due to the arc of a destroyed fuse on a high-potential panel.

So in the instance of the destruction of the Blue Lakes power plant in California, though the real cause was never ascertained, it is an established fact that it originated at the wooden high-tension switchboard and the burning insulation of the cables carried the flames to the wooden structure of the transformer platform, saturated with oil, through leaking transformers. Careful investigation proved conclusively that it was not a transformer trouble, as every foot of the winding was gone over carefully and it was established beyond any doubt that if the transformers were kept in separate fireproof compartments they would have been saved from destruction.

Again, in the instance of the disastrous fire in the power-house of the Helena Light and Traction Company, at Helena, Mont., it is interesting to note that almost the entire building and machinery were demolished and only some oil-insulated transformers were saved, due to the fact that they were immersed in oil, and so the vital parts of the transformers were left uninjured. If not for the open covers of the transformers which carried an overload, and were opened to facilitate the cooling, the transformers would have remained intact. Under the circumstances a part of the oil burned away, but no harm was done to the coils proper. There were also some oil-insulated potential regulators which were practically uninjured, with the exception of some damage done to the terminals. The result of the Helena fire has proved again that the oil-insulated apparatus is far more immune from fire than any other apparatus.

For the sake of comparison the writer would mention a case when air-blast transformers burned out, causing very near the destruction of the entire substation. Of the four banks of air-blast transformers burned out, causing very transformers per bank, delta connected, one bank was supplied on a new contract by the manufacturer to operate in multiple with the other three banks, dividing the load proportionately. The new bank had to be installed under the pressure of the heavy load in December

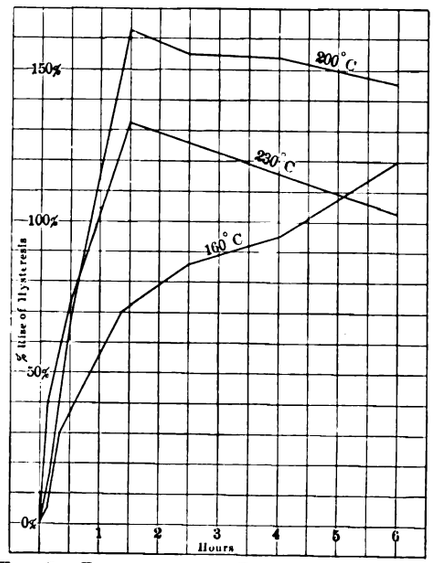


FIG. 5.—PERCENTAGE IN RISE OF HYSTERESIS.

and there was no time to have them tested to get the characteristics of the transformers. There were no separate meters on this bank and as the apparatus happened to be—as was proven subsequently by testing two other transformers supplied on same contract—of better regulation with a much smaller impedance they carried a considerable overload and finally broke down. Fortunately, they were installed over a separate air chamber, as otherwise the fire could have spread along the leads to the other transformers and destroyed the entire station. With proper precaution in installing the oil-insulated transformer possesses advantages which makes it a much safer apparatus, and the tendency in all new power transmission installations is toward the oil-insulated, water-cooled transformers, the use of which is considered good engineering. On several occasions the writer had an opportunity to be in a station where some old type

Digitized by Google

12,000-volt transformers broke down. On account of the usage they had the transformers were not in the best of condition and whenever a short-circuit happened in the transformer proper the oil took care of it every time, even when the short was held on for a minute or so.

Oil-insulated transformers should, to follow good practice, be placed in separate fireproof compartments, though this complicates the wiring of a high-voltage station. Means should always be provided to draw away the oil should the transformer catch fire. This latter can be accomplished as is being done in some instances by introducing water under pressure to the transformer case which displaces the oil. This refinement, which may very seldom be made use of, ensures further safety and makes the oil-insulated transformer the apparatus of the modernized and new station of to-day.

Scope and Effect of Competition on Telephone Development.

Mr. Vinton A. Sears, treasurer of the Automatic Telephone Equipment Company, Boston, Mass., has brought out a book entitled "Telephone Development, the Scope and Effect of Competition." In this work Mr. Sears compares the independent telephone systems with the Bell system, gives the status of the telephone industry, presents letters from editors of leading technical and trade journals, and, in fact, takes up the whole subject of telephony from the independent standpoint. The status of the telephone industry is shown in a number of tables. The Bell systems have a total value in capital stock, bonds and notes of $602,000,000. There are forty-four systems, 1,600 main exchanges, 2,000 branch offices, 4,000 switchboards and 1,800,000 subscribers. The independent systems represent an invested capital of $250,000,000, 5,000 systems, 7,500 public exchanges, 8,000 switchboards and 2,000,000 subscribers.

On a New System of Wireless Telegraphy.

The Royal Academy of Lincey, Turin, Italy, has published some abstracts of a letter to the chairman of the academy by Signor Alessandro Artom, on a new system of wireless telegraphy. This letter outlines the experiments which were made with Signor Artom's wireless telegraph apparatus in conjunction with the Royal Italian Navy.

POLARIZED ROENTGEN RADIATION.[1]

BY DR. CHARLES G. BARKLA.

Experiments on secondary radiation from gases and light solids subject to X-rays showed that the character of this radiation differs only very slightly from that of the radiation producing it, and that the energy of this radiation is proportional merely to the quantity of matter through which a beam of Rœntgen radiation of definite intensity passes, being independent of the kind of matter. These results, and the agreement between the energy experimentally determined and that calculated, led to the conclusion that this radiation is due to what may be called a scattering of primary X-rays by the corpuscles or electrons constituting the molecules of the substance.

On the hypothesis that Rœntgen rays consist of a succession of electromagnetic pulses in the ether, each electron in the medium through which these pulses pass has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the electron, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the electron. On this theory, a secondary beam whose direction of propagation is perpendicular to that of the primary, will be plane polarized, the direction of electric intensity being parallel to the pulse front in the primary beam. If the primary beam be plane polarized, the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement. The secondary radiation from light substances was too feeble to allow accurate measurement of the intensity of the tertiary radiation.

A consideration of the method of production of primary Rœntgen rays in an X-ray tube, however, leads one to expect partial polarization of the primary beam proceeding from the anticathode in a direction perpendicular to that of propagation of the impinging cathode rays, for there is probably at the anticathode a greater acceleration along the line of propagation of the cathode rays than in a direction at right angles; consequently, in a beam of X-rays proceeding in a direction perpendicular to that of the cathode stream there should be greater electric intensity parallel to the stream than in a direction at right angles. Such a beam was therefore used as the primary radiation, and the intensity of secondary radiation proceeding in a direction perpendicular to that of propagation of the primary beam from a radiator placed in that beam, was studied by means of electroscopes.

In the final form of apparatus the intensity of secondary radiation was measured in two directions perpendicular to that of propagation of the primary radiation and to each other, while the intensity of the primary beam was measured by a third electroscope. Using paper, aluminum, or air, as the radiator, as the bulb was turned round the axis of the primary beam studied, the intensity of a secondary beam was found to reach a maximum when the direction of the cathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel, one electroscope recording a maximum rate of deflection when the other recorded a minimum. Many experiments were made which proved the evidence of partial polarization conclusive. When heavier metals, such as copper, tin and lead, which emit a secondary radiation differing considerably in character from the primary producing it, were used as radiators, no variation in intensity of secondary radiation was observed as the bulb was rotated. This result was not found to be affected by a considerable variation in the penetrating power of the primary radiation. Experiments were made with several X-ray tubes.

[1] Abstract of a paper read before the Royal Society of London on February 16, 1905.

German Electrical Developments.

An interesting phase of the electrical developments in Germany is the increasing use of power. To illustrate this, the following are the figures showing the growth of one Berlin company: until 1889 all of the output of the station was used in lighting, and at this time the aggregate was a little over 2,000 kilowatts. In 1889 it was increased to 2,457, and there was sixty-five horse-power in motors. The motor load has increased rapidly, practically doubling every year for the first four years. In 1895 the lighting load was 10,752 kilowatts, and the motor load was 2,252 kilowatts. In 1900 the motor load overtook the lighting load, the former being 22,037 kilowatts, and the latter 21,122 kilowatts. For 1904 the loads on the station were: for lighting 36,195 kilowatts; for motors, 44,448 kilowatts. These figures do not include power used in railway motors. During this year the number of motors which were in operation was 12,933, and the number of consumers for both light and power was 12,265.

Digitized by Google

Safety Devices for Preventing Excessive Pressure Rise in Alternating-Current Systems.

Two patents have been taken out recently in England for methods designed to prevent excessive pressure rise upon opening or closing electric circuits. One of these patents has been granted to the Lahmeyer Electrical Company, of London, and is entitled "improvements in safety devices for protecting dynamo-electric machinery and the like against the excessive voltage occurring when they are switched in or out."

Experience has shown that when machines are switched in or out disruptive discharges may easily occur, and that this principally happens in the coils or parts of conductors which are nearest to the current-supplying mains. This is clearly seen by the following test made by the inventors. A three-phase motor wound for a phase voltage of 10,000 volts and having eight coils per phase was connected to a source of electromotive force of 10,000 volts. The voltages in the several coils then ascertained are recorded in the following table. It will be seen that while under normal conditions there

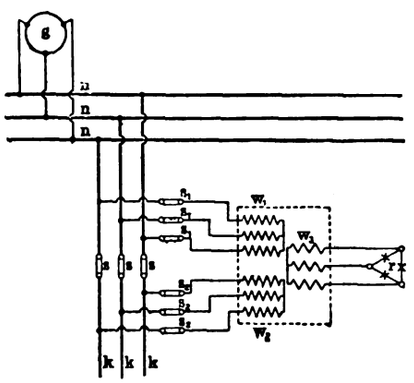
Voltage on Switching in the Motor as Measured Along	Without Any Choking Coil. Volts.	With a 720-Volt Choking Coil Switched In. Volts.	With a 1,100-Volt Choking Coil Switched In. Volts.	With a 1,800-Volt Choking Coil Switched In. Volts.
First coil.....	8,000	4,000	3,000	2,000
Second coil.....	4,000	2,500	2,000	1,500
Third coil	2,500	1,600	1,500	1,150
Fourth coil.....	1,800	1,300	1,100	900
Fifth coil.....	1,300	1,000	900	820

is in each coil a pressure of $10,000/(1.73 \times 8)$ or a little over 720 volts, there is set up in the first coil when the motor is switched in a voltage eleven times as high. To remove this dangerous pressure from the machine, the first coil, which showed the largest increase of voltage, was connected in series with a choking coil which chokes under normal working conditions the same amount of voltage as every armature coil.

It will be seen from the third column that the excess of voltage at the first coil is reduced from 8,000 to 4,000 volts, or one-half. Further measurement also showed that an increase of 8,000 volts took place at the choking coil. If an 1,100, or an 1,800-volt choking coil be switched in, the excess of pressure in the choking coil is 10,500, and 13,300 volts. This action of the self-induction can be explained as follows: when the self-induction is not switched in, the coils, or parts of conductors nearest to the supply main, exert a choking action when the current is turned on, so that the whole amount of excessive pressure is, so to speak, concentrated in these first portions of the coils. If, however, self-induction be switched in series with the machine, this self-induction takes up the excess of voltage. The self-induction coil can easily be so insulated that a disruptive discharge can not occur therein. The choking coil may be short-circuited by another movement of the switch after the starting has been effected. A single choking coil may be used for several machines, this single choking coil being only switched in when a machine is switched in or out.

The second patent is entitled "an auxiliary appliance for the prevention of the occurrence of excessive pressures on switching on and off electrical installations of high voltages; applicable also for testing purposes," and was granted to Siemens Brothers & Company, on behalf of the Siemens-Schuckert Works. The following are abstracts of the essential points covered by these patents, as given in the London *Electrician*, February 17:

Referring to the accompanying drawing, g represents a three-phase current generator, and n are the network conductors, from which the cables k are branched by means of the switches s. The auxiliary appliance consists of a transformer with three windings, of which w and w_2 have the same number of turns



SAFETY DEVICE FOR PREVENTING EXCESSIVE PRESSURE RISE IN ALTERNATING-CURRENT SYSTEMS.

and are connected in the same direction by means of switches s_1, s_2, respectively, before and after the main switches s to the cables k. The third winding w_3 of the transformer, on the other hand, which is advantageously arranged for low pressures, is connected to a non-inductive loading resistance r of suitable value. Assuming, in the first instance, that the winding w_3 is open, but that all the switches are closed, then only the magnetizing current of the transformer will flow in the equal windings w_1, w_2. As regards the conditions of magnetization, nothing will be altered if the winding w_3 be connected up with the resistance r. Practically the same pressure of the connecting points w_1, w_2 will still be maintained if the switches s (which are to be considered as combined to form a three-pole switch) are opened; in consequence, no sparks can be formed at the switches, and no oscillations can be produced in the cables. In the same way, dangerous oscillations in the cables will be prevented, if now the switches s_1 be opened, as sparks are produced at these switches the extent of which depend upon the resistance r. Such sparks, as is known, allow of no rapid oscillations, in contradistinction to the charging sparks produced on the switching in of unloaded cables. The application of the loading resistance therefore acts as a damper of oscillations.

The application of the arrangement, which can, of course, be applied to networks having any number of phases, will be as follows: if the unloaded cables k are to be separated from the network n, then, in the first instance, the switches s_1, s_2 of the auxiliary appliance are closed, one after the other; the switches s are then opened and the direct connection between the cables k and the network conductors n thereby broken; the switches s_1 are then opened whereby the cables k are deprived of their pressure, and, finally opening the switches s_2 the cables are separated from the auxiliary appliance. When connecting unloaded cables k to the network n the switches have to be manipulated in the reverse order by first closing s_2, then s_1, and by finally closing s. When the cables are connected to the mains direct, the switches s_1 and s_2 are opened one after the other and the auxiliary appliance thereby disconnected. The auxiliary appliance, described above, is also very suitable for testing cables under pressure. In this case the main switches s would be open or entirely dispensed with. If a higher pressure than that of the existing network pressure is to be used for the testing, then the translation ratio of the windings w_1 and w_2 is not made as before as 1:1, but is made to correspond with the intended testing pressure.

National Electric Light Association.

Several novel features will be introduced by the entertainment committee which will have charge of the entertainment of the guests at the convention of the National Electric Light Association, to be held at Denver and Colorado Springs, Col., June 6 to 11. The typical life of the western cowboy will be shown in a bronco-busting contest to be given in Denver during the week of the convention. The work of the different committees in charge is proceeding with much expedition, and the members of these committees express the opinion that this will be one of the most successful conventions that has ever been held by the association. A hurried canvass of the different cities which will be represented shows that the attendance will be greater than had been expected. Several special trains from eastern cities have been engaged by delegates, and a number of large parties are being organized to make the trip. The financial support for the convention will be all that could be desired. The finance committee is receiving liberal contributions from Colorado Springs and Denver.

Digitized by Google

Power-House and Single-Phase Car Equipment of the Indianapolis & Cincinnati Traction Company.

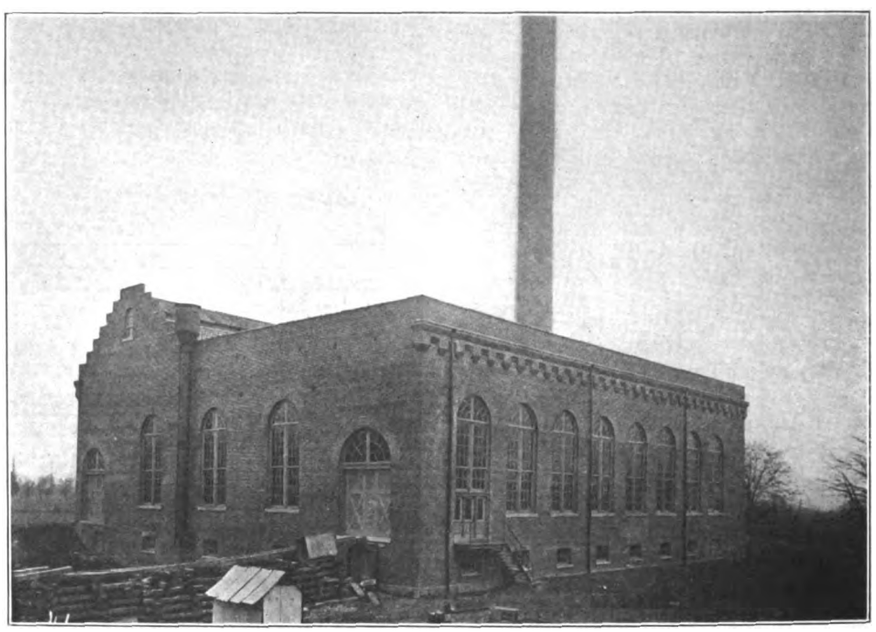
ANNOUNCEMENT has already been made of the opening to the public by the Indianapolis & Cincinnati Traction Company of the first road to be operated on the new alternating-current, single-phase system. The single-phase operation is, however, not the only interesting feature of the installation; the general engineering involved, and especially the equipment of the power-house, being worthy of careful attention.

POWER-HOUSE.

The 120 miles of railway are operated from a single power station. The station is located in Rushville, Ind., about forty miles from Indianapolis and about eighty miles from the other end of the completed line. The site is adjacent to the C. H. & D. Railway, with a connecting track from that road to the company's side track alongside the power station, which track in turn is connected to the main track of the operating company. This arrangement is convenient for ordinary business and will be especially useful whenever it becomes necessary to burn coal under the boilers (natural gas is now being used). It will be possible for the operating company to deliver coal from its own line or take it from the line of the C. H. & D. Railway Company, cars being shifted by electric power. The side track along the power station is built at a proper level for the dumping and crushing of coal, so that it can be handled by carrier and elevator, and fed under the boilers on chain grates without manual handling of any kind. A mill-race, from the stream known as "Flat Rock," runs along the east side of the power station and furnishes water for condensing and other purposes.

The station building is 113 feet by 128 feet 10 inches, and is of very heavy and substantial construction. The foundations are of concrete and the upper walls are of brick laid with cement mortar. The framework and roof structure are of steel. Floors are of concrete and a gravel asphalt roof is laid upon a concrete base with expanded metal, making the building entirely fireproof. The building is designed and constructed with a view to the installation of coal-crushing and automatic coal-handling machinery, with overhead bunkers feeding direct to the boiler grates. The coal bunkers and carriers have not yet been put in, but everything is prepared for their installation.

Foundations for the engines, boilers, pumps and other machinery are all of concrete. Stairways are made of either steel or concrete. The cellars and chambers for electric wires, cables, switches, transformers, protective apparatus, etc., are built according to the most modern practice and in the most substantial manner. The structural and architectural features of the building were designed by Sargent & Lundy, Chicago, Ill., the consulting engineers, and constructed under their supervision. The John A. Schumacker Company, of Indianapolis, was the general contractor, and the American Bridge Company furnished the larger part of the steel work.



POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

A concrete tunnel three feet six inches in diameter, running under the basement floor, conveys the water from the mill-race to the condensers, and a similarly constructed tunnel is provided to carry the water back to the mill-race, connecting at a point some 300 feet below the intake. The supply tunnel is provided with an intake crib which is equipped with an iron grill and removable screens.

At the east end of the power station, erected upon a heavy concrete base, is a well proportioned, self-supporting steel stack 180 feet high, entirely lined with firebrick. The inside diameter of the stack is eleven feet. It is of sufficient size to take care of eight 350-horse-power boilers, space for which is provided in the present building. The stack was constructed by the S. Freeman & Sons Manufacturing Company, of Racine, Wis.

The power-house is so framed and constructed that the west wall can be taken out without disturbing the other walls or the present steel framework, and the building extended to the west. For this purpose a space of over 200 feet has been reserved for extensions to accommodate the future needs of the company.

The present equipment includes three Babcock & Wilcox water-tube boilers of 350-horse-power capacity each. Each boiler contains in the setting a Babcock & Wilcox superheater proportioned for about 100 degrees of superheat. Space is provided in the building for five additional boilers of the same capacity, which will be installed as rapidly as additional power is required. Provision is made for the use of coal if at any time the supply of natural gas becomes exhausted. The boilers are now equipped with flat grates set in an extension furnace, but the setting is arranged so that chain grate stokers can be easily installed when the coal-handling apparatus is put in.

The boiler room is equipped with a large, open, exhaust feed-water heater of the Stilwell-Bierce make, and with two vertical "Atlantic type" feed pumps, built

Digitized by Google

by the Dean Brothers Steam Pump Works, of Indianapolis.

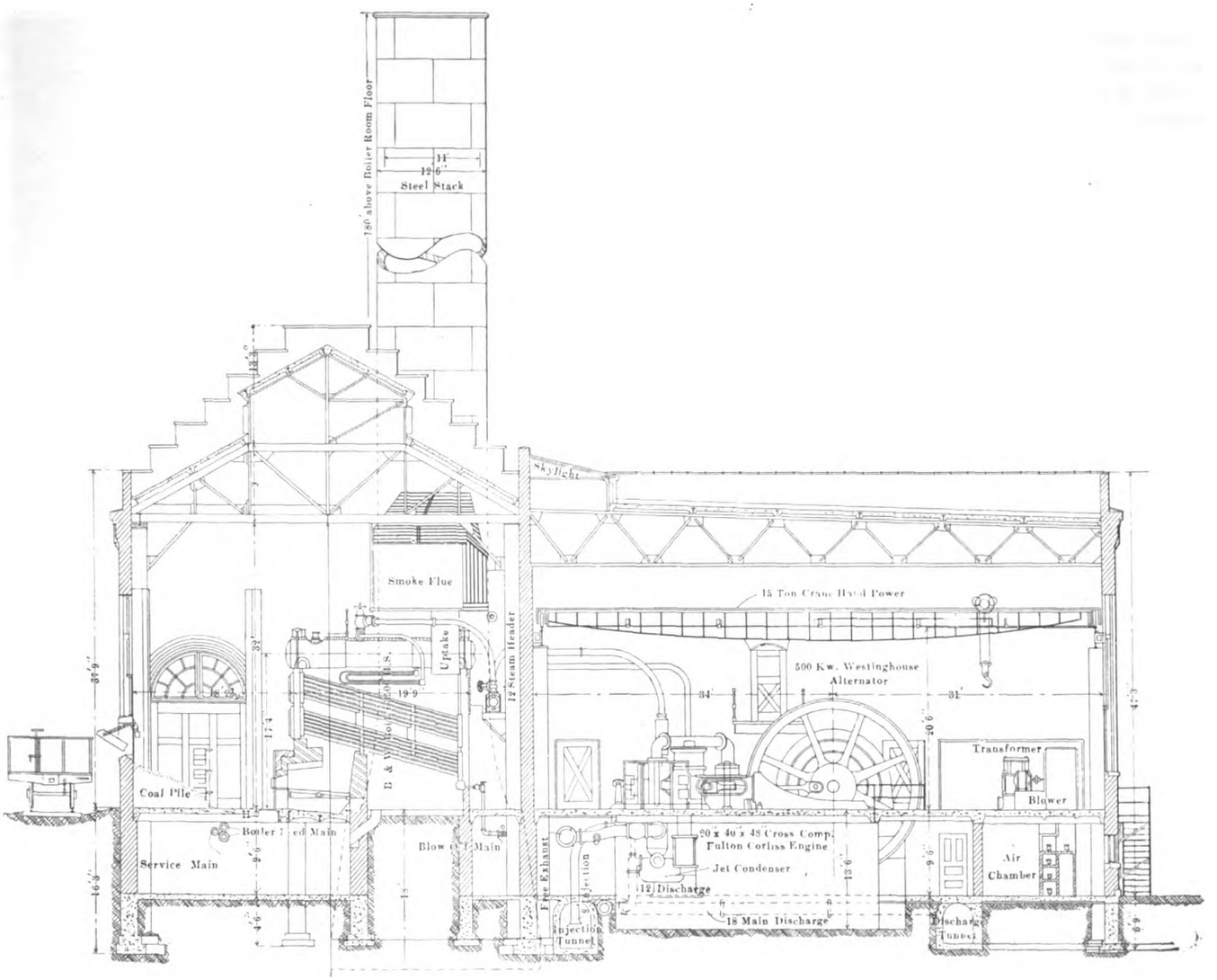
The engine room is provided with a traveling crane, built by the Northern Engineering Works, of Milwaukee, of sufficient capacity to handle all its machinery and which greatly simplifies the work of installation. The present generating equipment includes two 700-horse-power Corliss type, cross-compound, condensing engines, built by the Fulton Iron Works, of St. Louis, Mo. Each engine is equipped with an independent steam-driven jet condenser, made by the Dean Brothers Steam Pump Works. The condensers are set in the basement, but are arranged for operation from the main floor level.

Each engine is direct-connected to a 500-kilowatt, 2,300-volt, three-phase, twenty-five-cycle, Westinghouse revolving-field, alternating-current generator, running at a speed of ninety-four revolutions per minute. The engines are operated at a steam pressure of 140 pounds per square inch.

The generators are of standard Westinghouse construction. The frames of the stationary armatures are of cast iron and surround inner cores of laminated steel which are built up with overlapping joints so as to form a circular ring, slotted to receive the coils. The slots are of the partially closed type, and the coils are connected to give the three-phase relation. The field cores are formed of laminated punchings dove-tailed to a cast-iron spider. The field has thirty-two poles, each of which is wound with machine-formed coils. The field is separately excited. The generators will develop full load continuously under normal conditions with a temperature rise not exceeding thirty-five degrees centigrade above the surrounding air, and immediately following such a full load run will carry fifty per cent overload for a limited period with a temperature rise not exceeding fifty-five degrees centigrade. The generators have a close inherent regulation, but arrangement has been made to further control the voltage by means of Tirril regulators mounted on the switchboard. The present engine room provides sufficient space for the installation of two additional generating units.

Two exciter sets have been installed, one of which is driven by a Westinghouse compound steam engine, the other by a type C induction motor which, in turn, is driven from the main generators through transformers.

The generators are connected directly to two pairs of 250-kilowatt air-blast transformers which are connected according to the Scott three-phase, two-phase system, to transform the current from 2,300 volts, three-phase, to 33,000 volts, two-phase, at which higher potential it is delivered to the transformer stations along the line of the railway, and to the



TRANSVERSE SECTION OF POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

Digitized by Google

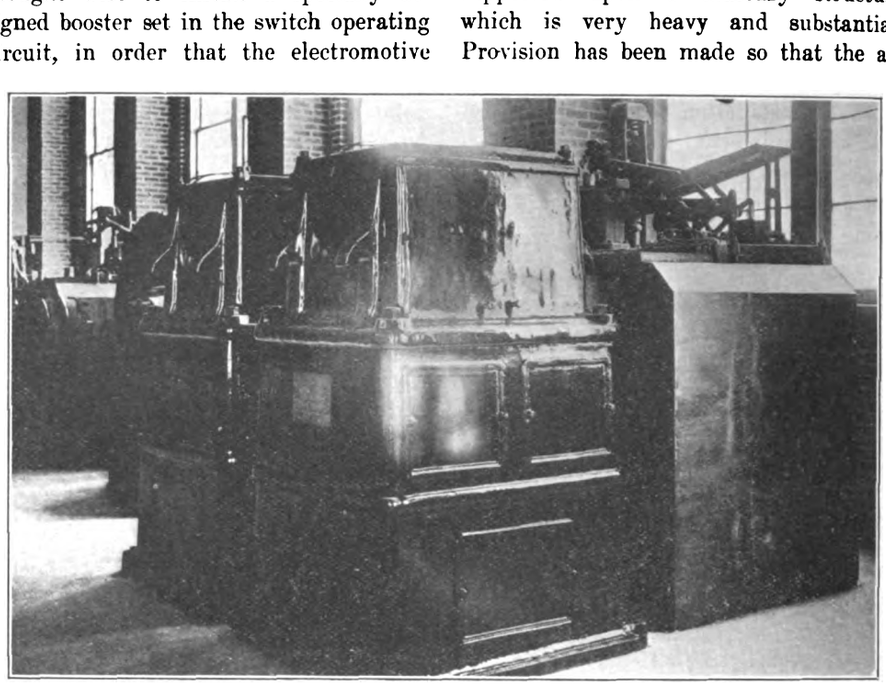
lowering transformers in the power-house which supply the portions of the road located in and near the city of Rushville. Air to cool these step-up transformers is furnished by a pair of ninety-inch fans, made by the Sturtevant Company, and driven by Westinghouse type C induction motors.

The air-blast transformers are connected in pairs and each pair is connected in turn with its own generating unit. The high-tension coils of the transformers are divided so that they may be connected for either 16,500 volts or 33,000 volts, while the low-tension winding is designed for 2,300 volts, the potential of the generators. The insulation between the high-tension coils and core was submitted to a test of 66,000 volts, alternating current, for one minute, and for the same length of time a potential of 4,600 volts was applied between the low-tension coils and core. These transformers are designed to carry full load for twenty-four hours with a temperature rise of twenty-five degrees centigrade above the temperature of the surrounding air, and after a full load run under these conditions each will carry an overload of forty per cent for two hours with a final temperature rise not exceeding fifty-five degrees centigrade. Their efficiencies are approximately as follows:

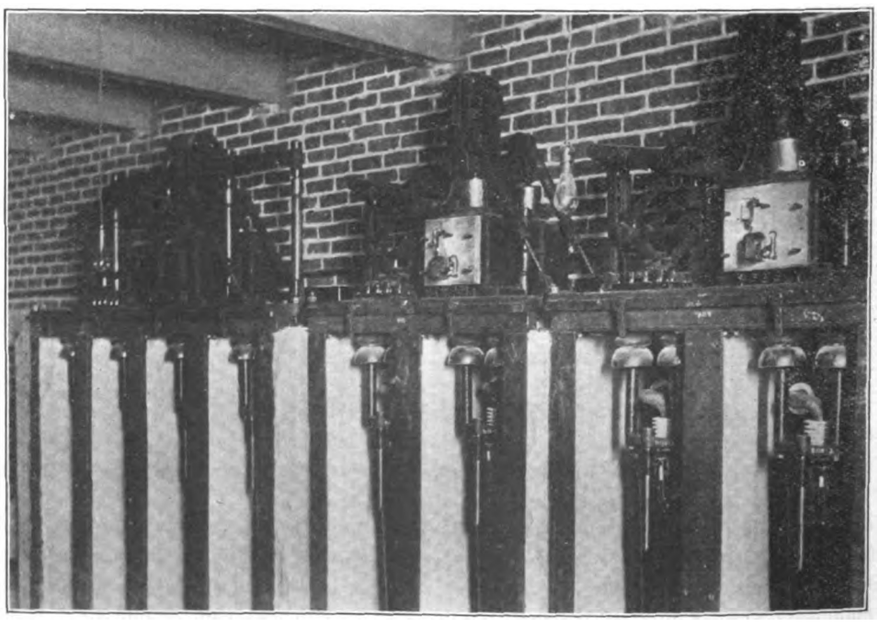
	Per Cent.
Full load	97.4
Three-quarter load	97.0
Half load	96.1
One-quarter load	92.8

Between the high-tension coils of the step-up transformers and the main bus-bars, 33,000-volt, oil-insulated, electrically operated, two-phase non-automatic switches have been installed. On each outgoing feeder leading to the transformer stations, a double-pole automatic switch of similar type has been inserted, and each outgoing feeder is also protected by disconnecting switches, which were made by the Westinghouse company in accordance with designs especially prepared by Sargent & Lundy.

The generators are connected in parallel. The operating panels are located in the main engine room, forming two switchboards of blue Vermont marble. The first board is composed of five panels and provided with apparatus for the control of the two exciter sets, the motors which drive the ventilating fans for the step-up transformers, and the ammeters, voltmeters, wattmeters, Tirril regulators, synchroscopes and switch-control mechanism for the two 500-kilowatt main generators. All the switches are electrically operated, current for this purpose being supplied by the exciter set. As, however, the generators are governed by Tirril regulators, it was thought wise to install a specially designed booster set in the switch operating circuit, in order that the electromotive force of the exciters may not be so reduced by the action of the Tirril regulators that the switch mechanism may fail to act; and in this way all possibility of failure has been overcome. The second switchboard is composed of twelve blue Vermont marble panels, designed to control the outgoing feeder circuits. Five of these panels are now blank, but will be equipped with the necessary apparatus when the operations of the road are more extended. The main bus-bars occupy a portion of the basement. They are mounted upon heavy insulators which are supported upon a masonry structure which is very heavy and substantial. Provision has been made so that the air from the transformer fans is carried through the bus-bar chamber. The bus-bars are arranged in a double set, each of which is protected by a disconnecting switch.



PAIR OF 250-KILOWATT, 2,300 TO 33,000-VOLT, WESTINGHOUSE AIR-BLAST TRANSFORMERS, IN ENGINE ROOM, POWER-HOUSE OF INDIANAPOLIS & CINCINNATI TRACTION COMPANY.



ELECTRICALLY OPERATED, OIL CIRCUIT-BREAKERS IN HIGH-TENSION CHAMBER OF POWER-HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

The east end of the building constitutes what is called the high-tension chamber, and is divided into four floors. The basement contains the bus-bars which are mounted similarly to those leading from the generators, together with the

Digitized by Google

instrument transformers. On the main floor are installed the oil-insulated, electrically operated, high-potential switches which are controlled from the panels in the engine room, the lowering transformers from which the 550-volt alternating-current trolley line in the city of Rushville is operated, the lowering transformers—33,000 volts to 3,300 volts—which feed the sections of the trolley immediately next to Rushville on either side, the lowering transformers for the operation of the motors which drive one exciter and the ventilating fans in the engine room, and the static interrupters for the protection of the lowering transformers.

On the third floor have been installed the static interrupters which are connected to the main outgoing feeder lines, while the low-equivalent lightning arresters are mounted upon the fourth floor of the high-tension chamber.

It will be noted that all switching is done on the high-tension side.

The general plan of operation is the transmission of alternating current over single-phase circuits at 33,000 volts to transformer stations which are located every ten or twelve miles along the road, where the potential is reduced to 3,300 volts and connected direct to the trolley circuit. The transformer stations require no attention, as the feeder lines are all controlled from the main power-house, and no moving apparatus is installed in the transformer houses. Because of the high potential at which the current is transmitted and fed to the trolley circuit, no auxiliary feeders are necessary, and the total expenditure in copper is exceedingly low. The possibility of this saving constitutes one of the most important advantages of the alternating-current single-phase railway system.

CAR EQUIPMENT.

The present car equipment consists of ten passenger cars constructed by the St. Louis Car Company. These cars measure fifty-five feet over all, and are each divided into three compartments, the first of which is nine feet ten inches long and is arranged for the accommodation of baggage. It is provided with doors opening on either side. In front of this baggage compartment and separated from it by a strong railing is the space allotted for the motorman. The middle compartment has a seating capacity for sixteen people and is fitted up as a smoker. The main compartment occupies the other end of the car and contains seating capacity for thirty-eight people.

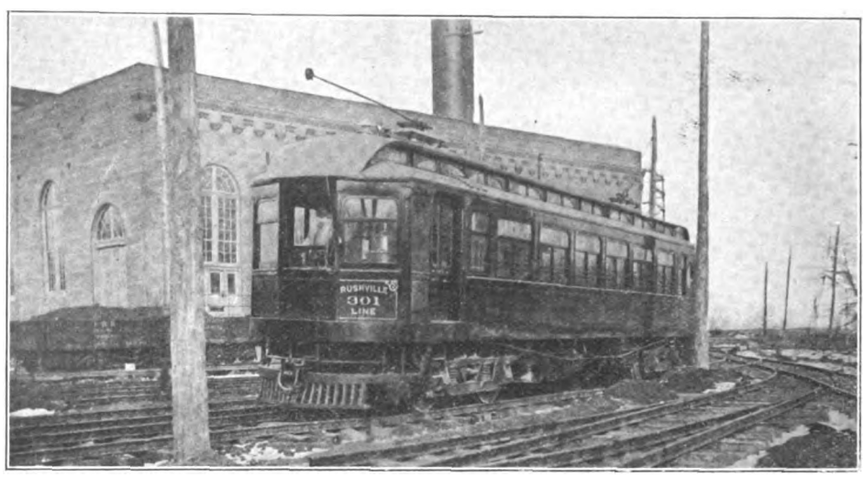
All the seats have reversible backs and are upholstered and covered with plush. Under normal conditions the cars will operate always in the same direction, though the equipment is such that they may be controlled from either end. At the rear of the car a vestibule is provided with space for ingress and egress of passengers.

The cars are finely finished in mahogany. The windows are of plate glass with art glass in the upper part and also in the ventilators. The toilet room is placed in the rear at the left side, so as not to obstruct the view of passengers entering the car at the right side. The cars are heated with the Smith hot-water heaters, placed in the front compartment and under direct charge of the motorman, with pipe running through all the car.

The framework is especially substantial, the floor and lower part being made of steel with steel ribs running from the top. The roof is covered with sheet copper. The finish of the car inside and out is very handsome and in every respect the work is fully equal, if not superior, to anything yet done for electric service. The trucks were made by the Baldwin Locomotive Works, and are of the M. C. B. type, with steel-tired wheels thirty-six inches in diameter. The axles are six inches in diameter and have five-inch by nine-inch journals.

As the cars of this line must be operated over the tracks of the local railway companies in the city of Indianapolis, which are all supplied with direct current, it was necessary in their equipment to make provision for operation on either direct or alternating current. Furthermore, as it was not considered advisable to use a high-potential trolley circuit within the limits of the town of Rushville, it became necessary to provide for the use of two alternating-current trolley voltages. The main portion of the trolley circuit is supplied with 3,300-volt, single-phase alternating current. The total arrangement, therefore, includes operation at 550 volts, direct current, within the limits of Indianapolis and 550 volts, alternating current, in Rushville, and 3,300 volts, alternating current, on the other sections of the line. Because of this complicated service, it seemed advisable to pass by the attractive and economical features of control by induction regulators and to adopt the rheostatic system on account of its simplicity and adaptability to both alternating and direct-current operation.

The car equipment includes four No. 106-A alternating-current, commutator-type, series-wound railway motors, rated at seventy-five horse-power each; one main autotransformer wound for a primary potential of 550, 1,650 and 3,300 volts and for a secondary potential of approximately 250 volts; reversing switch; motor cut-out switch; commutator or change-over switch to throw the equipment from alternating current to direct current and *vice versa;* a complete unit switch system of multiple control with two operating controllers arranged for the operation of the cars either singly or in trains; rheostats or current diverters for use on either alternating or direct-current circuits; air-compressors direct-connected to both an alternating-current and direct-current series-wound motor; air reservoirs; two sets of storage batteries consisting of seven cells each; complete Westinghouse air-brake equipment with control valve on either platform; complete hand-brake equipment with controlling lever on one

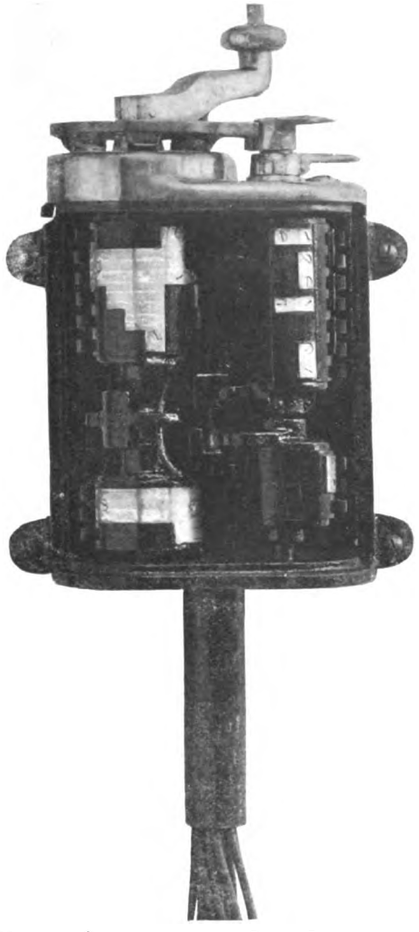


CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

Digitized by Google

platform; one wheel trolley for low-potential service; and one bow type trolley for high-potential service.

The motors, which are wound for 250 volts, are connected four in series for direct-current service, and four in parallel



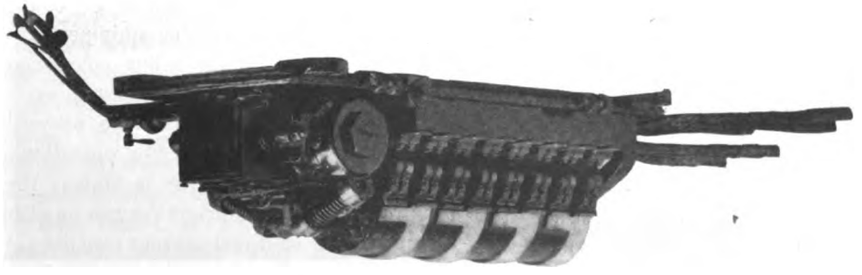
MASTER CONTROLLER ON CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

for alternating-current service. The motors are geared for a maximum speed of forty-five miles per hour for local service.

The frames of the motors are made of cast steel surrounding a circular core built up of laminated punchings, which form four inwardly projecting poles. In addition to the main series coils which are mounted direct upon the poles, auxiliary coils are provided which are threaded through partially closed slots in the pole-faces. The circular casting is made in one piece and is closed by circular end-pieces, which form supports for the armature bearings. The bearings are mounted in separate housings, a construction similar to that adopted as standard in the latest practice of the Westinghouse company in the construction of direct-current railway motors. Lubrication is by oil and waste. The axle bearings are supported by heavy lugs which project from the motor frame. The armature is of the slotted drum type, with machine-formed coils imbedded in open slots and held in place by retaining-wedges. Though rated at seventy-five horse-power each, these motors are guaranteed to develop 100 horse-power at normal potential on either direct or alternating current without injurious sparking.

The unit switch system of multiple control as adopted is the standard Westinghouse equipment modified to suit the double operation by alternating and direct current. The unit switches are arranged in groups, one of eight and one of four units, which are mounted under the floor of the car. They are operated by compressed air which, in turn, is controlled by magnet valves actuated by current from the storage batteries. The operating controllers are mounted one upon each platform and are very small and compact.

The current reverser is of the reciprocating type, generally used with the Westinghouse system of multiple control. The main autotransformer is of the shell form, air-cooled type. Before shipment it was subjected to a test of 10,000 volts between winding and iron, and was operated at double potential for ten minutes. It is designed for operation at twenty-five cycles, a frequency which has been adopted as standard for single-phase railway service.



REVERSER ON CAR, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.

A peculiar form of bow trolley designed for high-potential alternating-current circuits is used. The trolley is mounted upon a thoroughly insulated platform and is raised, lowered and controlled by the motorman by means of compressed air. There is therefore no danger at any time of contact with live parts of the trolley. The bow carries a large, flat aluminum shoe, which makes contact with the underside of the trolley wire.

For low-potential service, whether alternating or direct current, a modification of the Union Standard trolley is provided, as the bow type could not be used in the city of Indianapolis.

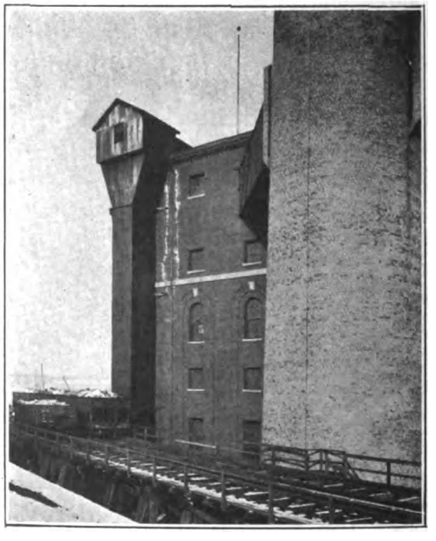
A novel feature of the equipment of these cars was installed at the suggestion of Mr. A. A. Anderson, general superintendent of the road. It consists of a speaking tube connecting the motorman's position with the rear platform, so that the conductor and motorman may talk with each other at any time.

The entire electrical equipment of these cars was furnished by the Westinghouse Electric and Manufacturing Company and installed under the supervision of Sargent & Lundy, of Chicago, the consulting engineers.

POWER-HOUSE FUEL SUPPLY.

A MODERN COAL-HANDLING PLANT.

A very interesting and modern equipment of coal-handling machinery is that recently installed in the new power-house



COAL ELEVATOR AT CHRISTIAN STREET POWER-HOUSE, PHILADELPHIA.

of the Philadelphia Electric Company, located at Christian street wharf, Schuylkill river, Philadelphia, by the Link-Belt Engineering Company, of Philadelphia.

The boiler house, which is a double-decked one, stands on low ground adjacent to the Pennsylvania Railroad tracks and has sufficient floor space to accommodate sixteen 650-horse-power boilers on each floor. At the present time twelve boilers have been installed on the first floor, nine of which are in use and consume on an average of 100 tons of bituminous coal per day of twenty-four hours.

Coal cars are shifted into the yard on

Digitized by Google

a double-track trestle, elevated twenty-seven feet above the basement of the boiler house, at which point they drop their contents into a steel hopper spanning both tracks. This hopper is fitted with a Link-Belt reciprocating feeder which controls the delivery of lump anthracite or bituminous with masses thirty inches and larger in diameter as readily as it does the delivery of buckwheat coal. This is rendered possible by the fact that the rate of delivery is entirely independent of the size of the discharge opening in the hopper, and that the opening can therefore be made large enough to suit the lumps to be handled.

By means of the reciprocating feeder coal is automatically transferred in uniform quantities and regularly to a Link-Belt inserted steel tooth crusher, and besides dispensing with the labor of one man at the hopper, to assist and regulate the flow of coal, it prevents overloading the machine and consequent dangers.

The crusher is mounted on a cast-iron frame and enclosed by a steel housing. It is made with two charcoal iron, chilled rolls, one of which is mounted in spring bearings to allow it to yield to a piece of iron or other hard article that may enter the machine. The crusher and feeder are driven by a fifteen-horse-power motor.

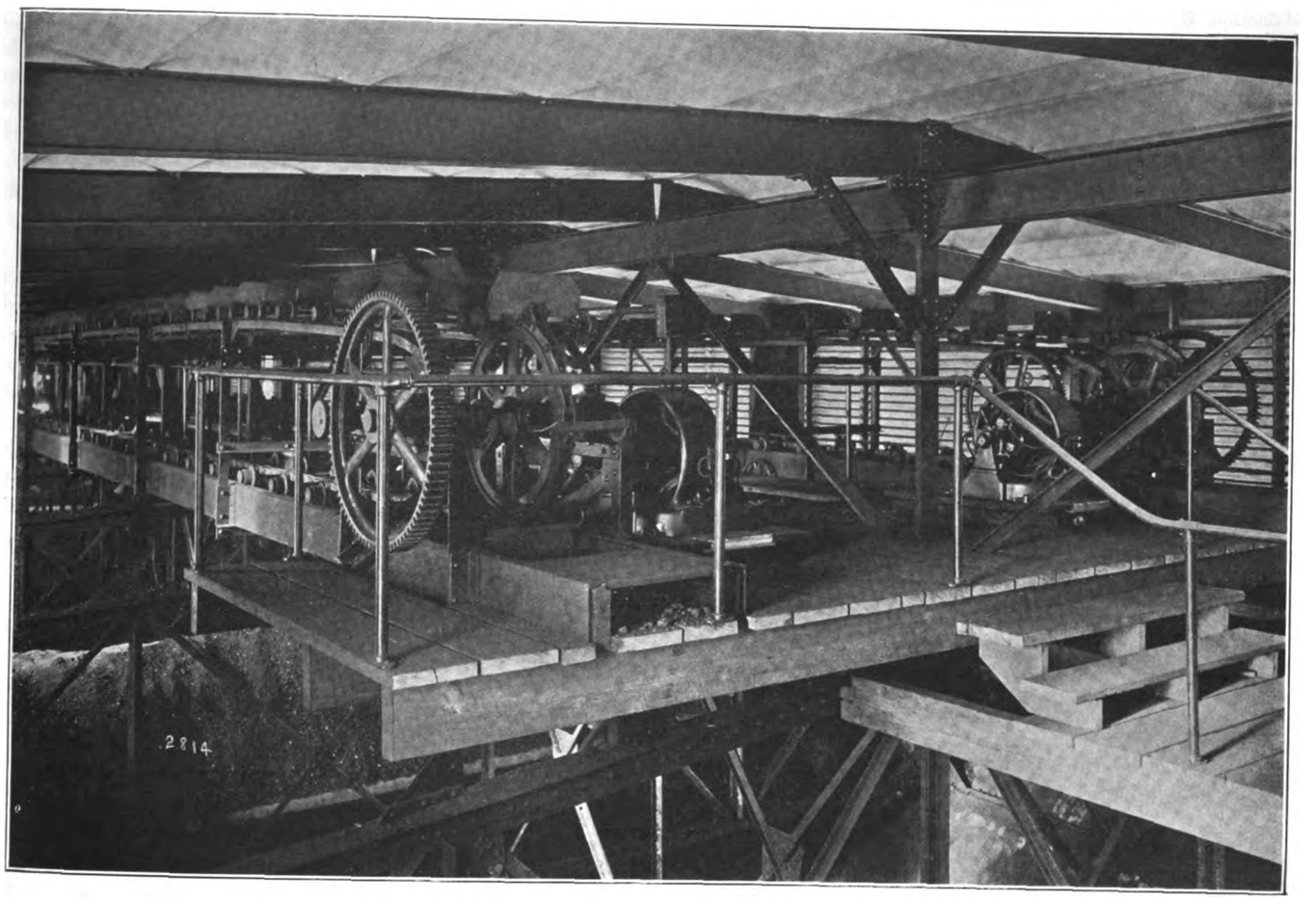
From the crusher coal is spouted to the lower horizontal run of a Link-Belt patented gravity discharge elevator and conveyer consisting of two strands of forged chain with steel buckets attached at intervals. The vertical run of the machine is supported on foundations by a steel tower sheathed with corrugated iron.

After receiving coal from the crusher the gravity discharge elevator and conveyer conveys it thirty feet horizontally, then 106 feet vertically, and then sixty feet horizontally directly under the roof of the boiler house. A thirty-horse-power motor is used for operating this machine.

On the upper horizontal run coal is discharged into either one of two roller flight conveyers, at present only 155 feet centres each, but designed to permit an increase in length when the boiler house is extended. Each of these machines is driven by a fifteen-horse-power motor and consists of suspended roller flights attached at intervals to closed-joint link-belting. On the conveying run the rollers serve to suspend the flights, so that they will not come in contact with the trough, thus preventing noise and reducing wear to the minimum. The coal is distributed in the 2,000-ton pocket through Link-Belt rack and pinion discharge gates with which the conveyer troughs are fitted.

The coal bunker is equipped with eight chutes which are arranged to spout the coal in front of the boilers on first and second floors.

While this machinery is guaranteed to handle 100 tons per hour, the crusher easily reduces run-of-mine bituminous coal to about three-inch cubes or smaller at the rate of 130 tons per hour, the elevator and conveyer having capacity to handle the crushed coal at the same rate.



ROLLER-FLIGHT CONVEYERS IN CHRISTIAN STREET POWER-HOUSE, PHILADELPHIA.

Before the installation of the elevating and conveying machinery coal was unloaded by a crane equipped with a clam-shell bucket to a pile about 200 yards from the boiler house and then reloaded by the same crane into trolley cars and carried to the boiler house. This operation required the services of six men every day, whereas the present equipment necessitates the employment of but one man one hour each day to keep the bunker well supplied with coal and has the further advantage of always having in reserve enough coal to meet all demands of the boilers for twenty days.

Digitized by Google

BOOK REVIEWS.

"The Beginner's Guide to the Lathe." Model Engineer Series No. 25. Percival Marshall & Company. Paper. 76 pages. 5 by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is one of the Model Engineer Series, and, as its title indicates, is devoted to lathe work.

"The Study of Electricity for Beginners." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 88 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is a non-technical book, and describes in simple language the elementary facts of electrical science, and shows the application of some of the fundamental laws.

"Suction Gas." Oswald H. Haenssgen. Cincinnati. Gas Engine Publishing Company. Cloth. 88 pages. 5¼ by 7 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This book describes and illustrates the Dowson gas producer, gives directions for operating the same, tells of results obtained in Europe, and discusses the advantages of suction gas, and of combined Dowson and suction gas plants.

"Electrical Circuits and Diagrams Illustrated and Explained." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 72 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This little book gives the diagrams in common use in electrical work and describes such, when necessary. These diagrams include everything from annunciator work to wireless telegraphy, and give the different methods of connecting up in use in the various applications.

"Hyde's Telephone Troubles and How to Find Them." Milwaukee. W. H. Hyde & Company. Paper. 56 pages. 5 by 6½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

This is the eleventh edition of this valuable little book on telephone troubles. It has been revised and brought up to date, and contains a quantity of new matter on low and high-frequency systems for four-party selective lines, and on methods of testing and repairing toll lines, specifications for inside wiring, the use of condensers, and rural lines.

"Ferric and Heliographic Processes." George E. Brown. New York. Tennant & Ward. Cloth. 149 pages. 5 by 7½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.

This useful little book describes the various processes for reproducing drawings. All of the well-known methods are explained, and formulæ given for the various processes. Samples or prints are shown, and directions are given for preparing of the paper and for printing and fixing a plan of a suitable laboratory in which this work may be carried out is offered.

"How to Install Electric Bells, Annunciators and Fire Alarms." Norman H. Schneider. New York. Spon & Chamberlain. Paper. 64 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

In this book the principle of the electric bell is explained, and the methods of installing bells and the batteries used in the work are described. The common types of thermostat are also described and directions are given for their installation. The book deals, as well, with the ordinary forms of annunciators.

"Dry Batteries." A Dry Battery Expert. New York. Spon & Chamberlain. Paper. 60 pages. 4¾ by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 25 cents.

The different types of dry cells in use are here described, methods of manufacturing explained, and the tools useful in this work shown. A number of useful hints for conducting the work are given, as well as formulæ for preparing the chemicals. Methods of connecting the cells for different purposes are explained.

"Short Course in Alternating Currents." Fitzhugh Townsend. New York. D. Van Nostrand Company. Paper. 32 pages. 5½ by 8½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 75 cents.

This is a synopsis of the course in alternating-current laboratory work which is now given to the graduating class in mechanical engineering at Columbia University. Experiments illustrating the properties of alternating-current circuits, and tests of transformers and other alternating-current apparatus, both for illustrating the physical principles and for commercial uses, are given.

"The Art of Generating Gear Teeth." Howard A. Coombs. New York. D. Van Nostrand Company. Boards. 129 pages. 4¾ by 6 inches. 37 illustrations. Supplied by the ELECTRICAL REVIEW at 50 cents.

This book consists of a number of papers which have been reprinted from the *American Machinist*. It contains six chapters, which are devoted to the theory of tooth curves, formation of gear teeth, the first generating machines, American generating machines, modern generating machines, and generating other forms of teeth. The theory of gearing is gone into quite extensively, and the history of tooth generation is fully described.

"Cyclopædia of Applied Electricity." Five volumes. Chicago. American School of Correspondence at Armour Institute of Technology. Three-quarters leather. 424, 422, 410, 490, 398 + 19 pages, respectively. 7 by 9¾ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $18.

This set of books forms one of the most complete libraries of applied electricity that has yet been compiled. It has been prepared by men widely known as authorities in electrical matters, as well as teachers. The work, as a whole, is intended for students who have not had a technical education nor advanced training in mathematics. Mathematical analyses are avoided as far as possible. The subject matter of the work is explained in simple language, in connection with a large number of diagrams prepared especially for the text. Where the matter dealt with relates to particular machines, illustrations of standard American types are used freely, thus familiarizing the student with the appearance of the machines used in actual work. While the books have been designed to be used as text-books, they are arranged to form a convenient and useful reference work, and for this purpose a complete subject index has been compiled. In addition, each volume contains a number of practical examples dealing with the different subjects taken up, and there is a list of review questions, by means of which the reader can test the knowledge which he has obtained from his study. The particular value of these books to the student may be judged, in part, by the standing of certain of the authors. Of these we may mention Professor F. B. Crocker, of Columbia University; Professor William Esty, of Lehigh University; Professor D. C. Jackson, of the University of Wisconsin, and Professor Louis Derr, of the Massachusetts Institute of Technology. Vol. i deals with current measurements, wiring and telegraphy. Not too much time is spent in explaining the elementary phenomena, with which every one is to-day familiar. Electrical resistance is defined. Methods of determining resistance and tables of copper wire are given, showing to the student that the knowledge which he is obtaining has practical value. The different types of measuring instruments are described, and their use explained. Under "electric wiring," methods of installing electrical apparatus, the necessary precautions which must be taken for both inside and outside work, and directions for computing lines, are explained. A brief chapter tells how bell wiring and annunciator work should be done. The section on the telegraph describes the various systems and apparatus, and explains the methods of operating. This volume concludes with a brief chapter on wireless telegraphy. Vol. ii deals with dynamos, motors and storage batteries. This volume first ex-

Digitized by Google

plains the physical theory of the dynamo. The different elementary types are described, their behavior being illustrated by characteristic curves, which are explained. A chapter on dynamo designs shows how this important work should be approached, and this is followed with descriptions of standard machines. A section on direct-current motors explains the theory of the motor, and the characteristics of the various types. In the section on storage batteries, the theory of the chemical action is stated, and the different types of cell are described. Directions are given for charging and for caring for the cells, for locating trouble and remedying faults, and the methods of using batteries for various purposes are explained. Vol. iii takes up electric lighting, electric railways and electric power stations. The section on electric lighting describes the incandescent and arc lamps, giving methods of manufacturing the former, and then passes to special types of lamps, such as the Nernst and the flaming arc. After explaining systems of distribution and methods of street lighting, photometric methods are described. The section on electric railways deals with this subject in the same thorough manner, describing first the railway motor and its accessory appliances. Distributing systems are described, and methods of locating faults. The chapter on railways is followed by two long and valuable chapters on the management of dynamo-electric machinery. Both of these give full instructions for caring for the plant. The last chapter in this book deals with power stations, showing the method of location, describing the different types of machinery used and the method of placing the machinery in the buildings. Vol. iv deals with alternating currents and power transmission. The first part of this forms a very satisfactory non-mathematical treatment of alternating-current theory. The author has spared no pains to make this important branch of electrical theory clear and understandable to the reader, and he has put the subject in such a way as to interest and convince him. Following the theory, the different types of alternating-current machines are described. The final section of this volume deals with power transmission, and gives practical methods for calculating lines, and instructions for arranging the conductors. A short chapter in this section describes and explains the theory of the Cooper Hewitt mercury vapor rectifier. Vol. v is a full treatise on telephony. The theory of sound transmission is explained, and the means by which air vibrations set up electric currents, which reproduce the sound at a distant point, is given. The different types of telephone instruments are also described. The line work is explained, and conduits, manholes, cables and switchboards are all dealt with satisfactorily. Following the discussion of the manual system is a description of automatic systems, and a short chapter on wireless telephony. This volume contains the subject index. The cyclopædia as a whole, as the above brief digest shows, forms a complete reference work. Besides the large amount of valuable information which is usually found in text-books, it gives many short-cut, practical methods which have been developed by practising engineers to facilitate calculations. The practical value of the subject in hand is always kept in view, so that the student never feels that he is wasting his time over matters that will never be useful to him.

Single-Phase Repulsion Motor Driving a Pump.

A new condenser has been placed in the generating station of the Burton-upon-Trent (England) corporation, for condensing the steam from the new 500-kilowatt set. Both the water-circulating pump and the air pump are driven by a Fynn single-phase repulsion motor. The latter is driven at 135 revolutions per minute, through gearing, while the former is coupled direct to the motor, which runs at 1,440 revolutions per minute. The length of circulating pipe which draws from and delivers water to the river Trent is 308 feet. The height above normal river level is seventeen feet. According to the specifications, the condensers had to deal with 13,500 pounds of steam per hour to give a vacuum of twenty-seven inches, with circulating water at a temperature of not more than sixty degrees Fahrenheit.

The motor is rated at fourteen horse-power, with an overload of about forty per cent. The stator is constructed on lines similar to those of the stator of an ordinary three-phase motor, while the rotor is generally similar to the armature of a rotary converter. It has two interconnected windings on it, the free ends of one being connected to slip rings, while the ends of the coils of the other are connected up to a commutator. The motor is started as follows: after closing the main switch putting the current on the stator windings, the starting switch is put on the first notch of the resistance in circuit with the brushes on the commutator side of the machine. The motor, driving the condensing plant, reached, in five seconds, a speed on the first notch of about 1,060 revolutions per minute. There are thirteen resistance notches, the speed rising to full as the switch moves over these. The slip rings are then short-circuited by pushing in a projecting knob on the spur-wheel end of the motor shaft. The starting switch is then moved back to the first position, and all of the brushes bearing on the slip rings are raised by means of a small lever handle at the same time. The motor may be started and brought up to full speed in about one minute. Commutation is said to be sparkless under all conditions. The starting current is just equal to full-load current, and is eighty-two amperes. The makers offered to guarantee an efficiency of eighty-three per cent, but as a special request was made for a higher power-factor, the latter was raised to eighty per cent, causing a slight reduction in the efficiency. Characteristic curves show that neither the efficiency nor the power-factor varies much from eighty per cent between a load of nine and nineteen horse-power.

The motor is not arranged for reversing, it not being necessary in this plant. When it is desirable to reverse the motor, as is generally the case, the stator is provided with a second winding in quadrature with the first winding. These two are connected in series, and when it is desired to change the direction of rotation, one of the windings is reversed, thus shifting the stator field with reference to the brushes.

In the large sizes of Fynn motors—from fifty horse-power upward—and in the Fynn traction motors, a peculiar method of self-excitation is provided, which enables the motor to work at all loads at a higher power-factor.

This is thought to be the first application of a repulsion motor to driving the pumps for a condenser. It is said, also, to be the second Fynn motor which has been put in operation in England.

The "Brooklyn Edison" for February, published by the Edison Electric Illuminating Company, of Brooklyn, N. Y., contains an editorial on the prophecy made by Thomas A. Edison, in 1878, when he said he could light the lower part of New York city from one machine. The editorial shows how this prophecy has been fulfilled. A poem entitled the "Age of Light" is printed on the front cover. The body of the magazine is devoted to the applications of the incandescent light to advertising and other uses.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Homopolar Dynamos.

A description is here given of one of the homopolar dynamos which was designed and constructed some years ago by the author, Mr. A. H. Finley. This machine was built up of twenty-four segments, and had twelve pairs of collecting rings. It gives twelve volts at 750 revolutions, and twenty-four volts at 1,500 revolutions. It is self-exciting, the field winding being divided into two sections to permit the two speeds. When the machine was first built, there was considerable end thrust, but it was overcome by adjusting the armature. The machine is of the double-disc type, the armature segments consisting of two iron radial sectors connected together at the bottom by a copper strip, and at their outer ends to the collecting rings. The copper connecting bar passes through the central pole. The brushes used are flexible bands sliding in grooves on the rings, and have about a ninety-degree arc of contact. Each unit of the armature consists of two segments and two rings. They were all connected in series through the brushes and the stationary conductors. A second type of machine, which has been patented by the author, is also described. This has a solid armature, and is provided with armature and field magnet conductors in slots or tunnels close to the air-gap. The conductors passing through the field magnet are for connecting the armature conductors in series through the brushes and rings. The object of placing the field magnet conductors so near the air-gap is given as follows: "if any of the magnetic flux is caused to rotate, by reason of the rotation of the armature, then such flux-cutting return conductors will set up an electromotive force in such conductors in the opposite direction to that of the electromotive force in the generating conductors. Such electromotive force will help that of the generating conductors when the generating and return conductors are connected by means of a collector ring and brushes." It is also claimed that the armature reaction will be neutralized by the currents flowing in the return conductors, when arranged close to the generating conductors. In this machine it was considered sufficient to connect several armature conductors, equally spaced, to each ring, to do away with the trouble due to the currents' change in direction in the ring when flowing to the brush or brushes. It is suggested that this type of machine could be used in the alternating-current series motor.—*Abstracted from the Electrical Review (London), February 24.*

Eddy Current Losses in Massive Pole-Shoes.

A careful study of the effect of the eddy current losses in the pole-shoes of dynamo-electric machinery has been made by Herr Reinhold Rüdenberg. As the result of this work, the following equation is given for the energy losses taking place in the pole-shoe:

$$W_0 = \frac{1}{8\pi} v \sqrt{\frac{v\, t_1}{s\, \mu}} \left(B_0^2 \cdot 10^{-7} \right)$$

In this equation, W_0 represents the energy loss in watts; v is the velocity of motion of the armature teeth past the pole-face; s is the resistivity of the pole material; t is the pitch of the slots expressed in centimetres, and v in centimetres per second; b represents the amplitude of the variation in flux density produced by the armature teeth. Applying this formula to a certain class of machines given in Arnold's book on continuous-current machines, the author determines the eddy current loss in the pole-faces for a large number of different machines having different types of pole-face. A machine rated at one and one-half kilowatts showed a loss of 119 watts in the pole-face when the pole-shoe was constructed of sheet iron. The loss amounted to eighteen watts when cast steel was used. A machine rated at twenty-five kilowatts showed a loss of 8.2 per cent in the pole-shoes. The pole-face was made up of sheet iron. The velocity of the armature teeth in this case was fifteen metres per second. A machine rated at 100 kilowatts, in which the velocity of the teeth was 10.7 metres per second, showed a loss of 3,140 watts in the sheet-iron pole-faces. A 500-kilowatt machine, in which the speed of the armature teeth was 22.2 metres per second, showed a loss of 3,000 watts when the pole-face was of cast steel. A machine with a similar rating, in which the velocity of the teeth was 12.5 metres per second, showed a loss of 5,000 watts when the pole-face was formed of sheet iron. A machine rated at 1,000 kilowatts, in which the speed was 16.5 metres per second, showed a loss of 3,900 watts, the pole-face being of cast iron.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), February.*

An Enclosed Mercury Reversing Commutator.

The ordinary mercury cup reversing commutator is one of the most common pieces of apparatus to be found in the physical laboratory. It has, nevertheless, some serious objections, in spite of its simplicity. To overcome these objections the following ingenious arrangement has been made by Herr J. J. T. Chabot. The usual form of rectangular base is retained, with the rocking table above it. In place of the six mercury cups upon the base there are six brass terminal bushings on the rocking table. These are cross-connected in the usual way and are attached to four fixed terminals on the base by means of flexible conducting cord. The brass terminals on the rocking table are arranged in two rows of three each, and to each is attached a commutating tube. This tube has three legs and a neck. All the legs are filled nearly full of mercury. Through the bottom of each projects a conducting wire of platinum. These wires are clamped in the brass terminal bushings, thus serving for good electrical connection and to hold the tube in place. When the rocking table is placed in a horizontal position, it is held by a catch, and as the mercury in the legs of the tubes does not come up to the top, the circuit is broken. However, when the table is tilted one way or the other, the mercury from the upper leg flows over and closes the circuit between the centre and the lower leg of each tube. The reverse action takes place when rocked in the other direction. To avoid oxidation of the mercury, the tube may be filled with some inert gas, such as nitrogen, or it may be exhausted and sealed. This device is suitable for commutating fairly strong currents of ten amperes or more.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), February 15.*

Variations in One Period of the Luminous Flux Emitted by an Alternating-Current Arc.

A very interesting study has been made by M. C. Léonard of the variations in the luminous flux or light given out by the alternating-current arc during the

Digitized by Google

different phases of the arc. The results of this research are here given. Considering the subject generally, light is emitted from four parts of the arc: first, the crater of the positive carbon; second, the crater of the negative carbon; third, the arc or vapor column itself; fourth, from the incandescent tips of the carbons. The most important source of light is the crater of the positive carbon, the others following in the order named. In order to investigate the variations in luminous radiation, the arc was placed within a parabolic mirror, which focused the light upon a white screen. The light radiated from this screen was allowed to fall upon the photometer screen, and between the two was placed a rotating disc having a slot cut in one side. This disc was driven by a synchronous motor. The only light falling upon the photometer screen passed through the slot, and by varying the position either of the photometer screen or of the rotating disc respective to its armature, the screen could be illuminated by the light of the arc for any particular instant. The duration of this illumination was only about one-seven-hundredth of a second. Considering the variations of the luminous flux, the following deductions are made: the frequency of the variation of the total flux is double that of the frequency of the alternating current. The total luminous flux does not fall to zero with the current. There is apparently a slight phase displacement, equal to about one-thirty-second of the period of the current, between the minimum total luminous flux and the zero value of voltage or of current. There is no appreciable phase displacement between the maximum values of the curves showing the variation of the luminous flux and of current. The relative variation of the total luminous flux is sixty-four per cent. Passing to a consideration of the radiation in the lower hemisphere, the following was found to be true: the frequency of the variation of the luminous flux in the lower hemisphere is equal to that of the current. The phase displacement between the minimum luminous flux and the point where the voltage is zero is about one-forty-eighth of a period. The relative variation of luminous flux is 120 per cent—about double that of the total flux. Separating the flux into its components, with regard to the sources of light, the following is true: the luminous flux emitted by the incandescent extremities of the carbon is sensibly constant. The flux emitted by the arc proper is small in the normal arc, and has a frequency double that of the current. The luminous flux given by the positive crater of the lower carbon has a frequency equal to that of the current. The luminous flux emitted at the positive crater of the upper carbon has the same frequency as the latter, but is displaced with reference to it by half a period. The luminous flux due to the negative craters has the same frequency as that due to the positive craters, but is displaced with respect to the latter by half a period. In studying the arc, the author was led to divide the luminous arc into three parts: first, a small surface where a violet color predominates, forming a horizontal zone which is lighted by the arc proper, and, in part, by the incandescence of the carbons. The variations in the luminous flux reaching this zone are not easily perceived by the eye. The second zone extends up from the first, and has about double its width. In this area the eye easily perceives the variation of light. The third zone is that situated below the horizontal zone, and the phenomena there are similar to those in the second.—*Translated and abstracted from L'Éclairage Électrique (Paris), February* 18.

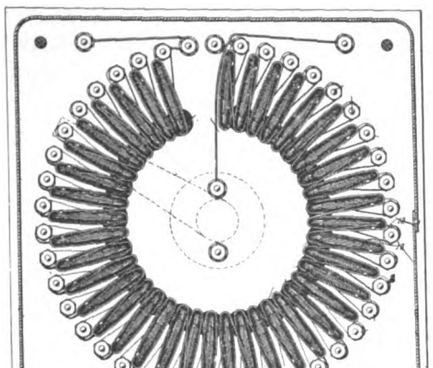
General Instructions for Accepting Electrical Machinery.

The Syndicat Professionnel des Industries Électriques, Paris, has issued a set of instructions governing the acceptance of electrical machinery. These are here given in full, but can be referred to but briefly. The rating of the machine must be as follows: for direct-current dynamos, in kilowatts at the terminals of the generator; for alternating-current generators, in kilovolt-amperes at the terminals, the power-factor being imagined; for motors, in horse-power of seventy-five kilogrammemetres per second or poncelets of 100 kilogrammes per second. The power-factor must be mentioned. For heating, the following limits are established: for field circuits traversed by continuous current, forty-five degrees centigrade; windings of transformers, fifty-five degrees centigrade; all other electric circuits, except those always closed upon themselves, forty-five degrees centigrade; for electric circuits always enclosed within themselves, sixty degrees centigrade; for collectors and terminals insulated with mica and brushes, fifty-five degrees centigrade; for iron cores, sixty degrees centigrade; for bearings, terminals and connections, forty degrees centigrade. For machines, having collectors, which are intended to serve day and night, and for machines of more than 2,000 volts, except transformers, the temperatures are five degrees lower than the above. These temperatures suppose a temperature of the surrounding air of thirty-five degrees. The temperatures are to be measured by thermometers. For machines intended for intermittent service, the duration of the test is half that of a machine for continuous service. For the latter, the duration of the run is to be specified. With transformers for intermittent service, the test must be made after the transformer has been under load for a period equal to the time during which it would be called upon to operate. If the transformer is always connected to supply circuits, the time must be counted from the time when the transformer has reached its normal temperature at no load. For the transformers supporting a continuous load, the measurement must be made after the temperature has become constant. The following overloads must be supported: twenty per cent for one-tenth of the duration of the heating test; thirty per cent for five minutes. Traction motors must support an overload of twenty-five per cent for a quarter of an hour and fifty per cent for five minutes. These overloads must be carried after the machine has reached its working temperature. Continuous-current motors must support, for five minutes, a speed fifty per cent above normal. The coefficient of self-regulation of voltage or speed is defined by referring variations of voltage or speed to the voltage or speed under normal load. For generators and transformers, the regulation must be determined for both unity power-factor and a power-factor of 0.8. Rules for determining the efficiency are given, and the different losses defined. Insulation tests are made by applying an alternating potential to the windings and the core, having a value about sixty per cent greater than the normal voltage of the machine. The following are the allowable variations from the specifications: a variation of three degrees centigrade above the guaranteed heating is allowed. If the temperature rises not more than ten degrees, the machine will be accepted, but a reduction of one-half per cent of the price per degree above the three degrees allowed will be made. A variation in regulation of twenty per cent from the guarantee will be allowed. A variation of fifty per cent will be accepted, with a reduction of one-half per cent of the price for every ten per cent above the allowable twenty per cent variation. A variation of twenty per cent from the total or measurable losses is allowed. A variation of fifty per cent in these losses will be accepted, with a deduction of one per cent for every ten per cent above the allowable twenty per cent.—*Translated and abstracted from Le Revue Technique (Paris), February* 10.

Digitized by Google

Electrical Patents.

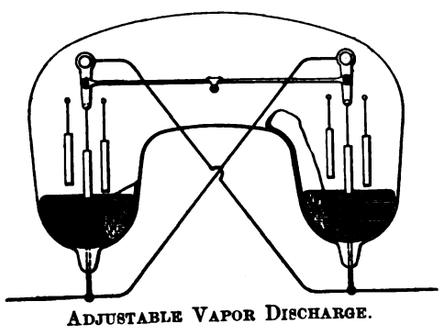
The Westinghouse Electric and Manufacturing Company is the assignee of a patent recently granted to Hermon L. Van Valkenburg, of Pittsburg, Pa., on a rheostat (782,887, February 21, 1905). The object of the invention is to provide a rheostat which shall be simple, compact and relatively inexpensive in construction,



RHEOSTAT.

and the resistance elements of which shall be so constructed and mounted as to be durable and thoroughly insulated and at the same time be so exposed to the air as to be effectively ventilated. A series of stationary contact terminals is provided and a movable arm adapted to make engagement therewith. A series of resistance elements is employed, each of which comprises a sheet-metal base fastened at one end to a corresponding stationary contact terminal. A non-conducting heat-resisting sheath has a coil of wire mounted thereon and connected at one end to the corresponding end of the sheet-metal base and at the other end to the next sheet-metal base in series.

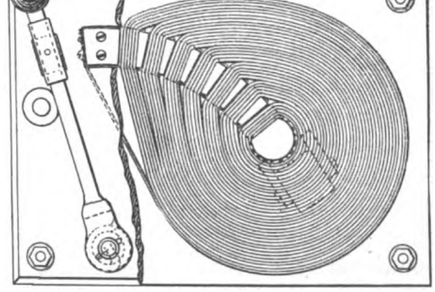
An adjustable vapor-discharge has been recently devised and patented by Percy H. Thomas, of Pittsburg, Pa., and



ADJUSTABLE VAPOR DISCHARGE.

assigned by him to Cooper Hewitt Electric Company, of New York (783,483, February 28, 1905). The qualities of the Cooper Hewitt gas or vapor electric apparatus which adapt it to serve the purposes of a spark-gap are already well known. It is known that apparatus of this character may be so constructed as to require a high voltage in order to break down the reluctance to starting which appears at the electrode, which for the time being is the negative electrode. Hitherto it has been customary to construct each apparatus for a definite breaking-down voltage and to adapt it in other respects, either to permit discharges in one direction only or in both directions. It is the object of the present invention to provide means whereby a discharge-vapor device of this general character may be constructed so as to be adjustable, that is to say, so that a given device may be adapted to discharge under different pressures. The invention comprises an enclosed conducting-gas or vapor and electrodes therefor. An electric circuit is connected to the electrodes and is adapted to impress upon the device a definite electromotive force. One or more starting-bands are provided and means for varying the effective relations of the starting band or bands and the negative electrode.

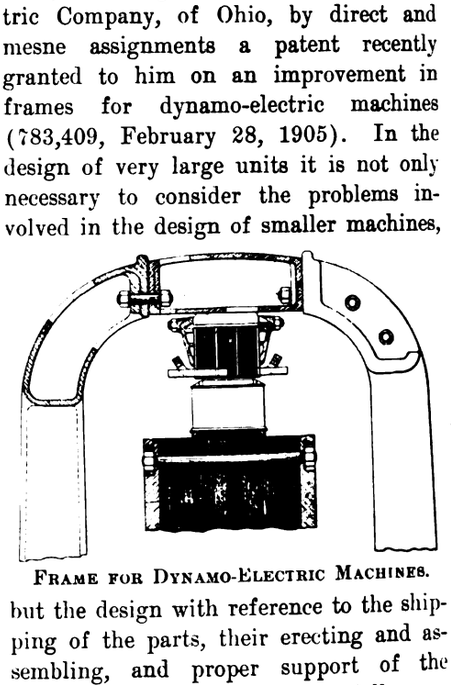
A patent on a rheostat recently granted to William H. Powell, of East Orange, N. J., has been assigned by him to Crocker-Wheeler Company, of Ampere, N. J. (783,979, February 28, 1905). The invention relates to the manner of arranging and combining the resistance-conductor and contact-blocks and the



RHEOSTAT.

manner of their support to form a substantial and compact rheostat of few parts and simple construction. The present form is designed for hand operation and for use as a starting rheostat for electric motors, as the construction is especially well adapted to this purpose, wherein a considerable mass is requisite to absorb the heat generated upon the operation of the rheostat; but special provision for the radiation and dispersion of the heat is of little importance, owing to the fact that a considerable interval of time elapses between successive operations The invention consists of rheostat terminals and a resistance element consisting of a coiled conducting-ribbon connected at the inner end of the coil to one of the terminals. A movable contact member is adapted to be moved above and parallel to the flat face of the spiral coil, and contact-blocks are disposed in the path of the movable contact member and contact with the different convolutions of the ribbon. Connections are provided through the movable contact member to the other terminal.

Bernard A. Behrend, of Norwood, Ohio, has assigned to the Bullock Electric Company, of Ohio, by direct and mesne assignments a patent recently granted to him on an improvement in frames for dynamo-electric machines (783,409, February 28, 1905). In the design of very large units it is not only necessary to consider the problems involved in the design of smaller machines,



FRAME FOR DYNAMO-ELECTRIC MACHINES.

but the design with reference to the shipping of the parts, their erecting and assembling, and proper support of the enormous weights must be specially considered; also as the diameter of large units is very great in comparison with their depth, any construction by which the diameter is reduced without correspondingly reducing the capacity is very advantageous. In the present invention the difficulties as to shipping and erecting have been overcome, and the advantage of a comparatively small diameter obtained. In the embodiment of the invention, the stationary frame is made up of two shields or end frames, provided with pedestals, which shields act as a support for the main frame, which is clamped between them. The shields and main frame may be subdivided into segments to a degree which the size of the machine requires. Since the shields or end frames support the main frame, the latter need not be designed as a supporting-yoke, but only of such strength as to take the weight of the laminations and windings carried thereby. For this reason the outside diameter of the machine is greatly reduced compared with what would be necessary if the main frame of the machine also served as a supporting-yoke.

Digitized by Google

The Cunard Twin-Screw Steamship Caronia.

THE Caronia is the latest addition to the fleet of the Cunard Line, and is the first of a quartette of large ships to be put into service in the near future by the Cunard Steamship Company, Limited. The vessel is 678 feet long, seventy-two feet six inches wide, and ninety-seven feet deep from keel to bridge. The draught loaded, is thirty-two feet, and the gross tonnage is 20,000 tons. There are twelve transverse bulkheads built in the vessel, all stiffened to resist any pressure that may be brought suddenly to bear upon them by flooding. The vessel has a cellular double bottom of very stiff construction. The ballast tanks have a combined water-carrying capacity of 3,450 tons. On each side of the vessel bilge keels are fitted, each eighteen inches deep, and extending a distance of about half the vessel's length amidships. The Caronia has eight continuous decks, namely: boat, promenade, bridge, shelter, upper, main, lower and orlop. The first six decks are for the use of passengers, and some of the third-class passengers are accommodated on the lower deck. There are accommodations for 300 first-class passengers and for 350 second-class. One thousand third-class passengers can be carried. The crew of the vessel comprises about 450 officers and men.

Steam is furnished the engines by thirteen Scotch boilers, eight of which are double-ended, and five single-ended. The boilers are fifteen feet ten inches in diameter. The single-ended boilers are twelve feet long, and the double-ended boilers are twenty-two feet long. Each single-ended boiler contains three furnaces, which are three feet ten inches in diameter. The double-ended boilers have three furnaces in each end, four feet in diameter. The depth of the furnace is eight feet in each case. The total heating surface of the boilers is 38,660 square feet in the double-ended boilers, and 16,110 square feet in the single-ended boilers. The total grate surface of all the boilers is 1,560 square feet. The boilers are operated at 215 pounds pressure per square inch. About 260 tons of coal are burned in each twenty-four hours. Forced draught is furnished the boilers by Howden's closed ash-pit system. Air is furnished by four fans 108 inches in diameter, each fan being driven by two direct-connected twelve by fourteen-inch engines running at 600 revolutions per minute. Ashes are removed from the fire-room by means of a Crompton atmospheric ash hoist with a capacity of about 24,000 pounds of ashes per hour.

Power to propel the vessel is furnished by two sets of quadruple-expansion engines of 21,000 aggregate horse-power, with cylinders thirty-nine, fifty-five, seventy-seven and 110 inches in diameter, respectively, by five feet six inches stroke. The engines are balanced upon the Yarrow-Schlik-Tweedy system, which reduces vibration to a minimum. At full speed they run at ninety revolutions per minute, giving the vessel a speed of about nineteen knots per hour. The crank shafts are twenty-two and one-half inches in diameter, and the propeller shafts twenty-three inches. The thrust of each propeller is taken by a thrust shaft which is twenty-two and one-half inches in diameter by fifteen feet ten inches long, and which carries thirteen thrust collars.

The engines exhaust into two main condensers. Each condenser contains 4,690 tubes, three-quarters of an inch in diameter and fifteen feet six inches long. The air-pump for the condenser is twenty-two by twenty-four inches, and is direct-connected to the main engines. In addition to the main condensers there is one auxiliary condenser for the auxiliary machinery. This condenser contains 2,960 tubes of the same size as those in the main condenser. Condensing water is furnished by two Allen centrifugal circulating pumps with forty-eight-inch discs. These pumps are driven at 100 revolutions per minute by two ten-inch by nine-inch engines, built by W. H. Allen & Sons, Bedford, England.

The condensed steam, leaving the condenser, passes through two Harris feed-water filters, and then through feed-water heaters which raise its temperature to 220 degrees Fahrenheit. It is passed to the boilers by means of four Weir feed-pumps. In order to supply fresh water to the boilers, there are installed two Weir and two Quigans evaporators with a combined capacity of eighty tons of fresh water per twenty-four hours.

The ship has two sets of Brown steering gear, one located below the water line, and the other on the shelter deck. This gear consists of a pair of engines mounted on the tiller. The engines drive a pinion which works in a section of an internal gear fixed on the vessel. The engines can be controlled from the bridge by means of a telemotor system, which operates the valves of the engines. In case the telemotor system becomes disabled, the engines can be operated by a steering wheel in either steering engine compartment, the orders being telegraphed from the bridge.

Electric current is furnished for lighting the ship and for operating various winches by four 100-volt, seventy-five-kilowatt Clarke-Chapman generators, running at 450 revolutions per minute, which are direct-connected to Belliss compound engines with cylinders nine and fifteen and one-half inches by seven inches. The engines are entirely enclosed and operate at 150 pounds per square inch steam pressure.

The switchboard is installed in the same room with the engines and generators, and consists of five panels, six feet by thirty inches. Two of these panels are feeder panels, and three are output panels. The feeder panels each carry two 1,000-ampere ammeters and one 120-volt voltmeter, two double-pole, single-throw knife switches, and two rheostats. Each feeder panel takes care of two generators. The three output panels each carry twelve single-pole, four-throw knife switches, which control the circuits running to various parts of the ship. The four-throw switches enable any circuit to be connected to any generator.

About 3,000 sixteen-candle-power lights are installed throughout the ship. In addition to these there is a powerful searchlight upon the bridge.

On the boat deck are two electric winches for handling the small boats. These winches consist of a shaft extending the width of the vessel, with a drum on each end. In the centre of the shaft is a Clarke-Chapman twelve-horse-power motor running at 590 revolutions per minute. The motor is connected to the shaft by skew gearing. It can be controlled from either end of the shaft, a controller being placed on each side of the vessel. In addition to the electric winches there are sixteen steam winches installed in various parts of the ship for handling the cargo. These winches were built by John H. Wilson, of Liverpool, England.

The capstans are driven by two sets of eighty-horse-power engines, located in the forward part of the ship. These engines drive a countershaft through a set of bevel gears on the engine shaft and the capstan is driven from the countershaft by

Digitized by Google

means of a worm and wheel. The capstan engines were built by Napier Brothers, of Glasgow.

The refrigerating plant consists of three duplex double-acting compressors. The compressor cylinders are six by ten inches. The steam cylinders are fourteen by ten inches, and operate under 150 pounds steam pressure at 100 revolutions per minute. These three engines cool the rooms in which perishable portions of the cargo are carried. A fourth single engine of the same size as the duplex engine cools the provision room and the drinking water.

Fire protection is furnished by means of pipes arranged to blow steam into the hold, and by four direct-acting steam fire pumps. These pumps are nine by ten by twelve inches, and deliver water to 200 connections for fire hose in different parts of the ship.

The third-class quarters are ventilated by means of the Thermo-Tank Ventilating Company's system. Air is forced through coils, which may be heated if desired, by means of Sirocco fans directly driven by electric motors. Sirocco fans are also installed for ventilating the engine room. These fans are driven by five-horse-power motors.

The openings between the various water-tight compartments are closed by water-tight doors built on the Stone-Lloyd system. The doors are closed by hydraulic pressure from the bridge. At each door is a handle by which the door may be opened, in order to allow any one to escape from the compartment. The door will close, however, the instant this handle is released. The system is under 600 pounds pressure per square inch, and closes a door in about twenty-four seconds. A tell-tale system on the bridge shows the officer in charge just what doors are closed and which are open.

A telephone system is installed in the ship, connecting the wheel-house, the chief engineer, the captain's quarters and the tiller compartment.

The ship is in charge of Captain Robert Warr, and the chief engineer is Mr. John Currie.

The World's Production of Coal.

The world's coal production in 1903 reached the total of 864 million long tons, of which the United States supplied more than any other country. Statistics received by the Department of Commerce and Labor, through its Bureau of Statistics, indicate that the world's output of coal in 1903 was 864 million tons, of which the United States produced 319 million tons, as against 230 millions produced by Great Britain, 160 millions by Germany, thirty-nine millions by Austria-Hungary, and thirty-five millions by France.

The world's growth in coal production is coincident with its growth in commerce, indicating the close connection between coal supply and industry and transportation. From 1800 to 1850 the world's production of coal was relatively small, and only increased from eleven and one-half million tons at the beginning of that century to eighty-one millions in 1850; the world's commerce meantime increased from one and one-half billions of dollars to four billions. Since 1850 there has been a marked increase in the production of coal, and an equally notable expansion of international commerce. Coal production has, in the last half century, increased tenfold, and commerce more than fourfold, the former increasing from eighty-one million tons in 1850 to 864 million tons in 1903; the latter from four billion dollars in 1850 to twenty-two billions in 1903.

The rapid growth in the world's production of coal is even surpassed by the record of the United States. In 1800, when anthracite coal was practically unknown in the United States, the world was producing over eleven million tons of coal per annum. In 1870, when the world's coal production amounted to 213 million tons, the United States supplied but thirty-three millions, or about fifteen per cent of the whole, being exceeded by Great Britain with 110 million tons, and Germany with over thirty-three millions. From 1870 to 1903 the growth in the world's coal production has been from 213 millions at the first named year to 864 millions in 1903, a gain of 651 million tons, or over 300 per cent. For the United Kingdom the growth has been from 110 million tons in 1870 to 230 million tons in 1903, a gain of 120 million tons, or 110 per cent; for Germany, from thirty-three million tons in 1870 to 160 millions in 1903, an increase of 127 million tons, or 385 per cent; and the United States from thirty-three millions in 1870 to 319 millions in 1903, an increase of 286 million tons, or 867 per cent, and forming in that year thirty-six and one-half per cent of the world's coal supply, as against fifteen per cent in 1870.

The United States, the United Kingdom, and Germany supplied four-fifths of the world's coal product, the share contributed by these countries being: United States, thirty-seven per cent; United Kingdom, twenty-seven per cent; and Germany, eighteen and one-half per cent. These countries also lead in the production of domestic manufactures, and in like rank in the exportation of domestic products. For 1903, exports of domestic products from the countries named were, Germany, 1.20 billions of dollars; United Kingdom, 1.42 billions; and the United States, 1.44 billions.

The following table shows the world's production of coal and the share supplied by the United States, at quinquennial periods, from 1870 to 1900, and annually from 1900 to 1903:

Year.	World's Production Million Tons.	Produced by United States.	
		Total. Million Tons.	Per Cent.
1870.....	213.1	32.9	15.4
1875.....	275.4	46.7	17.0
1880.....	330.3	68.0	20.6
1885.....	399.8	99.2	24.8
1890.....	503.3	140.9	28.0
1895.....	575.1	172.4	30.0
1900.....	755.4	240.8	31.9
1901.....	777.4	261.9	33.7
1902.....	788.9	269.3	33.9
1903.....	864.1	319.1	36.9

Of this output of 319 million tons by the United States, practically the entire amount is consumed in the domestic market, as the exports of coal have averaged but about five and one-half million tons per annum during the last five years, and have never exceeded more than three per cent of the total product of a single year. Imports of coal into the United States are also small, and in the last calendar year amounted to but about one and one-half million tons, as against three and one-third millions in 1903, having averaged about one and one-half millions per annum in the decade from 1894 to 1903. The United Kingdom, however, is the world's greatest exporter of coal, her annual exports having ranged between thirty-five and forty million tons, out of a total product of from 200 to 230 million tons during the last five years.

Financial Statement of the United States Telephone Company.

The financial statement of the United States Telephone Company for the year 1904 shows total assets of $4,952,833.63. This compares with $4,685,048.22 in 1903. There is a surplus of $56,125.88. The gross earnings for 1904 were $418,308.07, as against $379,235.10 in 1903. The total expenses and taxes were $266,139.83, making the net earnings, $152,168.24. After making deductions for various charges, rentals and interest, there is a balance surplus of $40,905.62 for the period.

Digitized by Google

The Osmium Lamp.

The following is an abridged translation of a paper on the osmium lamp read by Herr Fritz Blau before the Elektrotechnischer Verein, of Berlin, on January 24:

The total energy radiated by a heated body is proportional to the fourth power of the absolute temperature of the body. As the temperature increases, the percentage of the short waves emitted, as compared with those of long length radiated, increases also very rapidly; but the absolute value of this percentage varies for different bodies, being smallest in so-called "black" bodies, but comparatively high in bodies with a metallic lustre and smooth surface. Only these short waves, it need hardly be said, are observed as light. An efficient light-giving body must, therefore, withstand very high temperatures; its radiating surface, at a given efficiency, should be as large as possible; the substance of the filament should be transparent or white to minimize the effects of blackening; the surface of the filament should not become blacker or rough with use, and its resistance should increase with increasing temperature.

Osmium, generally in the form of osmium-iridium, is found in platinum ores and also in gold sand with gold and silver. It is at present usually obtained by alloying the residue which remains when platinum is dissolved in aqua regia, with metals, such as zinc, lead or tin. The osmium-iridium passes thereby into a finely divided state, and if it is now heated in a current of oxygen it will split up into osmium tetroxide and iridium. Osmium may then be obtained by treating the osmium tetroxide with any reducing agent.

When Herr Auer von Welsbach invented the osmium lamp some six years ago, he found it impossible to draw osmium in form of wire, and he first tried the expedient of coating platinum wire with osmium and evaporating subsequently the greater part of the platinum. It was observed, however, that a platinum-osmium alloy was formed which—when containing more than four per cent of platinum—began to melt when the platinum was being evaporated. In order to keep the percentage of platinum below this figure, the finished filament had to be made about five times thicker than its platinum core. As uniform platinum wire was not obtainable in thickness less than 0.02 millimetre, it will readily be seen that the osmium filaments could not advantageously be made in diameters below 0.1 millimetre. Such filaments, however, are not suitable for lamps consuming less than one ampere.

The next and final step was to mix most finely divided osmium with certain organic binding substances to a thick tenacious paste. The paste is forced under high pressure through a diamond or sapphire die on to a card which is moved about in such a manner that the filament is deposited in loops. After drying, the organic binding substance is carbonized by heating the filament in vacuo. This

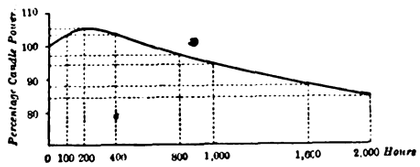


FIG. 1.—PERCENTAGE VARIATION IN CANDLE-POWER OF 37-44-VOLT AND 25-32 (HEFNER) CANDLE-POWER OSMIUM LAMP.

porous filament, rich in carbon, is then gradually heated to an intense incandescence by an electric current in an atmosphere containing much steam and a certain quality of reducing gases. The carbon of the raw filament changes into carbon oxide and carbon dioxide, and after a relatively short time the filament consists of pure, or very nearly pure, osmium only, the percentage of carbon being insignificant. Although the density of the filament has greatly increased during this process, the filament is still porous and its surface is far from smooth. After trying unsuccessfully several means of connecting the filament to the platinum leads, it was found that a very satisfactory method was to fuse them together by

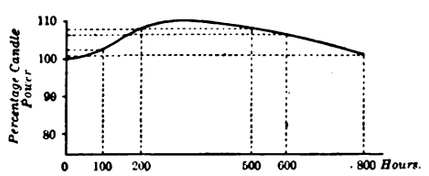


FIG. 2.—PERCENTAGE VARIATION IN CANDLE-POWER OF 110-VOLT, 32 (HEFNER) CANDLE-POWER OSMIUM LAMP.

the electric arc. Osmium is brittle when cold, but soft when heated, and for this reason the lamps as made at present are required to burn in a definite position.

When the manufacture of this lamp was taken up by the Deutsche Gasglühlicht Actiengesellschaft, the highest voltage that the lamp could stand was twenty-seven volts. After the lamps had been perfected to burn at thirty-seven volts, they were put on the open market. The lamp voltage was soon after brought up to forty-four volts, and during the last few months a considerable number of fifty-five and seventy-three-volt lamps have been sold. Quite recently 110-volt lamps have appeared.

The filament of an osmium lamp for thirty-seven volts, twenty-five candle-power (Hefner units) consuming one and one-half watts per candle-power, has a diameter of 0.087 millimetre and a length of 280 millimetres. The radiating surface is from three square millimetres to 3.2 square millimetres per candle-power. If an ordinary glow lamp be run at one and one-half watts per candle-power, its radiating surface per candle-power is only 1.6 square millimetres. The carbon filament, therefore, must be both hotter and "blacker" than the osmium filament. With an increase of voltage of ten per cent the current increases 6.5 per cent in the case of the osmium lamp, and twelve per cent in the case of the carbon filament lamp The corresponding increase in illuminating power is forty per cent and eighty per cent, respectively.

It is not possible to state definitely the life of an osmium lamp, but 5,000 hours have been repeatedly exceeded. Figs. 1 and 2 represent the relationship of illuminating power to time—for a thirty-seven-volt lamp, and 110-volt lamp, respectively. Blackening of the bulb is very rare (observed in ten per cent only of the lamps investigated so far).

The surface of the lamp filament is at first somewhat rough, but it gradually becomes smoother, and this is the reason why the candle-power increases during the first 250 hours or so. Before the lamp is ready for sale, it is burned in the factory for several hours in order to bring the lamp up to an approximately steady state.

If the lamp is run at less than one and one-half watts per candle-power, the structural changes in the filament occur too rapidly for practical purposes. Nevertheless, lamps consuming one watt per candle-power only have been observed to burn for several hundreds of hours without decrease in light. When exposed to hard shocks, the osmium lamp filament is somewhat more liable to break than the carbon filament, but if properly packed the loss through breakages in transit is small, being only about one and one-half per cent. These lamps stand the shocks of railway carriages and omnibuses very well. The osmium lamp is efficient also for very low voltages and a large number of two-volt lamps for mines are in use in connection with portable accumulators. For a long time it was not possible to make thin filaments, but recently it has become feasible to reduce the diameter down to 0.03 millimetre.—*Electrician (London), March 3.*

Digitized by Google

Special Report on Street and Electric Railways.

The Bureau of the Census has published an exhaustive report on street and electric railways for the year ending June 30, 1902, prepared under the supervision of Mr. W. M. Steuart, chief statistician for manufactures.

In June, 1903, a preliminary report on this subject was issued in the form of a Census bulletin giving the principal statistics for all street and electric railways doing a public business in the United States.

The report just published contains, in addition to detailed statistics, more than two hundred pages of text prepared by two expert special agents, Mr. T. Commerford Martin, of New York city, and Mr. E. Dana Durand, of the Bureau of Corporations. This text discusses the development of the modern street railway system, the generation and distribution of electric current, car equipment, and a variety of other features upon which the technical efficiency and economy of the street railway service depend. It also treats of methods of installing and operating interurban systems, handling passengers, freight, mail express, etc. Statistics are presented showing the growth of mileage and traffic, and the effect of development upon the distribution of the population.

During the twelve years from 1890 to 1902 the total single track mileage for street and electric railways increased from 8,123 to 22,577. This increase was due partly to the establishment of new railways, but principally to the extension of the lines already existing.

The mileage of the electric lines increased from 1,262 to 21,907, while there was a decrease for the lines operated by other motive power, the decrease being from 488 to 241 miles for cable lines, from 711 to 170 miles for steam lines, and from 5,662 to 259 miles for lines using animals for their motive power.

In proportion to its area, Massachusetts has much more electric railway mileage than any other state.

The average length of track per operating company increased from 10.56 miles to 27.63 miles during the same period.

The increase in mileage was accompanied by corresponding increases as follows: cost of construction and equipment, from $389,357,289 to $2,167,634,077, or 456.7 per cent; operating expenditures, from $62,011,185 to $142,312,597, or 129.5 per cent; number of passenger cars, from 32,505 to 60,290, or 85.5 per cent; number of fare passengers carried, from 2,023,010,202 to 4,774,211,904, or 136 per cent; and number of employés, from 70,764 to 140,769, or 98.9 per cent.

There were 66,784 cars of all classes in the United States in 1902. Of this number, 60,290 were passenger cars and 6,494 were cars used for express and other purposes. Of the passenger cars, 32,658 were closed, 24,259 were open, and 3,134 were combination closed and open cars, while 239 were combination passenger and express cars. There were 1,114 cars devoted solely to express, freight, and mail business.

An interesting development in electric railway service is the construction and equipment of sleeping cars for use on long-distance lines in Ohio and Indiana.

The largest number of cars of all classes for any state was reported for New York, the number being 14,040.

About half of all the cars in the United States were equipped with heating apparatus, 19,021 being heated by electricity and 11,138 by stoves, hot water, or other contrivances. Many railways, however, have two sets of cars—one for use in summer, and the other in winter—so that in winter the proportion of the cars in operation equipped with heating apparatus is larger than these statistics would at first glance indicate.

The report shows also that 62,369 cars, or 93.4 per cent of the total number, were lighted. Of these 55,703 were furnished with electric lights.

The total number of passengers carried was 5,836,615,296, of which 1,062,403,392, or 18.2 per cent, were transfer passengers.

The average number of rides per inhabitant advanced from thirty-two in 1890 to sixty-three in 1902 for the country as a whole, while the advance for the urban population was from 98 to 168. The proportion of rides to the total population is greatest in the District of Columbia, where the whole population is urban, and is next greatest in Massachusetts, while New York ranks third. California has the highest proportion of rides to the urban population, largely as a result of the hilly streets in San Francisco, which compel general resort to this method of travel.

Five cents is the almost universal rate of fare for the urban lines in the United States, although more than one-third of the companies offer lower rates under certain conditions. Frequently six tickets are sold for twenty-five cents, but occasionally a larger number is required to be purchased in order to secure a low rate. Some companies give reduced fares to workingmen during certain hours of the day and to children going to and from school, while a few other companies carry children between certain ages at a reduced rate.

Considerable competition has arisen between the steam roads and the electric interurban lines. While the steam roads have the advantage of greater speed, the frequent service, convenient stops, and low fares of the electric roads have, in many instances, seriously affected the local traffic of steam railways. Statistics show that in 1902 the street and electric lines of the United States carried more than seven times as many fare passengers as the steam railways. Such a comparison, however, means little, since steam railway journeys are, as a rule, much longer than those on street railways. In 1902 the average distance traveled by passengers on the steam roads was 30.3 miles. No definite average can be given for the distance traveled by passengers on the street lines, since no records have been kept by the street railway companies relative to this point. The receipts from passengers were $392,963,248 for steam railways, and $233,821,548 for street railways.

In 1902 the passenger earnings of the street railways were 94.5 per cent of the total receipts; the remainder of the revenue was derived from the sale of electric current, from freight, mail, and express service, and from advertising and other miscellaneous sources.

The average number of salaried officials and clerks employed by the street railway companies of the United States in 1902 was 7,128 and the average number of wage-earners was 133,641. The salaries paid amounted to $7,439,716, and the wages to $80,770,449. The wages alone formed 56.8 per cent of the total operating expenses of the street railway companies.

By far the most important groups of employés are conductors and motormen. These two classes, which are approximately equal in number and in wages received, constituted about three-fifths of the total number of wage-earners. The most common rate of pay was two dollars per day.

The highest wages were reported in Montana and the lowest in Alabama, Arkansas, Georgia, North Carolina, and Tennessee.

The accident statistics show that during the year 1,218 persons were killed and 47,429 were injured by street railway

Digitized by Google

lines. Of the total number killed 265 were passengers, 122 were employés, and 831 were persons on foot or riding in vehicles other than street cars; of the injured 26,690 were passengers, 3,699 were employés, and 17,040 were other persons. These numbers form only an inappreciable percentage of the total number of passengers carried. One passenger was killed for every 18,015,894 fare passengers carried, and one was injured for every 178,876 passengers. The rate of accident for the wage-earners was one killed out of 1,095 and one injured out of thirty-six. This rate is very much lower than the rate for steam railroads, for which one employé out of every 401 was killed and one out of every twenty-four was injured.

The reform in the direction of safety provisions for steam railway crossings has of late years been quite considerable in all large American cities, and has been carried on at an enormous expense, so that, of the steam railway crossings now unprotected, a large proportion are to be found in rural districts. The report states that in 1902 there were 4,481 crossings, of which more than half were protected; 1,967, however, were still without any form of protection, not even being supplied with bells or watchmen.

One of the most important factors in street railway progress has been the combination of formerly independent railways into great systems. Fifteen or twenty years ago most of our large cities were served by several separate animal power railways and there was usually no competition between these independent companies in the matter of fares. The introduction of mechanical traction, especially electric traction, developed a much stronger tendency toward consolidation than existed before. In most cases the establishment of a unified system made it possible to carry passengers more nearly where they wanted to go and to carry them longer distances; this augmented the traffic of the railways to such an extent that it proved decidedly profitable to the companies.

Legislation permitting municipalities to own and operate street railways has recently been enacted in a number of states. There is, however, no instance in the United States of municipal operation of a street railway. The leading instances of municipal ownership and private operation are the subways in Boston and New York.

This report gives some interesting illustrations of the extent to which the outer areas of cities have increased through the development of the street railway. For instance, the population in Manhattan borough of New York city increased from 1,441,216 in 1890 to 1,850,093 in 1900, or 408,877. Of this increase, 231,556, or considerably more than one-half, took place in that part of the island lying north of Eighty-sixth street, the population in this section having practically doubled during the decade. This district is situated about seven miles from the southern extremity of the city, and the great majority of its breadwinners do business downtown and make daily use of the street railways.

In Bronx borough the population increased from 88,908 to 200,507, the increase being mainly along the street and elevated railway lines. In Brooklyn and Queens boroughs the increase in population was thirty-nine and seventy-six per cent, respectively, and in each case the advance was mainly in the outlying wards.

Another conspicuous illustration of this influence is furnished by the city of Boston. Of the seven wards lying nearest to the business centre of Boston, five showed a decrease in population, while in the outlying wards there was an increase of 93,395 inhabitants, or nearly five-sixths of the total increase of Boston. Moreover, the population of the immediately adjacent cities of Cambridge, Somerville, Chelsea, and Brookline increased much more rapidly than that of the older parts of Boston. A very considerable proportion of the breadwinners, both of the outlying wards and of the adjacent cities, are employed in the business district of Boston and depend upon the electric railways for their transportation.

The change in the distribution of the population of Philadelphia since 1890 has been remarkable. Almost all of the wards in the heart of the city show a decrease in population, while several of the large outlying wards to the west and north of the business centre have added greatly to the number of their inhabitants.

Chicago, Cleveland, and other cities show this influence of railways in scattering population.

Even in medium-sized cities the street railways encourage the distribution of population and thus reduce the evils of overcrowding and unsanitary surroundings.

Moreover, the electric railway has given a powerful impetus to suburban life, not only for residence but also for manufacturing purposes. The effect of this influence is shown in the increased population of the suburbs of Boston and Philadelphia, two cities whose suburban residents are served largely by electric railways. Other cities showing this influence in a marked degree are St. Louis, Milwaukee and Cleveland.

The Ninth Annual Meeting of the Iowa Telephone Association.

The ninth annual meeting of the Iowa Telephone Association was held at the Hotel Chamberlain, Des Moines, Iowa, March 14, 15 and 16. The following programme was presented:

Tuesday, March 14, two P. M.—Organization. Appointment of committee on credentials. President's address, J. C. Sullivan, Creston. Address by W. H. Barth, of the Sheldon School of Scientific Salesmanship, on "The Science of Modern Business Building."

Wednesday, March 15, nine A. M.—C. H. Judson, Council Bluffs, "The Old Way and the New." Oscar Knell, Perry, "A Generator Call, Lamp Line Board." Charles E. Wells, Marion, Kan., "The Kansas Supreme Court Decision."

Wednesday, March 15, two P. M.—N. T. Guernsey, Des Moines, "The Iowa Assessment Law." J. M. Plaister, Fort Dodge, and R. D. Redman, "Magneto Multiple Versus Central Energy Multiple Boards for Small or Moderate-Sized Exchanges." C. A. Hollis, Hudson, "The Relations That Should Exist between Farmers' Mutual and Other Independent Telephone Companies."

Thursday, March 16, nine A. M.—J. E. Shoemaker, Waterloo, "The Development of the Toll Business, and the Checking of Tolls." James B. Hoge, Cleveland, Ohio, "The National-Interstate Telephone Association." New business and election of officers.

On Thursday afternoon a visit was made to the new exchange of the Mutual Telephone Company, and on Thursday evening the annual banquet was held.

F. F. Proctor is ever in the front in the way of providing timely attractions to his patrons. On the evening of March 4, inauguration day, there were presented at all of the Proctor houses in New York views of President Roosevelt and the inauguration, taken in Washington earlier in the day. A special corps of trained men were assigned to handle the photographs, their development into lantern slides, and their delivery at the respective houses. These snap-shot views are decidedly popular.

Digitized by Google

Oil for Insulating Purposes.

Under the title, "Oil for Insulating Purposes," the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has published a special pamphlet written by C. E. Skinner, which contains a great deal of practical information. Only one phase of the wide range of service for which the oil may be used as an insulating medium is taken up—that of its use for transformer and oil-switch work. The following paragraphs have been abstracted, as being of especial interest to our readers:

All oils—mineral, vegetable and animal—when pure, are good insulators. There is a wide difference in the insulating qualities of various mineral oils, but this difference seems to be more an index of the purity of the oil than an inherent difference due to variations in the chemical composition of the oil itself. By purity is meant freedom from acid, alkali, water or foreign matter of any kind. The method usually employed in determining the insulating value of an oil is to test its dielectric strength. Satisfactory insulation resistance measurements are difficult to make, and while showing something of the quality of the oil, are not of as much value as dielectric tests. As the actual values of the dielectric strength obtained vary greatly with the testing conditions, it is best to use a standard method and always follow this out carefully. Satisfactory comparative values may then be obtained and the general insulating values determined with sufficient exactness for all practical purposes.

The usual method of testing consists of immersing a spark-gap in the oil, the gap being set at a known distance, and gradually raising the potential until rupture occurs. In making such tests the following points should be observed:

The spark-gap terminals should always be of the same shape and nicely polished, especially if the gap is quite small. Slight roughness or points on the testing terminals will change the apparent dielectric strength of the oil.

The gap should always be at the same depth in the oil. A variation in depth, consequently a variation of the pressure, will cause a variation in the tests. The apparent insulating strength increases with the pressure.

The testing voltage should always be applied in the same manner. It is preferable to fix the gap and apply an increasing voltage until breakdown occurs; or a constant voltage may be applied and the gap gradually shortened until the distance becomes such that rupture occurs. In the former method the voltage may be very gradually increased as may be done by controlling the field of the generator, or it may be applied in steps either with or without opening the circuit between steps; but for comparative purposes one method only should be used.

The time of application of the voltage should be as nearly as possible the same, especially the time consumed after the voltage reaches, say, fifty per cent of the dielectric strength. A longer time will give lower results, especially if the oil contains impurities which may "line up" between the testing terminals.

It is a good plan to make more than one test on each sample of oil, as the test value frequently increases with the first few tests, especially if the oil is well shaken after each test so as to thoroughly mix with the oil the carbon formed by the arc and not allow it to concentrate between the testing terminals. When so shaken it must be allowed to stand until free from air bubbles before another test is made. This increase in dielectric strength seems to be due to the drying effect or to the burning out of impurities in the oil. The best oils do not usually show much increase with repeated tests. When the oil becomes very black and dirty from repeated tests the dielectric strength drops rapidly.

The amount of oil used for each test should be the same in every case, especially if more than one break is made in each sample. It is obvious that the carbon formed by the burning of the oil will be disseminated through the oil, and that the results will depend in some measure upon the amount per cubic inch of oil. It follows from the above that if more than one test is to be made on a given sample, the amount of energy expended by the arc formed due to the rupture of the oil should be the same as nearly as possible for each break. It is best to limit this to a comparatively small amount by a fuse or circuit-breaker in the primary of the testing transformer, arranged to open the circuit on a comparatively small current. By using small currents the work of keeping the terminals clean is much facilitated.

The frequency and the electromotive-force wave form of the testing circuit should be kept the same in the successive tests. It was pointed out some years ago by Professor Elihu Thomson that oil is not as good an insulator for low as for high frequencies. There is, however, little variation for commercial frequencies. It is well known that a pointed or saw-tooth electromotive-force wave will break down insulation of all kinds more readily than a flat, smooth wave of the same square root of mean square electromotive force. The use of a resistance for varying the testing voltage is therefore very objectionable.

All vessels and apparatus used must be kept perfectly clean. A single fibre in the oil may reduce the dielectric strength greatly if it happens to "line up" between the terminals. A small amount of moisture, as will be shown later, is particularly objectionable on account of the very great reduction which it may make in the insulating value of the oil.

It is best to allow the oil to stand a short time after pouring into the testing vessel, as the bubbles of air which are carried with the oil in pouring in, or due to the oil being agitated, will lower the apparent dielectric strength.

As a convenient method of testing, the author has devised a testing cup which is shown in the accompanying illustration. This consists of a 200-cubic-centimetre graduated glass cylinder one and three-eighths inches inside diameter, with a hole drilled through the bottom through which the lower terminal is inserted. The testing terminals consist of one-half inch diameter brass balls fastened to three-sixteenths-inch rods. The upper rod passes through a clamp which is connected to a micrometer screw actuated by a milled head. The lower terminal should fit in a socket so that it may be readily removed for cleaning. The bottom of the cup is made oil-tight by the use of gaskets where the lower rod passes through the cup. An extension of the lower rod comes in contact with a spring set in the base of the stand to which the line terminal is connected by means of a convenient binding-post. Stops are provided so that the oil vessel may always be placed in the same position. The upper rod may slide up and down easily when the clamping screw is free, or may be engaged with the micrometer screw at any point for adjusting the gap. All parts are therefore readily accessible for cleaning, and the zero point of the gap may be quickly adjusted for each test by allowing the upper rod to slide down so that the terminals are in contact and then clamping to the micrometer screw. The apparatus is always filled to the 200-cubic-centimetre mark (requiring a little less than 200 cubic centimetres of oil for each test). The gap is adjusted to

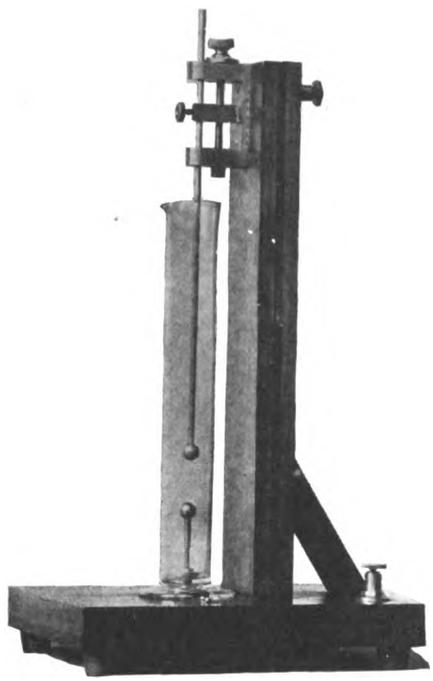
Digitized by Google

any convenient amount, usually 0.15 of an inch, and the electromotive force is raised gradually until the breakdown occurs. After trying numerous forms of testing apparatus for this purpose this method has been adopted as the most convenient, and it has the advantage of requiring a comparatively small amount of oil for each test.

Mineral oils begin to evaporate slightly at a temperature somewhat below their flashing point and the evaporation is quite rapid at the flashing point and above. It is therefore essential that a transformer oil have a flash test sufficiently high so that evaporation will not take place at the ordinary running temperature of the transformer. The evaporation test, if made at a temperature approximately 100 degrees centigrade, will also drive off any moisture which may be present in the oil. In the case of high flash test oils the evaporation test at 100 degrees centigrade may therefore show approximately the amount of moisture present in the oil. The evaporation test is not so necessary as the insulation and flash tests, but such test should be made occasionally on oil which is used for transformer work. A convenient method of making this test is to place a small amount of oil—usually approximately two grammes—in a small porcelain crucible and heat this over a water bath at a temperature of approximately 100 degrees centigrade for ten or twelve hours, then determine the percentage evaporation by loss in weight.

Moisture—The deteriorating effect of moisture on the insulating quality of an oil is very marked. As there are a great many ways in which the oil may take up moisture or moisture may be introduced into the oil, tests for moisture become very important. A very easy and satisfactory method of making test for moisture has been suggested to the author by a prominent oil chemist. The test consists in placing a small amount of oil in a cup, into which is plunged a piece of iron or other metal which is heated to a temperature just below a dull red heat. Any hissing or crackling noise indicates the presence of moisture. Another method of testing for moisture is to place a small amount of anhydrous copper sulphate in a test tube and then fill the tube with the oil to be tested. After thoroughly shaking, a bluish tinge in the copper sulphate will indicate the presence of moisture in the oil.

It is difficult to determine the exact amount of moisture in oil when the amount is small, and this is usually not necessary as it is sufficient to know qualitatively whether or not moisture is present. In making test for the effect of different percentages of moistures in the oil it was found necessary to thoroughly dry the oil, then introduce moisture in the form of water in minute quantities in a closed vessel and very thoroughly agitate the oil so as to disseminate the water through it. Moisture introduced into the oil to the amount of 0.06 per cent reduced the dielectric strength of the oil to about fifty per cent of the original value when it was known to be free from moisture, and that there was very little further decrease in the dielectric strength due to increasing the amount of moisture introduced in the form of water.



OIL-TESTING CUP.

In many transformers waterproofing compounds are used which may or may not be soluble in the oil in which the transformer is immersed. These waterproofing compounds are necessarily good insulators. The materials used may have either an asphalt, coal tar or linseed oil base. When asphalt or coal tar base compounds are used they are always somewhat soluble in oil, especially when the oil is hot. Compounds having a linseed oil base, when thoroughly dry, are practically insoluble in mineral oil. When large quantities of waterproofing material, with asphalt or coal tar as a base, are used in transformers, the compound resulting from the combination of the waterproofing material and the transformer oil may form a pasty mass, which will close up the ventilating spaces and consequently cause dangerous heating of the transformer due to lack of ventilation. From an insulation standpoint there is no objection to the waterproofing compound being dissolved out after the transformer is put in service, provided the design is such that the ventilating spaces which are essential to the cooling of the transformer are not filled up. Any compound which is soluble in mineral oil should not be depended upon for cementing parts of the transformer or for closing spaces when this compound may be dissolved out by the oil later. The linseed oil compounds are waterproof in the sense that they will not allow water to pass through where there is an unbroken film; but they are not waterproof in the same way that asphalt and coal tar base compounds are waterproof, *i e.*, they are not "water-repellant." When transformers are treated with linseed oil compounds more care must be taken to prevent the absorption of moisture than when the other class of compounds is used. It is to be hoped that the varnish chemists will be able to give us a compound which has all the waterproofing qualities of the asphalt and coal tar bases, but which will be entirely insoluble in mineral oil.

The requirements of oil for oil switch work are very similar to those of oil for transformers. As stated before, oil having a very low "cold test" may be desirable for use in switches which are intended for outdoor work; but as this use is comparatively small at the present time this point need not receive consideration in connection with the general application of oil to oil switch work.

It has been stated above that the more fluid the oil for transformer work the more rapid will be the cooling of the transformer on account of the more rapid circulation of the oil in the transformer tank. In switch work a more viscous oil seems to give better results, possibly on account of the fact that it is not so easily displaced by the arc as by the lighter oil. Otherwise the requirements throughout may be stated as being exactly the same for both transformer and switch work, and it has been found possible to manufacture an oil which is entirely suitable for both purposes.

It sometimes happens that through faulty bushings or lack of proper precautions in closing up the case when the transformer is installed, water will find its way into the case. This always settles to the bottom of the case and when in sufficient quantities will rise so as to reach the coils, causing a burn-out. In

Digitized by Google

high-tension transformers the presence of water in the oil is dangerous and may cause burn-outs even though the water does not reach the transformer windings. If water is suspected it may be readily found by inserting a thin glass tube down the side of the transformer to the bottom of the case, the upper end of the tube being stopped with the finger until the tube strikes the bottom. The finger is then removed and the oil allowed to enter the lower end of the tube. The upper end is then closed and the water from the bottom, if any be present, may be drawn out. The contents of the tube should then be discharged into a tall bottle or test tube, and if water is present in any quantity it should at once be apparent to the eye. The remedy in this case is to remove the oil from the transformer and substitute oil which is known to be free from water.

Oil which contains water is not injured for use provided the water is removed. This may be done by allowing the water to settle to the bottom, drawing off all this water and then drying out the moisture contained in the oil by heating it to a temperature of 100 degrees to 110 degrees centigrade until the hot iron test shows no moisture present. A more delicate test for moisture is made by breaking down the oil with high potential. Dry oil should stand a test of 20,000 volts or more and oil is frequently found which will stand 25,000 to 33,000 volts under these conditions (striking distance 0.15 inch).

Protective Apparatus.

The March issue of the *Electric Club Journal* contains an interesting article entitled "Protective Apparatus," by N. J. Neall. This details a method of investigating lightning arrester operation. In the summer of 1902 the Utah Light and Power Company offered Mr. Percy H. Thomas, of the Westinghouse Electric and Manufacturing Company, an idle branch of its transmission line for experimentation with lightning and static disturbances. This branch, known as the Sandy line, is some six miles in length, and situated south of Salt Lake City in a valley lying north and south, and bounded on both sides by mountains rising 2,000 feet or more. The particular value of this portion of the country for the investigation of lightning arrester operation lies in the fact that charged clouds and storms, passing east and west over these mountains, exhibit a pronounced tendency to discharge, thus affecting many transmission lines below. This idle line was disconnected from the main lines and absolutely without voltage. The experimental work was limited to the placing of spark-gaps between the line and the ground, and the interception of a standard choke coil in parallel with the spark-gap. The gaps were given various openings, and tell-tale papers were inserted to note discharges.

About September 1 a heavy storm occurred, and a very complete record of the discharges was obtained. In investigating the tell-tale papers after the storm, the papers are usually held to the light, some of the punctures being so fine as to be almost invisible. These tell-tale papers were greatly magnified and photographed so that an opportunity was afforded for a study of the detail of the punctures.

The punctures showed an almost total absence of charring around the end of the puncture. Some of the smaller holes were absolutely without current trace, the larger holes showing a very slight browning. The important information conveyed by this phenomenon was the substantiation of the theory of induced atmospheric charges, the exceedingly high-potential thereby imposed on the lines, and the value of the gaps to earth to relieve this strain.

The real test of a lightning arrester must be made in service. The materials necessary are light-weight bond papers of uniform texture, which should be inserted in the gaps to be investigated, and so shaped as to make it impossible for a discharge to pass without puncturing them. Each arrester on the system should have several of these papers, carefully dated, marked with the location on the line, and of sufficient size for any remarks as to the particular events registered thereon by a static discharge.

Electricity for Rio.

Announcement has been made of the formation of the Rio de Janeiro Tramway, Light and Power Company with a capital of $25,000,000 and a bond issue of a like amount. The company is organized for the purpose of developing a great water-power plant near Rio de Janeiro, and it is planned from a plant already in process of construction to transmit electric power to the city for street railway, industrial and lighting purposes.

A number of New Yorkers, including William L. Bull, of Edward Sweet & Company, Dr. F. S. Pearson, and Percival Farquhar, are interested in the formation of the new company, together with Sir William Van Horne, of Montreal, and William MacKenzie and E. R. Wood, of Toronto. The bonds are all underwritten, the Canadian Bank of Commerce, the Bank of Montreal, the National Trust Company, of Toronto, and the Guaranty Trust, of New York, being interested in the underwriting. The company has a concession which gives it the exclusive right to transmit to Rio de Janeiro electricity developed from water power.

A Change in the United Telpherage Company.

The Dodge Coal Storage Company has forwarded to this office the following notice:

After this date, the business of the United Telpherage Company will be conducted by the Dodge Coal Storage Company, as a coalescence of interests has been effected.

Therefore, all communications relative to the business of the United Telpherage Company should be addressed to the

United Telpherage Department,
DODGE COAL STORAGE COMPANY,
No. 49 Dey Street, New York,

where they will receive prompt attention.

Very truly yours,
THE DODGE COAL STORAGE COMPANY,
New York, March 2, 1905.

The United Telpherage Company, under the active and far-seeing management of Mr. H. McL. Harding, attained a commanding position in the electrical field for supplying and installing electrical conveying apparatus. The coalescing of the United Telpherage Company with the Dodge Coal Storage Company can not fail to be of mutual advantage and strength.

Meeting of the American Institute of Electrical Engineers.

The 195th meeting of the American Institute of Electrical Engineers will be held at the chapter room, Carnegie Hall, No. 154 West Fifty-seventh street, New York, on Friday, March 24, 1905, at 8.15 P. M.

The following papers will be presented and discussed:

1. "Line Construction for High-Pressure Electric Railroads," by George A. Damon.
2. "High-Pressure Line Construction for Alternating-Current Railways," by Theodore Varney.
3. "Application of High Pressure to Electric Railroads," by Ernest Gonzenbach.

The Michigan Central (the Niagara Falls route) is distributing an attractive and practical calendar beginning with March, 1905, and ending with February, 1906. The calendar pad is fifteen inches by twenty-two and one-half inches, and the figures are one and one-half inches high. The illustration shows a view of Niagara falls from the Michigan Central trains. All trains passing Niagara Falls by daylight stop five minutes at the Falls View Station. Mr. G. J. Grammer is vice-president and general traffic manager, Chicago, Ill.; R. H. L'Hommedieu, general manager, Detroit, Mich.; C. F. Daly, passenger traffic manager, Chicago, Ill.; O. W. Ruggles, general passenger and ticket agent, Chicago, Ill., and W. H. Underwood, general eastern passenger agent, Buffalo, N. Y.

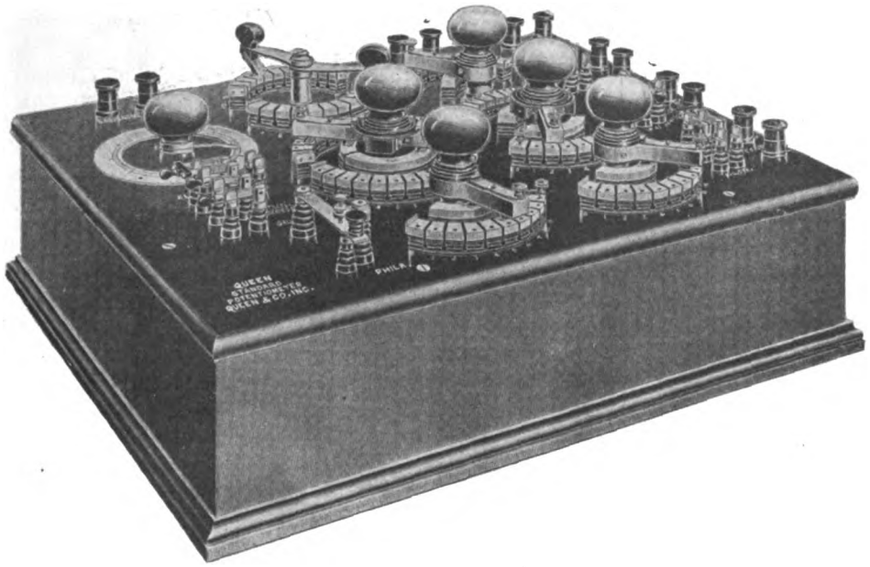
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Queen Standard Potentiometer.

Queen & Company, Incorporated, Philadelphia, Pa., have placed on the market their latest improved electrical testing instrument, which they have designated as the Queen standard potentiometer. The containing-case is of carefully selected, thoroughly seasoned, polished mahogany.



THE QUEEN STANDARD POTENTIOMETER.

The top plate is of heavy rubber sheet of the best grade, polished and engraved with distinct numbers on corrugated rubber blocks. These blocks are also highly polished. This renders the insulating surfaces of extra length, making them easily cleaned and of good appearance. Each of the studs over which the silding contact arm moves is heavily faced on the upper surface, and the brush is mounted in the sliding arm which makes contact with the surface of the stud and ring.

By employing the ring, the necessity of using a stud supporting the handle as a part of the electrical circuit is obviated. The rubber handles are round and easily grasped. The brushes are built up of thin laminations of spring phosphor-bronze, and are accurately ground into contact with the faced stud. Each of these brushes can be removed by slipping aside a steel spring which holds it in place. The switch arms are numbered, and a corresponding number is placed on the end of the brush next to it, so that they can be replaced without difficulty.

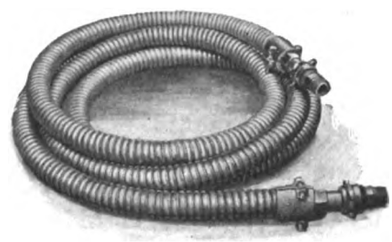
The sliding surfaces are large and ground together to such perfect contact that any variation in this resistance may be disregarded. The moving switch contacts are accessible and readily removable. The resistance coils are wound on metal spools, which are very rigid and permit an even distribution of heat.

Three pairs of terminal binding-posts are provided for various standard cells, one pair being for the Carhart-Clark cell, one pair for the cadmium cell, and the third pair for any standard cell which may be used. In order that the resistance of each cell may be independently determined, a tapered hole is drilled in each stud, in which a traveling plug fits, for connection to outside measuring instruments. The switches are so arranged that one or more standard cells may be connected to their respective terminal boards at the same time. They can not be interconnected, however, nor more than one used at the same time.

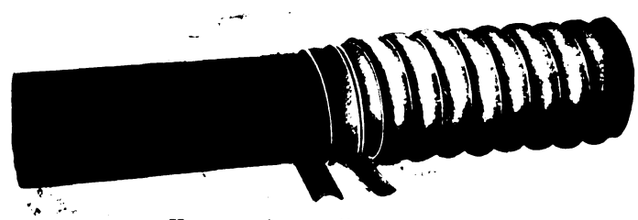
A double-pole, double-throw switch shows at once whether the standard cell or the unknown electromotive force is connected in the circuit. By throwing this switch to the side marked "standard," the strength of the current passing through the potentiometer can be checked. This can be done in the case of the Carhart-Clark and cadmium cell, regardless of where the main switch stands.

Flexible Steel-Armored Hose.

The Sprague Electric Company, 527 West Thirty-fourth street, New York city, has placed on the market a new product, to meet the demand for a steam or air hose which could be absolutely relied upon to withstand mechanical injury. The Sprague company's new product is known as flexible steel-armored hose. This consists of a suitable rubber hose encased in a steel armor, which prevents expansion, and thus greatly increases the life of the hose. It also protects the hose from mechanical injury, and ensures flexibility by making it impossible to flatten or kink when handled. Should over-vulcanization occur during the service of the hose, the steel armor binds the rupture so tightly that very little pressure is lost, and the work in progress does not stop. This permits the hose to be used until a new piece can be obtained.



COIL OF FLEXIBLE STEEL-ARMORED HOSE.



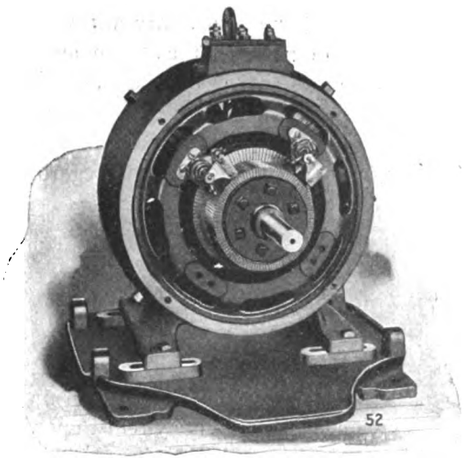
VIEW OF ARMOR CONSTRUCTION.

The Payne Company, Havemeyer Building, New York city, is distributing a reprint from the *Engineering Magazine,* entitled "The Economy of Isolated Electric Plants."

Digitized by Google

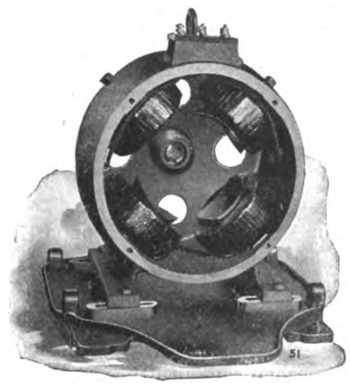
Small Multipolar Motors.

The Diehl Manufacturing Company, Elizabethport, N. J., has placed on the market a line of small multipolar motors.



TYPE "E" MOTOR, FRONT COVER REMOVED.

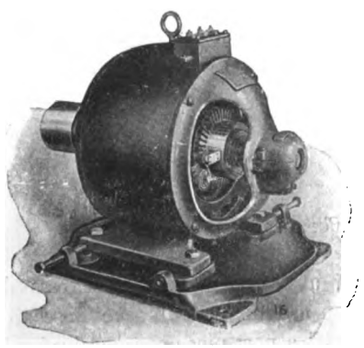
These are compact and symmetrical in appearance, and adapted for special as well as general power purposes. Two types have been designed, designated as



TYPE "E" MOTOR FRAME.

"D" and "E" motors. The accompanying illustrations show both types of motor in assembly and in detail.

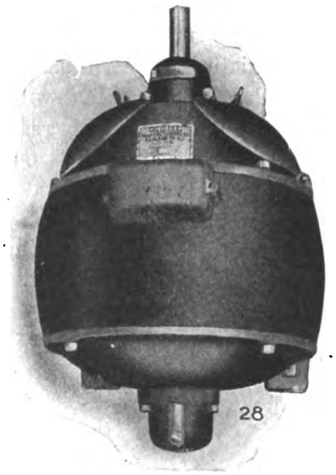
Particular attention has been paid to



TYPE "D" MOTOR, OPEN.

detail of construction, as well as to high efficiency, low heat limits and sparkless operation. The machines run up to twenty-five per cent overload without change in the position of the brushes.

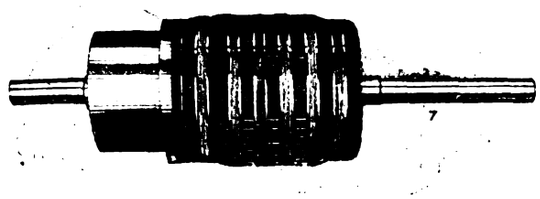
The yoke is circular in form, and is of soft cast steel of high magnetic quality, in the machines from three to twenty-five horse-power. The smaller sizes, up to



VERTICAL MOTOR.

and including two-horse-power machines, are of cast iron, with poles cast integrally with the yoke. Machines from two horse-power to twenty-five horse-power are multipolar, and all sizes smaller than this are bipolar.

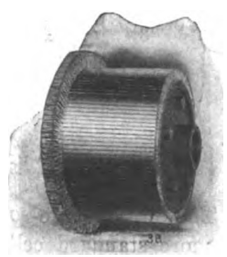
In the frames having steel yokes, the magnetic cores are separate and are of steel with cast-iron pole-pieces. The pole-



TYPE "E" ARMATURE COMPLETE.

pieces are of such form as has been shown by careful experiment to give the best distribution of the magnetic flux.

The end covers are secured to the yoke by four bolts, and the bolt holes are so spaced that the covers may be rotated



COMMUTATOR.

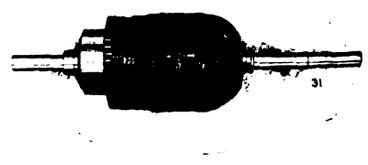
one-quarter or one-half a revolution and retain the oil chambers in their proper positions, when it is found desirable to fasten the motor to a side wall or to a ceiling. Upon the arrangement of the end covers depends the style of the motor, whether semi-enclosed, enclosed with screens, or entirely enclosed. The semi-enclosed motor has openings for ventilation, though the motor is well protected. The enclosed motor with screens has the openings covered with a fine wire screen, the mesh of which is small enough to protect the motor from small flying particles. The entirely enclosed motor is air-tight, and is for use where extreme moisture or injurious vapors would damage the motor. The rating of the

FIELD COIL.

entirely enclosed motors is lower, on account of the decrease in the ventilation and consequent increase in heating.

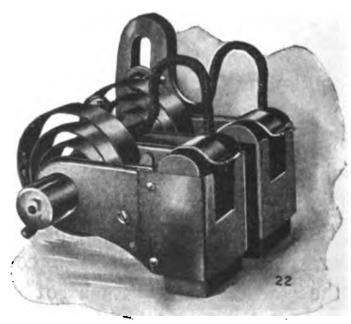
A rocking ring replaces the old style rocker arm, giving a neat appearance, adding rigidity to the brush-holder, and providing easy access to the commutator for cleaning.

The armature core is of the slotted



TYPE "D" ARMATURE COMPLETE.

drum type, and is made up of thin plates of soft steel of the highest magnetic permeability. The plates are slotted to the size required for the coils, after which



BRUSH-HOLDER.

they are carefully annealed and varnished. They are then assembled directly on the shaft, and, in the larger sizes, ventilating ducts are provided for proper circulation of air through the core. The armature

Digitized by Google

coils are machine-wound, and carefully insulated, taped, baked and varnished. Each coil, with its insulation, is self-contained and a complete unit in itself. There is no insulation in the slots.

The commutator is made of drop-forged or hard-drawn copper bars, carefully insulated with mica. The bars and mica are assembled in a ring especially made for the purpose. After being heated and compressed to the greatest possible degree, all surfaces are bored and turned. The ring is not removed until the brush is in place and carefully tightened. The proportions are ample, giving a low current density in the brushes, and making a large allowance for wear.

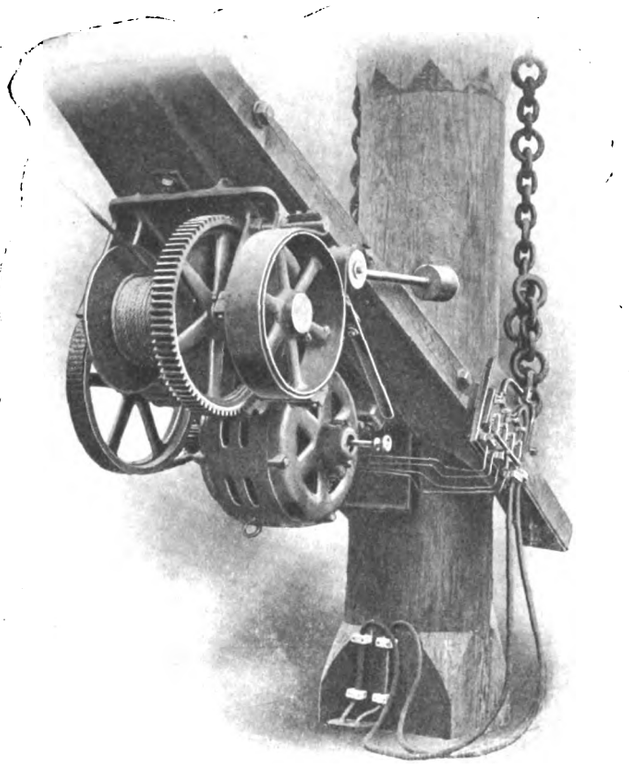
The field coils are form-wound, and heated to drive out all moisture. They are then dipped in insulating varnish and baked, after which they are insulated and taped. The bearings are of bronze, of ample dimensions, and are self-aligning and self-lubricating. Two rings in each bearing are continually carrying oil to the shaft, in such quantities that there is no chance of overheating. The bearing caps are provided with openings to allow of examination of the rings at all times.

The brush-holders are of the box type, simple and easy of adjustment. The brushes, which are of carbon, can be readily removed while the machine is running. The carrying capacity of both brushes and holders is ample, ensuring low temperatures. On the larger sizes a flexible lead connects the brush with the holder in such a manner that freedom of motion is not interfered with. At the same time, a solid joint between brush and holder is assured.

An Electric Derrick Winch.

The accompanying illustration shows the improved electric derrick winch, equipped for either alternating current or direct current, placed on the market by the Quaker City Electric Company, Philadelphia, Pa. This winch has been designed to provide a light but powerful lifting mechanism, easily applied and well adapted to either guyed or stationary mast and boom derricks.

The apparatus consists substantially of one main casting forming a bearing and support for the cable drum, countershaft, journals and motor, this casting being of proper shape to fit the underside of the gaff or boom. The casting is held in place by bolts extending through heavy cast-iron straps on the top side of the boom, forming a complete self-contained piece of apparatus, requiring only the wiring connections to make it ready for operation. Power is transmitted from the motor to the countershaft by a silent chain drive, and from the countershaft to the drum shaft by cut spur gears. The motor may be either direct or alternating current, of five horse-power, and should operate at a speed not exceeding 1,200 revolutions per minute.



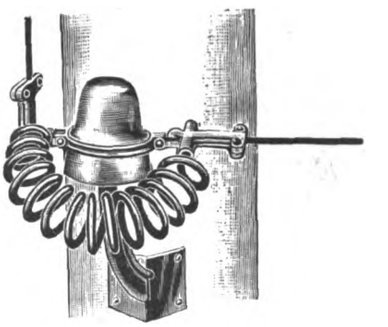
ELECTRIC DERRICK WINCH.

The method of control may be either an electric controller, varying the motor speed, which requires starting the motor from stand-still for each load hoisted, and the use of an electric brake with a hand attachment for lowering; or keeping the motor in operation continuously while the derrick is in use, and controlling the load with a powerful friction clutch and hand brake. Either of the above systems is practicable with direct-current motors. When induction motors are used, however, only the latter system is available.

The lifting capacity of the apparatus is 165,000 foot-pounds, and the approximate weight of the winch is 1,350 pounds.

The "Vitae" Stirrup.

The "Vitæ" stirrup is a safety device for arc light circuits, manufactured by the White Star Appliance Company, 1330 Kenmore avenue, Buffalo, N. Y. The apparatus is not designed to give a trouble signal or act in any way as an indicator, but the manufacturer claims that it is a positive trouble preventer. In places where the wires are subject to bending strains, particularly in the installation of arc lamps, and wherever open circuits are liable, this apparatus will eliminate breaking of the conductor.



"VITÆ" STIRRUP.

The stirrup is made of malleable iron, galvanized, and the parts are fastened together by galvanized bolts. The apparatus is equipped with a glass insulator or porcelain knob, as the service may demand.

Apparatus for the New Power-House of the Ohio Street Railway System.

The Toledo Interurban Construction Company has recently awarded to the Allis-Chalmers Company, Milwaukee, Wis., the contract for the complete equipment of the new power-house of the Toledo, Port Clinton & Lake Side Railway at Port Clinton, Ohio, including two 1,280-horse-power Reynolds-Corliss engines, two 800-kilowatt Bullock alternating-current generators; two fifty-kilowatt Bullock direct-current generators; one 400-kilowatt Bullock alternating-current rotary converter; two Tomlinson barometric condensers, and boilers, pumps, heaters, etc. The contract calls for the completion of the plant in every detail by or before July 1, and is noteworthy from the fact that of the very varied equipment to be furnished the greater portion will be constructed in the manufactories of the successful bidders. Bullock railway motors have been in successful operation on this road for some time past.

Digitized by Google

A New Type of Combination Fan.

The accompanying illustrations show a new form of column and electrolier fan which is being placed upon the market by the Essex Electric Company, of Newark, N. J. Fig. 1 and Fig. 2 represent column fans, and Fig. 3 and Fig. 4 show two forms of ceiling electrolier fans.

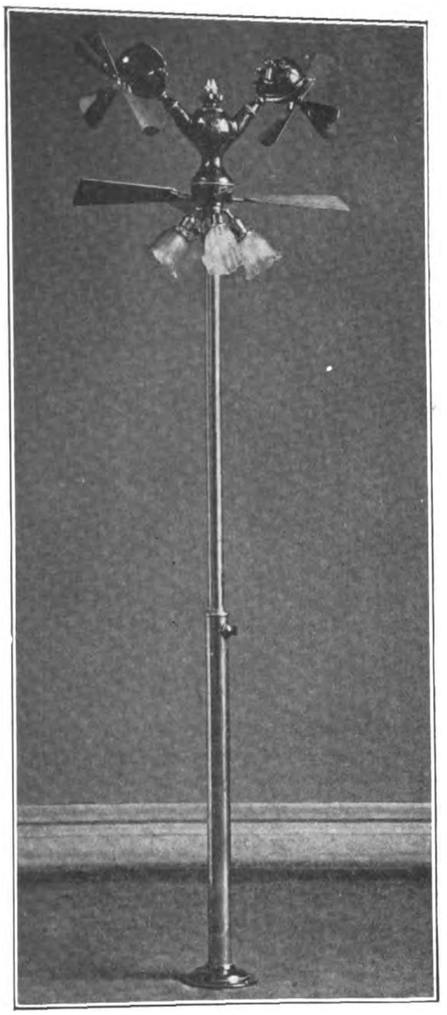


FIG. 1.—COLUMN FAN AND ELECTROLIER.

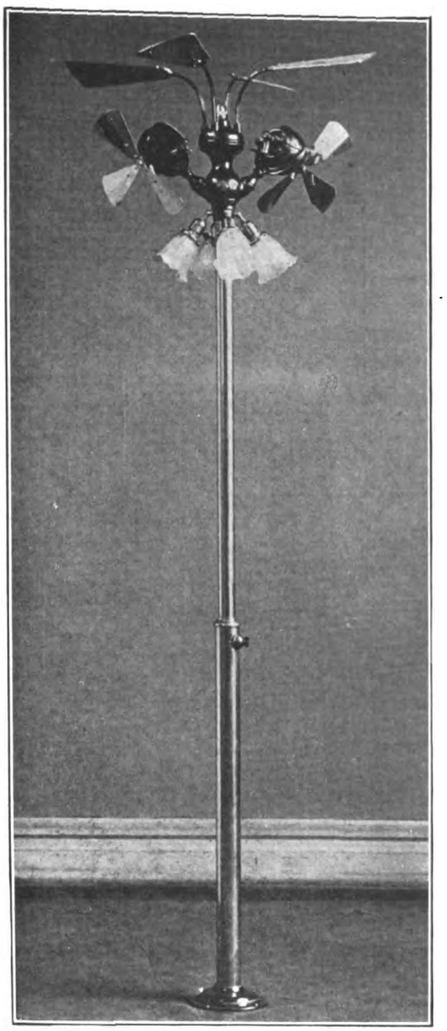


FIG. 2.—COLUMN FAN AND ELECTROLIER.

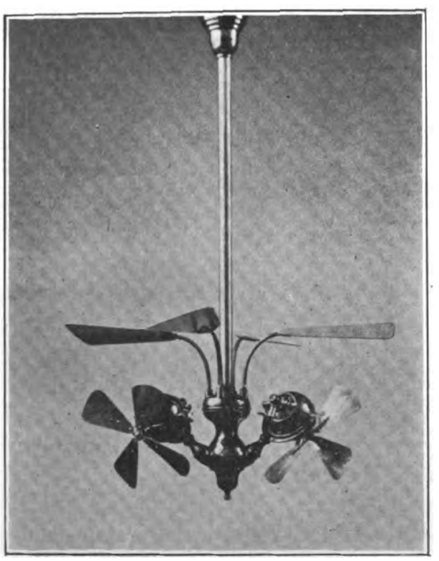


FIG. 3.—CEILING FAN AND ELECTROLIER.

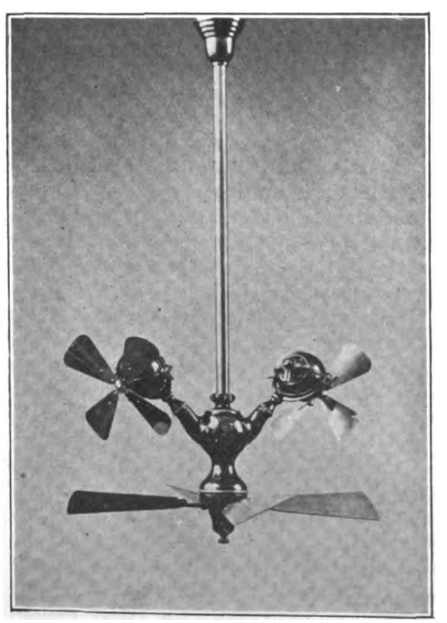


FIG. 4.—CEILING FAN AND ELECTROLIER.

The particular feature of this apparatus is that the smaller fan motors may be set so as to distribute a blast of air in any fixed direction, or may revolve so as to distribute air over a wide area. As the smaller motors revolve in the one direction, the wooden blades revolve in the opposite direction. This is made possible by a very simple gear train located in the expanded portion of the column, either just above or just below the large fan blades. The fans have two direct speeds, and when revolving in opposite directions, the ratio of the two sets of fans is as nine to one. The fan blades on the small motors are twelve and fourteen inches in diameter, and the large blades are thirty-two and thirty-four inches in length.

The apparatus is made for 100 and 130 volts direct current, 220 and 250 volts direct current, and 115 volts alternating current. The fans are finished in black japan with gold trimmings. The New York city sales office is at 120 Liberty street.

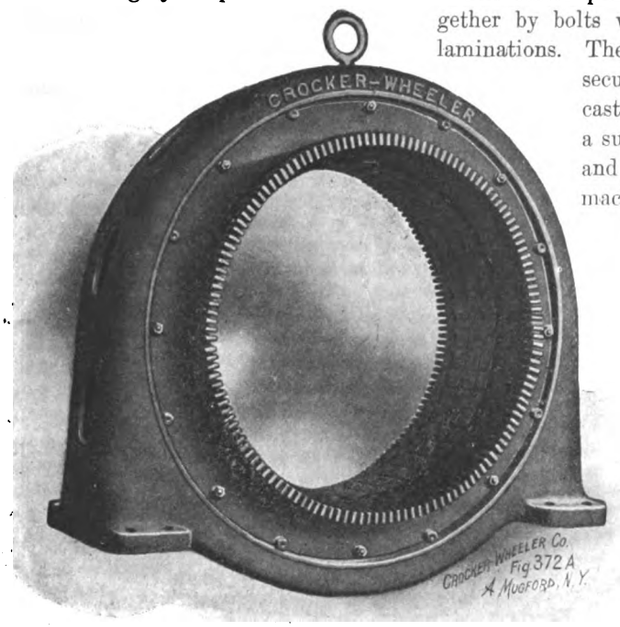
Fast Railroad Service as a Business Aid.

Mr. Albert M. Bigelow, of New York, writes in regard to a trip from New York to the Lake Superior mining region as follows: "I was absent from my office in New York Friday, Saturday and Monday. I had one day in Chicago, two days and a night at Lake Superior, and did not need to break the Sabbath by any business transaction. This was accomplished in this way: I took the Lake Shore Limited for Chicago on Thursday evening, leaving at 5.30. I arrived in Chicago at four o'clock on Friday. I stayed in Chicago four and one-half hours, meeting some people there and accomplishing some business. I took the train at 8.30 and arrived at Lake Superior at 6.50 in the morning. I had all day Saturday and the evening there. I spent Saturday night there and Sunday. Sunday evening at 6.50 I left Lake Superior and arrived at Chicago on Monday morning at six o'clock. I had a half-day there and left at 12.30 P. M. on the Twentieth Century Limited on the Lake Shore road for New York, arriving at 9.30 Tuesday morning, which enabled me to reach my office at the ordinary time. On each of the trains which I took I had a comfortable room for myself and was luxuriously supplied in dining cars on each road. This more than verified the story in the 'Arabian Nights' of the wonderful Persian carpet on which the Prince was transferred some one hundred miles in a single night." Mr. Bigelow adds that the above is in striking contrast to his first trip to the Lake Superior region in 1859, when it occupied seven or eight days of constant traveling in going one way.—*Troy Times.*

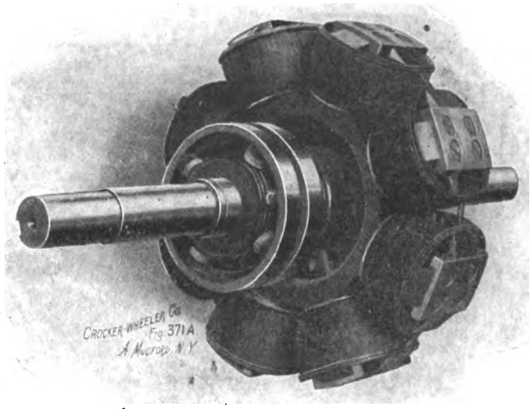
Digitized by Google

Belt-Type, Alternating-Current Generators.

The Crocker-Wheeler Company, Ampere, N. J., is placing on the market a line of belt-type, alternating-current generators. Arrangements have been completed for the cooperation of Messrs. Brown, Boveri & Company, of Baden, Switzerland, as consulting engineers, to take up the manufacture of alternators at the advanced point reached by them. The Crocker-Wheeler Company's output of alternating-current machinery is stated to be as thoroughly adapted to conditions in the United States as its long-established line of direct-current apparatus.



STATOR WITH WINDINGS FOR SIZE 100-KILOVOLT-AMPERE BELT-TYPE ALTERNATOR.



COMPLETE ROTOR FOR 100-KILOVOLT-AMPERE BELT-TYPE ALTERNATOR.

The standard compound-wound, direct-current generators are used as exciters at conservative ratings, in view of the fact that they are called upon to furnish the excitation, under severe conditions of overload and low power-factor. They are furnished with rail base and pulley for belt drive from the main generator shaft. Each generator is furnished with the field rheostat, base frame, rails and two pulleys. The machines, when wound either two or three-phase, will carry their full-rated load at unity power-factor for twelve hours with a rise of temperature not exceeding forty degrees centigrade in any part of the machine, and will carry a twenty-five per cent overload at unity power-factor for two hours with a rise of temperature not exceeding fifty-five degrees centigrade. The inherent regulation of this machine will not exceed eight per cent for a full non-inductive load.

These belted alternating-current generators are of the revolving type, running at speeds which were selected with reference to safety and satisfactory operation. The cast-iron frame supporting the armature punchings is mounted on a substantial iron base. To this base are bolted pedestals properly proportioned for the speed and output of the generators.

The revolving element consists of a rotor mounted on a stiff shaft of selected steel. Two pulleys are provided on the shaft, one for the main drive and one for the exciter.

The stator punchings are clamped together by bolts which pass through the laminations. These laminations are then securely attached inside a cast-iron shell which forms a support for the punchings and gives a finish to the machine.

A characteristic feature in the design of these alternators is the use of a partly closed slot. This type of slot makes it possible to reduce materially the weight of an alternator for a given rating, without affecting the behavior of the machine, and gives the additional advantage of a reduction in the total losses, which means a corresponding increase in the efficiency. The slot is lined with a heavy tube of insulating material, which is prepared and treated so that it becomes very hard, tough, and possesses the requisite dielectric strength to meet the insulation requirements. These tubes conform to the shape of the slot very closely, so as to have available a maximum of space for the winding. The top of the tube is slotted to correspond with the top of the slot.

The stator coils are form-wound, being slipped through the narrow opening at the top of the slot, and then arranged systematically in the insulating tubes. After the conductors are put in place, a wooden wedge is driven over the top of the insulating tube so as to close this tube and retain the conductors securely in place. The coil ends are then heavily taped and insulated in order to give protection and add a finish to the coils.

To give additional protection to the stator winding and add to the appearance of the machine, shields are attached to the side of the frame and project just beyond the winding.

The revolving element, excepting the pole-shoes, is one solid steel casting. The pole-shoes are made of forged steel and bolted securely to the projecting pole cores. Because of the partly closed slot solid pole-shoes can be used. These solid shoes greatly facilitate the parallel operation of machines, which is an important consideration, as generators are more frequently run in parallel than singly.

On sizes of 200-kilovolt-amperes and larger, the rotor coils are made of copper strip wound edgewise. The layers are insulated from each other by means of paper, and an insulating compound, after which the whole coil is carefully baked. A coil of this kind will withstand without injury the severe mechanical strain, and the great overloads to which machines of this class are subjected. On machines below 200-kilovolt-amperes the rotor is wound with square copper conductor, special care being given in winding and insulating to make them perfect.

The collectors used for leading in the exciting current to the rotor coils consist of cast-iron rings mounted on a cast-iron shell, which is fitted to the shaft. These rings are carefully insulated from the shell by means of porcelain bushings, and the entire construction is such that the rings can be easily inspected and cleaned.

All of these machines are carefully tested before shipment and are guaranteed by the Crocker-Wheeler Company to be in perfect condition when they leave the works. The guarantee includes the rating, stability and performance of the apparatus, and the company stipulates that it will, without charge, during a period of one year from the date of shipment, repair or, at its option, furnish to the purchaser a new part in exchange for any part of the machines of its manufacture that, under normal conditions of operation, and under proper supervision and attendance, develop any mechanical or electrical defect.

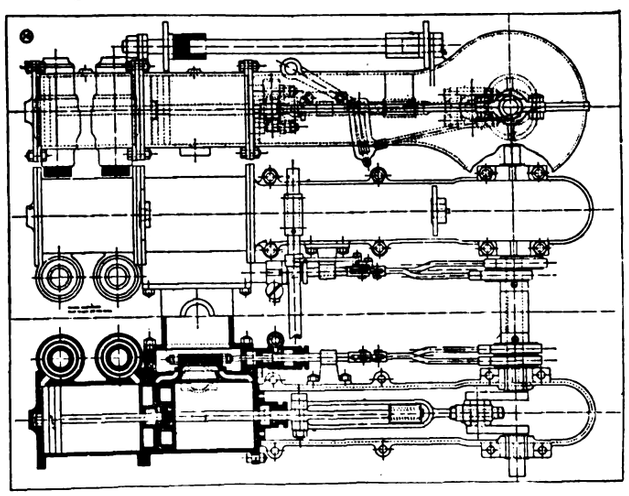
Digitized by Google

THE SVEA CALORIC ENGINE.

BY G. EMIL HESSE.

Cool air, split up into limited portions, and rapidly heated by being forced over a hot surface, is the foundation of the system which has been adopted for the Svea engine. The engine is self-starting, double-acting, reversible, and is regulated like a steam engine, making 450 revolutions per minute. A six-horse-power Svea engine is now being built, applicable for laundries, automobiles, etc., and a 100-horse-power stationary engine is in preparation. The six-horse-power engine has two cylinders, with a diameter of four and one-quarter inches and a stroke of four and seven-eighths inches.

The heater is twenty inches in diameter, sixteen inches long, with a heating surface of sixty square feet. The engine and heater complete weigh 450 pounds. A one-half horse-power Ericsson engine, with a cylinder ten inches in diameter, weighs 1,700 pounds and makes seventy-five revolutions per minute. This is the handicap with which that type has been hampered and which makes it an impossible proposition for even a few horse-power.



THE SVEA CALORIC ENGINE.

The Svea engine consists of a power cylinder and an air pump. The cool air is drawn in from the atmosphere for small sizes and pumped into a heater, where it is forced over the heated surface well divided up, which causes it to rapidly absorb the heat. The air heated to a temperature of about 430 degrees centigrade goes then into the power cylinder, where it does the work, and from there to the atmosphere.

The large stationary and marine type works with the air at a pressure of 100 pounds per square inch, using the same air over and over again, alternately heating and cooling it. The same system of heating it is, however, employed, no dependence being placed on the mere rising of the warm air into the cooler above.

The Svea engine does not expose a larger surface per horse-power than the steam engine and the heater utilizes all the available heat as perfectly as any steam boiler. All conditions consequently being equal, the saving by the hot air engine would be the amount of heat required to vaporize the water, minus the heat recovered by condensation. One kilogramme of 100 degrees centigrade water requires 537 thermal units in order to convert it to steam of the same temperature.

The heat recovered by condensation is:

$$\frac{10{,}334 \times 1{,}649}{424\left(\frac{10}{9}-1\right)}\left[1-\left(\frac{1{,}649}{14.55}\right)^{\frac{1}{4}}\right]=$$

76 units,

making a total net loss of 537—76=461 units, which clearly explains the reason why the best triple expansion steam engine only shows an efficiency of fourteen per cent.

The cylinder of the Svea engine does not require any cooling water, which is the cause of a very large loss in the gas engine.

The theoretical efficiency of the Svea engine with the air at 430 degrees and the exhaust at forty degrees is:

$$1-\frac{273+40}{273+430}=0.56=56 \text{ per cent.}$$

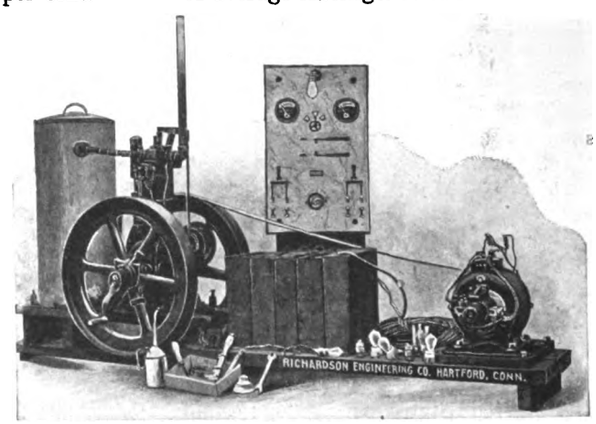
The Use of the Wright Demand Meter.

The Edison Electric Illuminating Company, Boston, Mass., which began, in 1898, to experiment with the Wright demand system of charging, has steadily extended its use, and is now making a final extension of the system to all its customers, both for light and power. Up to the present time the Wright demand indicator has been used only to measure the demand of customers having fifteen lights or more installed. Its use now is to be extended to measure the demand of all contract customers having five or more lights. To meet the above extensions, over 4,000 Wright demand indicators will be required, orders for which have been placed with the General Incandescent Arc Light Company.

With the extension of the Wright demand system, the Edison Electric Illuminating Company, of Boston, will put into effect a scale of rates which, it is expected, will do away with the inconvenience and expense of figuring out what rate a customer is entitled to. This new scale of rates is designed to automatically give to each customer the proper rate—that is, a rate having, as nearly as possible, a definite ratio to the cost of supplying him.

Small Electric Light Equipments.

The Richardson Engineering Company, 36 Pearl street, Hartford, Ct., builds complete electric light plants suitable for house or small marine work. With each outfit the company furnishes complete plans and directions for setting up and operating the plant, so that any person of average intelligence can install and run an equipment up to a capacity of 100 lights.



COMPLETE ELECTRIC LIGHT EQUIPMENT.

The line of equipments made by this company ranges from 4 to 1,500 lights capacity, and the generators may be driven either by steam, gas or gasoline engines. For example, the company's No. 5 outfit consists of a six-horse-power, throttle-governed gas or gasoline engine, with an extra heavy flywheel, cooling tank, supply tank, pipe and foundation bolts, a semi-enclosed dynamo, a belt, a 160-ampere-hour storage battery, and a switchboard complete with pilot lights, instruments, voltmeter switch, counter-cell switch, rheostat, underload circuit-breaker and switches. The switches are so arranged that any desired combination of generator and battery may be secured. The engine may be run at full load as long as it is desired, the battery being charged when the load is not heavy enough to use the entire output of the machine.

The accompanying illustration shows a No. 3 twenty-light outfit, which is suitable for a residence.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

EDISON COMPANY IN GERMANY—A new American stock company was incorporated in Berlin on March 4, under the name of "The German-American Edison Accumulator Company." The paid-up capital of the new company is 3,000,000 marks and Thomas A. Edison is one of the directors.

MEXICAN LIGHT AND POWER COMPANY ISSUES BONDS—The Mexican Light and Power Company is issuing $1,000,000 additional bonds to provide for the construction of a few branch lines into the mining districts of Mexico. This will make $8,500,000 of the authorized total of $12,500,000 bonds which the company has in the treasury.

NEW ELECTRIC ROAD IN ARGENTINE REPUBLIC—An electric tramway is projected for Buenos Ayres, to run from the Plaza Mayo to Androgue and other suburbs in that direction. It is the first enterprise of the kind in which Argentina capital only is to be employed. The promoters are J. B. Mignaguy, B. Villasueva, J. M. Massini and D. S. Hale.

SALE OF MEMPHIS STREET RAILWAY—Announcement is made of the sale of the Memphis Street Railway Company to the firm of Ford, Bacon & Davis, engineers, of New York city. The purchase price is stated to be approximately $4,500,000. George H. Davis succeeds C. K. G. Billings, of Chicago, as president of the company. Mr. Billings was one of the largest stockholders.

ELECTRICITY IN THE STRAITS SETTLEMENTS—Several electric lighting and power projects are proposed for towns in the Straits Settlements. An installation at Kuala Lumpur is estimated to cost $880,000. The town of Ipoh has appropriated $90,000 for an electric plant. The Howarth-Erskine Company, Limited, of Singapore, recently secured large contracts for an electric installation of the Sultan of Perak's palace at Kuala Kangso and for an additional plant at Penang. At the latter place an electric tramway is being built to supersede horse-drawn cars.

WIRES IN WASHINGTON TO BE PUT UNDERGROUND—Congress having granted the various telephone and electric companies, operating in Washington, D. C., the right to lay conduits, the district commissioners have ordered all wires in the city to be placed underground. Work is to be started at once, and is to be completed in five years. Telegraph companies have been given the right to use telephone conduits. The Postal Telegraph Company will use the telephone conduits, while the Western Union Company will lay conduits of its own.,

NORTHWESTERN TELEPHONE COMPANY TO IMPROVE ITS LINES—The Northwestern Telephone Exchange will expend $1,000,000 for improvements on the system in North and South Dakota and Minnesota during the present year. Upward of $400,000 will be expended in North Dakota, almost entirely in the construction of new lines. The principal line is to be from Jamestown to Bismarck and Mandan, which will give long-distance connection from Dickinson to the Twin Cities. There will be several other lines constructed, but all of these have not been definitely decided upon as yet.

TELEPHONE SYSTEM FOR THE CHICAGO & ALTON RAILROAD—A contract between the Chicago & Alton Railroad and the Bell Telephone Company has been signed providing for the construction of a complete telephone system over the entire Alton lines. To begin with fifty exchanges will be established, the central exchange being located in East St. Louis, Ill. From this station the lines will ultimately be operated over the road north to Chicago and west to Kansas City, with lines to the different branches. The construction of the new system will be started in about two weeks. It is not the intention at present to use the telephone service in the operation of trains. The value of the telephone is in the handling of messages relating to traffic, principally freight.

WHEELING, W. VA., TROLLEY, LIGHT, WATER AND BRIDGE PROPERTIES TO BE CONSOLIDATED—A merger of city and suburban tractions, electric light, water and bridge properties of the city of Wheeling, W. Va., has been announced. The deal involves properties valued at $7,000,000 and the plan is to put all the separate companies into one new corporation which will control the entire city railway system and all the suburban traction lines running into the city, also the electric lighting plants and the waterworks. The companies that have been bought outright and will be taken over in the merger are: the Wheeling Traction Company; the Wheeling & Elm Grove Traction Company; the City Railway, Wheeling; the Suburban Water and Light Company, Wheeling; the Steubenville, Mingo & Ohio Traction Company; the Wheeling Bridge Company; the Wheeling & Western Traction Company, and the Wheeling & Western Park Association.

BALTIMORE ELECTRIC LIGHT COMPANY FILES MORTGAGE—A trust mortgage for $7,500,000, from the Baltimore Electric Power Company to the Northern Trust Company of Philadelphia, Pa., has been recorded to secure an issue of $7,500,000 five per cent gold bonds, to run thirty-four years. The proceeds will be used to erect a power-house and to purchase the outstanding bonds of the Maryland Telephone and Telegraph Company. A majority of the stock of the Telephone and Telegraph Company is owned by the Power Company. The plans for the expenditure of the money are as follows: for a new plant, now in course of construction, $2,245,000; to redeem the first mortgage bonds of the Maryland Telephone and Telegraph Company, $1,000,000; to take up the outstanding general mortgage bonds of the same company, $1,155,000; to redeem the ground rent on the American Telephone Company building at Lexington and Courtland streets, $100,000; for future extensions and improvements, including increased electric power, $3,000,000, bringing the total up to the issue of $7,500,000, as provided. The company expects to be ready to supply electric current by July 1. The Standard Underground Cable Company, of Pittsburg, Pa., is placing the wires in the conduits for the Power Company. Several gangs of men are now engaged in the work, and about $200,000 worth of wire is in position.

FINAL SURVEYS FOR THE NEW YORK, WESTCHESTER & BOSTON RAILWAY—The New York, Westchester & Boston Railway Company has begun its final surveys for the route between Mount Vernon and Port Chester. This work is being conducted under the general supervision of Mr. J. C. Cryder, the company's division engineer, located at Mount Vernon. This is in addition to the preliminary surveys which were made over the Westchester county part of the route last year when three lines were laid. In special charge of the new work is Mr. F. Lavis, resident engineer, with the following staff: W. B. Leonard, assistant engineer; Ernest J. Howe, transitman; W. T. Snodgrass, levelman; I. R. Hall, transit rodman; Peter Krudler, Jr., level rodman; Frank Lamb and A. D. Berstler, chainman; P. Bible, axeman. At the present time five corps of engineers in all are at work for the company, three operating in the borough of the Bronx, one on the branch from Mount Vernon to White Plains, and the additional squad mentioned above, from Mount Vernon to Port Chester. The company is rushing forward this work of making its final surveys, in order that every preparation may be made for pushing the work forward as rapidly as possible during the coming spring. A large section of the right of way in New York city has been purchased during the past ten days. The entire route within the city limits, except in crossing streets, must be over private right of way.

ELECTRICAL NOTES FROM MEXICO—The aldermen of the city of Tlaxcala and the governor of the state, Colonel Cahuantzi, are constructing a hydraulic work near the city, which will produce 300 horse-power. The project consists of utilizing the waters of the Zahaupan river by a canal starting from a point near San Pablo Apetatitlan, 700 metres long, two metres wide, and the necessary depth according to the topography; a tunnel 420 metres in length,

Digitized by Google

and an immense reservoir, with capacity for 1,280 cubic metres of water. The power will be applied to various industries to be established near the city of Tlaxcala. The work was commenced about two years ago, and over $50,000 has been already expended on it. William V. Backus, of Cleveland, Ohio, and J. N. Zermeno, of Mexico City, respectively vice-president and general manager of the recently organized Jalisco & Michoacan Railway Company, at which they agreed with Governor Ahumada that construction of the electric road from Guadalajara to Lake Chapala will be commenced following the rainy season next October. The concession allows five years for the completion of the road, but the company expects to have it finished in little more than a year after work is started. A second link of the road is to be built from a point on the southern shore of Lake Chapala to Morelia, the capital of the state of Michoacan, and steamers are to be operated across the lake between the terminals.

EXPRESS TROLLEY LINE PROPOSED BETWEEN NEWARK, N. J., AND NEW YORK—Thomas N. McCarter, president of the Public Service Corporation of New Jersey, has issued a signed statement in which he says that if the New Jersey legislature authorizes the abandonment of navigation upon the Morris canal, and permits the sale of the property of the canal company and its diversion to other public uses, the Public Service Corporation will endeavor to acquire so much of the roadbed or right of way of the Morris canal as lies within the city of Newark and northwest of the city as far as Bloomfield. It will proceed also to acquire, by purchase or condemnation, whatever private or reversionary rights there may be in the canal bed, and devote the property to subway purposes free from grade crossings, and operate therein high-speed trains similar to those in use in the New York subway. Stations will be constructed at proper points in the lower portion of the city, and in such portions of the northwesterly section of the city as are traversed by the bed of the canal. There will be connection by transfer, without extra charge, on all local fares, with the surface lines using the streets. The company will also connect this right of way with a private right of way across the meadows, which it has already acquired, and will build a high-speed line to and through Jersey City over a route already surveyed, to a point where it will connect with the new tunnels now being constructed to various portions of New York city. It will thus give a new route and direct connection to different parts of New York city from the portions of Newark above referred to, as well as furnishing rapid transit between Newark and Jersey City, and between the entire Hudson hill and New York city. Negotiations to this end between the companies controlling the tunnels and the Public Service Corporation are now awaiting the result of legislation for the abandonment of the canal.

ENGINEERING SOCIETIES.

THE ENGINEERS' CLUB, OF ST. LOUIS—On Wednesday evening, March 15, at the regular meeting of the Engineers' Club, of St. Louis, Mr. Lionel R. Viterbo delivered a lecture upon "Fundamental Principles of Reenforced Concrete."

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The sixteenth regular meeting of the Toronto branch of the American Institute of Electrical Engineers will be postponed until March 24, but as per arrangement with the Engineers' Club a joint meeting of the American Institute of Electrical Engineers and the Engineers' Club was held at the club-rooms of the latter, 96 King street West, on Thursday evening, March 9, at 8 P. M. Mr. H. A. Moore introduced for discussion Mr. Mershon's paper upon the "Maximum Distance to Which Power Can Be Economically Transmitted."

THE STEVENS CLUB OF NEWARK—The Stevens Club of Newark (N. J.), was organized with a membership of about thirty on March 10, 1905, at a meeting held at Stetter's restaurant. The organization is composed of the graduates and upper classmen of the Stevens Institute of Technology who reside or are in business in the vicinity of Newark, N. J. Meetings are to be held every month, at which papers on engineering subjects will be presented and discussed. The officers elected were: president, Frederick C. Fraentzel; vice-president, Edwin R. Douglas; secretary and treasurer, Arthur P. Hagar. The next meeting will be held on April 14, and Mr. E. R. Douglas, of the Crocker-Wheeler Company, will present a paper on "Motor Driving of Machine Tools."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—The transactions of the American Society of Mechanical Engineers for 1904 are being distributed. These form vol. xxv, and contain, among a goodly number of valuable papers, several which are of interest to electrical engineers. A paper by Frank B. Perry is entitled "A Method for Determining Rates and Prices for Electric Power." Another, by Benjamin T. Allen, is entitled "Construction and Efficiency of a Fleming Four-Valve Engine Directly Connected to a 400-Kilowatt Generator." "Commercial Gas-Engine Testing and a Proposed Standard of Comparison" is the title of a paper by William P. Flint. J. H. Wells discusses "The Power Plant of the Tall Office Building," and the same subject is considered by R. P. Bolton. "Different Applications of the Steam Turbine," the valuable paper by A. Rateau, is here given with one by W. L. R. Emmet on "Steam Turbine in Modern Engineering," and one by E. S. Lea and E. Meden, on "The De Laval Steam Turbine." "The Middlesboro Dock Electric and Hydraulic Power Plant" is described by Vincent L. Raven, and "Refuse Destruction by Burning, and the Utilization of Heat Generated," by C. N. Russell. Another paper on the same topic is contributed by George Watson. This volume contains also the presidential address of James M. Dodge, entitled "The Money Value of Technical Training."

WASHINGTON UNIVERSITY BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The first regular meeting of the St. Louis branch of the American Institute of Electrical Engineers, since the close of the World's Fair, was held in the rooms of the Engineers' Club on Wednesday evening, March 8, with an attendance of twenty-three members and visitors. The chair was occupied by Mr. H. H. Humphrey in the absence of the regular chairman, Professor W. E. Goldsborough. The branch organized for the year by electing a new executive committee of five members, composed of the following gentlemen: Messrs. H. H. Humphrey, W. A. Layman, A. S. Langsdorf, G. Swope and R. McCulloch. At a meeting of this committee held later Mr. Humphrey was elected chairman and Mr. Langsdorf, secretary. A discussion as to the work to be undertaken during the year was participated in by many of those present. It seemed to be the prevailing opinion that a continuation of the former policy of reading and discussing the regular Institute papers would be best, but that papers by local members should be encouraged as much as possible. A committee consisting of C. R. Meston, chairman, C. Marshall, W. A. Baehr, R. McCulloch and F. R. Mott was appointed to secure new members, with the object of having the local electrical industry represented as fully as possible. The paper of the evening, on "Electrical Engineering at Washington University," was then presented by Mr. A. S. Langsdorf. After some discussion the meeting adjourned.

NEW PUBLICATION.

ELECTRICAL TRADES DIRECTORY AND HANDBOOK FOR 1905—The 1905 issue of the "Big Blue Book," published by the Electrician Publishing Company, London, England, is now ready. This is the twenty-third year of this directory of the electrical engineers and electrical manufacturing or supply houses throughout the United Kingdom, the British colonies, Europe, Asia, Africa, Central and South America, and the United States. Naturally, the British and the colonial divisions are the most complete, but most of the prominent engineers of this country are included. In addition, there is a lot of local matter of interest to the electrical trades in Great Britain, and a good deal of statistical information of the British industries. There is also the usual biographical section, which contains brief sketches of men who have been prominent in electrical science or its applications. This section includes a good number of portraits. The arrangement of the present edition is a little different from that heretofore. The book is divided into two volumes—one consisting merely of the directory, the other containing all the other sections.

Digitized by Google

PERSONAL MENTION.

MR. C. E. ANTHONY has resigned as manager of the Palo Alto, Cal., office of the Sunset Telephone Company.

MR. C. A. COOK, manager of the Hannibal exchange of the Missouri & Kansas Telephone Company, has been made manager of the company's St. Joseph exchange.

MR. J. F. STOCKWELL, manager of the Ontario Telephone Company, Oswego, N. Y., has been elected vice-chairman of the New York State Independent Telephone Company.

MR. CHARLES R. HUNTLEY, general manager of the Buffalo, N. Y., General Electric Company and the Cataract Power and Conduit Company, has just returned to his home from a trip of about a month through the far West and Southwest.

MR. EDMOND ROBB has succeeded Mr. Owen M. Burgess as manager of the Nashville, Ill., and Okawville, Ill., exchanges of the Central Union Telephone Company. The latter has gone to Kansas City, Mo., where he will be assistant superintendent of the Missouri-Kansas line.

MR. GEORGE S. REINOHL has resigned as manager of the Pennsylvania Telephone Company, Scranton, Pa., his resignation to take effect April 1. From Scranton Mr. Reinohl will go to Reading, where he will open an office and act as the representative of J. B. Russell & Company, brokers.

MR. H. W. MOSHER, district manager at Iron Mountain, Mich., for the Michigan State Telephone Company, has been transferred to southern Michigan as district manager, with headquarters at Battle Creek. Mr. Mosher will be succeeded at Iron Mountain by Mr. A. A. Sheperd, of St. Ignance.

MR. M. K. EYRE, formerly of the Buckeye Electric Company, of Cleveland, Ohio, has recently become associated with the Sawyer-Man Electric Company, and will make his headquarters in New York city. Mr. Eyre is an experienced incandescent lamp manufacturer, a graduate of Annapolis, and possesses a wide acquaintance in the electrical field.

MR. WALTER H. WHITESIDE has been appointed vice-president of the Allis-Chalmers Company, Milwaukee, Wis., to take the place of Mr. William J. Chalmers, resigned. For some time Mr. Whiteside has been general manager of sales for all the departments of the Allis-Chalmers Company. He entered upon this duty about the middle of July last.

MR. J. SIEGEL was elected treasurer and director to succeed Mr. F. Siegel at the annual meeting of the Strowger Automatic Telephone Exchange Company, Chicago, Ill. Mr. C. C. Wheeler succeeds Mr. A. G. Wheeler, Jr., as vice-president and director. Mr. S. F. Harris was elected assistant treasurer, a new office. The company reported that it was free from debts and had a surplus on hand.

MR. E. H. WESTERFIELD, manager of the Tampa, Fla., office of the Western Union Telegraph Company, has resigned his position to become identified with the American Sand, Brick and Lime Company, of Chicago, Ill. He will be succeeded temporarily in Tampa by Mr. W. G. Peebles, assistant superintendent of the Florida division of the Western Union Telegraph Company.

MR. J. H. HALLBERG, the well-known consulting engineer, has been retained on the commission on municipal electric lighting in New York city, in an advisory capacity. Mr. Hallberg has had a great deal of experience in matters of this nature. His work as superintendent of the Cincinnati Gas and Electric Company was especially successful, and since resigning this position and engaging again in consulting engineering last May he has devoted much time to central station problems.

MR. GARDINER C. SIMS, the well-known steam engineer and inventor, has become general manager of the Marine Engine and Machine Company, of New York. The works of this company are at Harrison, N. J. In addition to its present business the company is going to build Armington & Sims engines, and announces that the original characteristics of the engine are still its fundamental features, but have been improved in detail as required by modern steam practice. The present patterns are all new, having been developed by Mr. Sims since the Spanish-American war, in which he served with high honors in the marine service.

ELECTRICAL SECURITIES.

The favorable conditions in the stock market still continue to indicate a decided tendency to cheerfulness and confidence in the business outlook. All influences seem to be exerted to maintaining high securities values, and although advances have been irregular during the past week the closing quotations show in many cases new high levels for the year so far. Notwithstanding the large number of transactions, the report is current that the public as an investor has been conspicuous in its absence. There is no extreme anxiety to buy anything and everything that shows an inclination to rise in value over night, but rather a quiet investment in securities of undoubted stability, depending on future growth rather than present-day speculative possibilities. From many sections of the country come reports of improving trade. It is not unlikely that the steel stocks will again become leaders in industrial securities, and if the reports for the present quarter come up to what is being said for the demand, it is possible that they will be active within a very short time. The increase in output and demand for these materials means in nearly all cases new construction or rehabilitation of existing properties. This in turn means more work in almost every class of industry. From present indications the spring will see a large amount of work being undertaken, and it is not too much to say that the money circulated through this form of enterprise will find its way into every channel which goes to make up the national prosperity.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 11.

New York:	*Closing.*
Brooklyn Rapid Transit	66⅝
Consolidated Gas	213
General Electric	188
Interborough Rapid Transit	219
Kings County Electric	200
Manhattan Elevated	171
Metropolitan Street Railway	123¼
New York & New Jersey Telephone	172
Westinghouse Manufacturing Company	190

The annual meeting of the Commercial Cable Company has been postponed until April 3.

Manhattan quarterly dividend of 1¾ per cent is payable April 1. Books close March 17 and reopen March 30.

The Metropolitan Street Railway Company will pay the regular guaranteed rental of 1¾ per cent on April 16. Books close March 24 and reopen April 16.

The gross earnings of the Brooklyn Rapid Transit Company for February show a gain of $85,000, as compared with the same month of 1904.

The Western Union Telegraph Company has declared a quarterly dividend of 1¾ per cent upon the capital stock, payable April 15 to stock of record at the closing of the books on March 20. The quarterly report of the company shows a net revenue for the quarter ending December 31, 1904, of $1,872,966, leaving a balance, exclusive of bond interest, of $1,575,416; dividends, $1,217,021, and a surplus of $358,395. This, added to the previous surplus of $15,434,863, makes a total surplus of $15,793,258.

Boston:	*Closing.*
American Telephone and Telegraph	146¼
Edison Electric Illuminating	251
Massachusetts Electric	65
New England Telephone	137
Western Telephone and Telegraph preferred	102

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	87½
Electric Storage Battery preferred	87½
Philadelphia Electric	10¾
Philadelphia Rapid Transit	30
United Gas Improvement	116½

United Gas Improvement directors have declared the regular quarterly dividend of 2 per cent ($1 per share), payable April 15 to stockholders of record March 31.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	170
Metropolitan Elevated preferred	65
National Carbon common	42
National Carbon preferred	113
Union Traction common	12
Union Traction preferred	47

Digitized by Google

ELECTRIC LIGHTING.

PETROS, TENN.—The town of Petros will be lighted from the plant of the Big Brushy Mountain Coal and Coke Company.

JEFFERSONVILLE, IND.—James H. Duffy is proposing to establish an incandescent electric light service in Jeffersonville.

BELLEFONTAINE, OHIO—Bellefontaine expects to rebuild this summer its entire municipal plant with a bond issue of $50,000.

ALMA, NEB.—At a special election for waterworks and electric lights, 175 votes were cast for waterworks to 25 against, and 186 for electric lights to 15 against.

VICTORIA, B. C.—The electric light committee has recommended the purchase of a new dynamo of 230-light capacity, additional arc lamps, transformers, etc.

URBANA, OHIO—A new company headed by C. H. Marvin and T. A. Edmondson now holds a franchise for an electric lighting and hot-water heating plant in Urbana.

BROWNSVILLE, PA.—The Brownsville Light, Heat and Power Company proposes installing a 250-horse-power engine and a 200-kilowatt generator. J. M. Bell is manager.

RHINEBECK, N. Y.—The Duchess Light, Heat and Power Company in order to provide for its growing business has purchased a 200-horse-power water-tube boiler.

CADOTT, WIS.—The village of Boyd has granted a franchise to the Cadott Light and Power Company. The company will extend its line to that village in the near future.

SCRANTON, PA.—W. T. Davies, John H. Williams, Herbert L. Taylor, Thomas P. Gordon and Edward Recum will incorporate the West Scranton Light, Heat and Power Company.

NEWARK, OHIO—Bids will be received by the board of public service, T. P. Kellogg, clerk, March 21, for furnishing for a period of ten years a system of electric lamps or of gas lamps, or a combination of them.

WILKESBARRE, PA.—The Wyoming Valley Gas and Electric Company has secured control of the Hazleton Gas Light Company, which is capitalized at $125,000. The purchasing company was recently formed by Chicago capitalists.

TURTLE CREEK, PA.—The Rose Hill Electric Light Company has purchased a site for a plant in Newtown, where a large powerhouse will be erected. Bids are being taken for the construction of the buildings, which will be of iron and brick.

WHEELING, W. VA.—The Dillonvale Heat, Light, Power and Water Company has been organized, and has already purchased a site for the plant, which will be located on Piney creek. The work of setting poles and stringing wires has been begun.

TERRE HAUTE, IND.—J. F. McColloch, of the firm of McColloch & Company, of St. Louis, has been employed by the board of public works in procuring data and drawing up plans and specifications for the erection of a municipal lighting plant in Terre Haute.

SELINS GROVE, PA.—George W. Wagenseller and David Goldstein have secured the franchise for lighting by electricity all the principal towns in Snyder County. The generating power will be furnished by Hoover's dam, three miles south of Selins Grove.

NIAGARA FALLS, N. Y.—At a meeting of the council a franchise was granted to the Niagara Falls Hydraulic Power and Manufacturing Company to build conduits in the city streets and lay cables for the distribution of electricity for heat, light and power purposes.

NILES, OHIO—The city light and waterworks contemplates changing its street lighting from direct current open to alternating current enclosed; also the installation of either a 300-kilowatt turbine or direct-connected engine and generator, and a new feedwater heater

MEMPHIS, TENN.—A franchise for a period of thirty years has been granted to the Merchants' Light and Power Company by the Memphis legislative council. In exchange for the franchise, the new company gives to the city of Memphis fifty arc lights, to be erected along Main street.

NEW YORK, N. Y.—Plans for the city electric light plant for the Williamsburg bridge have been filed. It will be the city's first venture into municipal ownership of light plants. The plant will be built in Tompkins street, south of Delancey slip, adjoining the new incinerating plant, and will cost $20,000.

WICKFORD, R. I.—The Wickford Light and Water Company which recently purchased the electric light plant in Wickford, owned by H. S. Dixon, is having transformers and other apparatus placed in position. The plant will be connected with the powerhouse of the Sea View Railway Company, which will in future furnish the electric lights of Wickford.

GEORGETOWN, DEL.—The Georgetown council has granted to the Georgetown Electric Light Company a franchise and a contract to light the city. There will be 100 lights installed. The company consists of George W. Goodley, W. R. Goodley and W. J. Peal, of Wilmington. The company has already awarded the contracts and the work of installing the plant will begin at once.

COLORADO SPRINGS, COL.—The following officers were elected at the meeting of the directors of the Colorado Springs Electric Company: W. A. Otis, president; George R. Buckman, first vice-president; S. R. Bertron, second vice-president; Irving W. Bonbright, secretary and treasurer; F. H. Stehr, assistant secretary and treasurer; George B. Tripp, general manager.

MACON, MO.—By a detailed report submitted by the electric light and waterworks committee of the council it is shown that the municipal plants earned last year $867.76, the first time in the fifteen years' existence of the utilities named that the balance has been on the right side of the ledger. The installation of meters and more systematic methods are said to have accomplished the reform and placed the city properties on a paying basis.

EASTON, PA.—The plant of the Lehigh-Northampton Gas and Electric Company at Catasauqua will be overhauled, modernized and enlarged. The improvements will require several months' time. William W. McKee, the receiver, is arranging for the work. Two new engines of 200 and 400-horse-power capacity, a new Stirling boiler, improved condenser, water heater, pumps and switchboard will be installed, and a third wire run through the boroughs of Alliance and Coplay, to afford better service.

DETROIT, MICH.—The Indiana & Michigan Electric Company reports for the year ended December 31, 1904, gross earnings $214,339; operating expenses and taxes $109,405; net earnings $104,934; interest charges $37,500; surplus $67,434. It is reported that $550,000 of the company's first lien five per cent gold bonds have been sold. There are $1,500,000 of these bonds authorized, but the company reserves in its treasury $750,000. The bonds are subject to call at 105 and interest. The net earnings of the company are about three times the amount required for interest on the bonds.

DULUTH, MINN.—The Great Northern Power Company has awarded the contract for the construction of its canal to Porter Brothers, of Duluth. The work has been started, and will be completed within a year, the limit set being March 1, 1906. Three large steam shovels will be in continuous operation. The canal will be two miles long. Where it goes through rock it will be thirty feet wide at both the bottom and the top, with perpendicular sides, but where earth is to be excavated the canal will be thirty-six feet wide at the bottom and the sides will extend outward, with the width at the top ninety-six feet.

CANTON, GA.—A. J. Warner, formerly of Ohio, but now of Gainesville, and his associates, have been granted a charter by the Cherokee superior court incorporating the Etowah Power Company, with a capital of $10,000, with the privilege to increase to $1,000,000. The company expects to build a dam 600 feet long and thirty feet high across the Etowah river, about four miles below Canton, which probably will be completed during the year. The company organized by the election of A. J. Warner, president; E. P. Kirby, vice-president; W. H. Slack, secretary and treasurer; P. P. DuPre, of Canton, general counsel; W. A. Carlisle, chief engineer, and F. P. Catchings, electrical engineer. Board of directors: A. J. Warner, W. A. Carlisle, W. F. Huntley, E. P. Kirby, all of Gainesville; C. M. Merrick, of Pennsylvania, and P. P. DuPre and F. P. Burtz, both of Canton. The company has already acquired some property along the Etowah river.

Digitized by Google

TELEPHONE AND TELEGRAPH.

TRESCOTT, KAN.—The Trescott Telephone Company will install an exchange at Culver.

MARBLE FALLS, TEX.—The Texas Telephone Company has purchased the Martin lines for $27,500.

WALLA WALLA, WASH.—A rural telephone line has been built by the Hudson Bay Telephone Company.

FORT WAYNE, IND.—At a meeting of the board of the town trustees of Roanoke the Farmers' Mutual Telephone Company was voted a fifty-year franchise.

DOYLESTON, PA.—The Mutual Telephone Company held its annual meeting at Eureka on February 20. The treasury showed that the company was in a flourishing condition. The old officers were reelected.

ELMONT, N. J.—The New York & New Jersey Telephone Company has secured permission from the property holders along the Elmont road to run a telephone connection from the Hempstead road to the Merrick road.

AUBURN, N. Y.—The Empire State Telephone and Telegraph Company has elected the following directors: Charles I. Avery, U. N. Bethell, C. F. Cutler, F. P. Fish, F. G. Fincke, Thomas Sherwin, H. L. Storke, George Underwood, F. G. Wood.

SARATOGA SPRINGS, N. Y.—The Granville Telephone Company has purchased the Comstock-North Granville private telephone line, which was practically owned by C. K. and I. V. Baker, and the line will probably be extended to Fort Ann village in the spring.

CLINTON, N. J.—It is reported that the Farmers and Merchants' Telephone Company is about to extend its line from Cokesbury to Califon and German Valley, and that the Lebanon Telephone Company will also extend its line from Califon to Vernoy, Teetertown, etc.

BUTLER, PA.—Butler, Kittanning and Pittsburg parties have organized the Butler & Coylesville Telephone Company, and will construct a line from Butler to Kittanning by way of Coylesville. The new line will be connected with the Pittsburg and Allegheny Telephone Company's line.

DECATUR, ALA.—The Long-Distance Telephone and Telegraph Company, with a capital of $500,000, has been incorporated to build and operate a system of long-distance telephones in Alabama and other states. The main leader in this enterprise is E. L. Barber, of Wauseon, Ohio. Associated with him is J. C. Monteith.

UNION, S. C.—The Bell telephone and exchange, at Union, which began business March 1, 1902, with fifty-six subscribers, and which by the absorption and consolidation of the independent exchange on January 1, 1903, secured fifty-two additional subscribers, is about to make extensive improvement, which will give the exchange a capacity of 500 stations.

RICHMOND, VA.—A telephone company has been organized with Cleve Harding, president, and E. L. Sterne, secretary and treasurer, to build a line from Tackett's Mill, in Stafford, to White Ridge, in Fauquier County, where it will connect with the Cedar Run Company's line. It is expected that the line will be in operation in sixty days.

ELLSWORTH, ME.—The Union River Telephone Company has been organized at Amherst for the purpose of operating telephone lines in the towns of Amherst, Aurora, Mariaville, Otis, Eastbrook, Waltham, Clifton and the city of Ellsworth with a capital stock of $8,000. Albert E. Mace, of Aurora, is president, and Herbert T. Silsby, of Aurora, treasurer.

FIRTH, NEB.—Firth has organized a telephone company to be known as the Firth Telephone Company. The following officers were elected: J. M. Van Burg, president; C. Wismer, vice-president; M. H. Wittstruck, secretary; John Remmers, treasurer. The plans are to have the stockholders and patrons buy and own the telephones and lines outright.

ROCHESTER, N. Y.—It is understood that a company is about to be organized, to be known as the Inter-Laken Telephone Company. The company will be connected with the Inter-Ocean Telephone Company, at Auburn, thus giving long-distance service. It is expected to furnish telephone service to King's Ferry, Aurora, Scipio Center, Fleming and all intermediate points.

KILLAWOG, N. Y.—The Rural Telephone Company, of Killawog, has sold its interest in the line to the Killawog Telephone Company, and at a recent meeting nine directors were elected as follows: R. J. Tarbell, T. R. Hitt, Marvin Muckey, Killawog; Carley Adams, A. C. Baker, C. A. Brooks, Marathon; A. Dickinson and Messrs. Shevaliers and Messengerville. The line is to run through Messengerville, and west to meet the Dryden line.

CHEMAWA, ORE.—Poles have been set and wires strung for the Chemawa farmers' telephone line. A stock company has been formed and incorporated, and the members of the association have done the construction work among themselves. An agreement has been entered into with the Pacific States Telephone Company on terms that will assure the subscribers of the system very reasonable rates. They now have about thirty telephones on the system, which taps one of the best suburban districts.

SAN DIEGO, CAL.—The Southwestern Home Telephone Company has been at work for the last three months establishing lines in the towns of Banning and Beaumont. From Banning a toll line is under way to San Jacinto *via* Relief Hot Springs. As soon as this is completed the company will begin running the lines on to Indio, and from there to Mecca. The company will then push eastward to Yuma *via* the Imperial valley. At Yuma the company connects with the independent toll lines from Prescott and Phoenix.

ALBANY, N. Y.—At a meeting of the stockholders of the Hudson River Telephone Company, the annual report submitted by the directors showed an increase in income for the twelve months of $18,890, an increase in interest charges of $27,435, and a decrease in funds remaining for dividends of $8,545. The net revenue applicable to dividends was $244,416, and the dividends paid amounted to $234,372. Additions and betterments during the year placed in the construction account aggregated $527,915. The gain in the number of telephones was 5,176.

WILLIAMSPORT, PA.—The North Mountain Telephone Company has been organized, and will run a new line from Muncy Valley *via* North Mountain post office and Lungerville to Unityville. Work will be started immediately, and it is expected the line will be in operation by July 1. The following officers have been elected: president, Burgess Swisher, of North Mountain; vice-president, James Lunger, of Lungerville; secretary, Jefferson Secules, of Muncy Valley; treasurer, Albert Myers, of Muncy Valley; directors, Thomas Schug, George Chestnut and Abraham Bigger.

PITTSBURG, PA.—The Pittsburg & Allegheny Telephone Company is completing the installation of one of the largest private branch exchange systems ever ordered from any telephone company. The Carnegie Company has adopted the Pittsburg & Allegheny system exclusively for its private exchange system, and now has in operation nine exchanges with almost a thousand telephones There are about one hundred telephones in the Carnegie Building, Fifth avenue, with trunk lines and branch exchanges at Homestead, Duquesne, Braddock, the Edgar Thomson works, South Sharon, Youngstown, etc.

MINNEAPOLIS, MINN.—H. J. Pettengill, Boston, Mass., who succeeded C. E. Yost as president of the Northwestern Telephone Company, has assumed charge, with headquarters in Minneapolis. Mr. Pettengill is planning many changes and improvements. One of the most important improvements will be the erection of a large toll office on the east side, which will be made the central toll office of the company. The American Telephone and Telegraph Company has been requested to have its wires in the East Minneapolis office. Much underground laying of wires is also planned for this year. Mr. Pettengill proposes stringing 1,000 miles of toll circuits. The company now has 30,000 miles of copper wire strung, which accommodates over 30,000 subscribers.

UTICA, N. Y.—The annual meeting of the stockholders of the Central New York Telephone and Telegraph Company was held at the offices of the company recently. Only routine business was transacted. The president made his annual report to the stockholders. The following directors were elected for the ensuing year: U. N. Bethell, New York; G. L. Bradford, Utica; C. F. Cutler, New York; F. P. Fish, Boston; L. H. Lawrence, Utica; J. F. Maynard, Utica; F. T. Proctor, Utica; C. B. Rogers, Utica; Joseph Rudd, Utica; Thomas Sherwin, Boston; F. G. Wood, Utica. At the meeting of the board of directors the following were elected: chairman of the board, C. F. Cutler, New York; U. N. Bethell, New York, president; Joseph Rudd, Utica, vice-president; F. G. Wood, Utica, secretary and treasurer.

Digitized by Google

ELECTRIC RAILWAYS.

JERSEY SHORE, PA.—The Jersey Shore Street Railway Company will install a 225-kilowatt railway outfit.

UNION, S. C.—A plan to connect Union, Spartanburg and Gaffney with the summer resorts of North Carolina by an electric line is on foot.

SYRACUSE, N. Y.—An extension of the Syracuse, Lakeside & Baldwinsville road to Phoenix, and possibly to Fulton, is contemplated. About $400,000 will be expended.

MANSFIELD, OHIO—Surveyors for the Citizens' Electric Railway Company are reported to be laying out a line to connect with the Cleveland & Southwestern Traction Company.

COLUMBUS, OHIO—The Columbus Railway and Light Company will make a number of improvements this year, among them being the installation of a large storage battery station.

ELIZABETHTOWN, PA.—Ordinances have been passed by the Elizabethtown council granting franchises to the Philadelphia, Lancaster & Harrisburg Electric Railway Company.

CINCINNATI, OHIO—The Cincinnati Rapid Transit Railroad Company, J. G. Schmidlap, president, plans to build an elevated railroad in Cincinnati, operated by the third-rail system.

SCRANTON, PA.—W. L. Connell is said to be at the head of a company which proposes to construct an electric railway through Chinchilla, Glenburn and Dalton, from Providence Square.

OTTAWA, QUEBEC—The Ottawa River Railroad Company has awarded a contract to M. P. McGrath, of Easton, Pa., for the construction of an electric line between Montreal and Ottawa.

SHENANGO, PA.—The Shenango Street Railway Company will ask for bids for its road, sixty-four miles long, as soon as rights of way are secured. W. H. Waugh, Greenville, Pa., is chief engineer.

WOOSTER, OHIO—C. V. Hard, of Wooster, is reported interested in the construction of the Cleveland, Ashtabula & Mansfield Railway, which will connect with the Cleveland & Southwestern at Wellington or Medina.

LIMA, OHIO—The last franchise for the construction of the Toledo, Ottawa and Lima electric railway has been secured and work is assured for the early spring. J. B. Mayer, president, Lima Electric Railway and Light Company, is interested in the project.

PHILADELPHIA, PA.—Work on the construction of the Washington, Baltimore & Annapolis electric line will be started within a few weeks. The Bishop-Sherwin syndicate will soon take charge of the property, and the Roberts & Abbott Company will do the construction work.

ADRIAN, MICH.—The Adrian & Jackson electric road is to be built. J. W. Helme and W. H. Hand, of Adrian, have been working on the proposition for a year, and have now practically secured all the franchises except in Adrian, where the route has not yet been decided upon.

BALLSTON, N. Y.—The Eastern New York Railroad Company has given to the Metropolitan Trust Company a mortgage of $1,750,000 to cover that amount of five per cent bonds. The railroad company will build electric lines from Ballston to Gloversville, Amsterdam and Johnstown.

SAN MARCOS, TEX.—The company which purposes to construct the electric line from San Marcos to Luling has been organized. San Marcos capitalists are interested. A. L. Davis, of San Marcos, is president, and A. K. Lipscomb, of Luling, is vice-president. The surveying party has begun work.

FREEPORT, ILL.—The city council of Freeport at a special meeting granted a franchise to the Freeport-Dixon Electric Railway Company to operate its line in that city. The ordinance provides that the company is to enter the city on its own tracks and that it must provide a city service on the south side.

SIOUX CITY, IOWA—Improvements costing between $125,000 and $150,000 will be made by the Sioux City Traction Company as soon as material arrives from the East, and the company is assured of continued good weather. Rails for six miles of new track have been ordered. The plans announced call for double, standard gauge tracks on nearly every line in the city.

NEW LEXINGTON, OHIO—It is reported that Edward S. Martin, of New Straitsville, has completed arrangements for the financing of the Perry Electric Railway, Light and Power Company, which proposes to build an electric railway from New Straitsville to Zanesville by way of New Lexington. Work is to be started soon.

LAKE CHARLES, LA.—The contracts have been let for the supplies necessary to change the present horse car street railway to an electric line. President Bird, of the Lake Charles Street Car Railway Company, says that about five miles of track will be laid; that construction will be begun immediately, and that the line will probably be in running order by June 1.

WATERBURY, CT.—The New England Engineering Company has secured the contract for the electrical work for a trolley line from Jeanette to West Newton, Pa., which is to be built by the Jeanette, West Newton & Monongahela Valley Street Railway Company. The road will be about thirteen miles long, and it will pass through the towns of Edna, Arona and New Madison. The construction work will begin about April 1. Approximately $325,000 is involved in the contract.

ST. THOMAS, ONT.—The Southwestern Traction Company and the city council have come to an agreement, the city accepting the Traction Company's offer for the use of the St. Thomas's street railway lines through the city. The company has received a fifty-year franchise and makes an agreement for twenty-five years to pay the city $1,200 per year per mile for the first five years, $1,350 for the second, $1,500 for the third, $1,550 for the fourth, and $1,750 for the last five years.

BIRMINGHAM, ALA.—At the annual meeting of the stockholders of the Birmingham Railway, Light and Power Company it was agreed to stand by the action of the stockholders in proposing to expend $700,000 this year for improvements on the local light and street railway plants, and it was further decided to reduce the cost of electric lights to the public. The year 1904 was the best the company has had. It paid $590,000 in interest and dividends. All the old officers were reelected.

WAPSKONETA, OHIO—F. D. Carpenter, general manager of the Western Ohio Railway Company, states that bids have been received for the construction of the Lima, Findlay & Fort Wayne electric line, a distance of thirty-two miles, between Lima and Findlay. The Lima, Findlay & Fort Wayne company has also decided to issue $300,000 in first preferred cumulative stock at par. When this line is completed the western part of Ohio will have an unbroken trolley route between Toledo and Cincinnati.

LAWTON, OKLA.—It is announced by the Lawton, Wichita Mountain & Western Electric Railway Company that it expects to begin the construction of a line from Lawton to the Wichita mountains, by way of Fort Sill, as soon as the game preserve has been established and Fort Sill has been made a regimental post, both of which have been recently provided for by Congress. The company has a franchise in Lawton, and a certified check for $1,000 has been presented as a guarantee that it will build the line. It will be about twenty-five miles in length, and will probably be extended northwest to Hobart.

DES MOINES, IOWA—Engineers have commenced work on the proposed Porter electric road, from Des Moines, through Nevada, to Eldora. It is intended to build the Des Moines and Nevada section this season. This is the line that is to be built in conjunction with the Polk lines out of Des Moines, the Polks to supply an entrance to Des Moines from near Saylor and the Porter interests to build the balance of the line. The survey has been started from the end of the old Polk survey about midway between the old town of Saylor and the town of Ankeny, where it is proposed this new road will cross the Northwestern.

YORK, PA.—The lower end of York County is to have better transportation facilities. A bridge will be built over the Susquehanna, at York Furnace, this spring, it is said, by a number of capitalists, chief of whom are the owners of the Lancaster & Pequea Trolley Company, and the Pequea, Chestnut Level and New Oxford trolley companies, of Lancaster County. The presumption is that the lines will be immediately extended into the Chanceford townships in York County, and on to Delta and Red Lion to con-

Digitized by Google

nect with the existing lines of the York County Traction Company. The surveys already have been made, and a charter for the bridge will be applied for.

EDUCATIONAL.

LECTURES FOR THE ENGINEERING STUDENTS OF THE UNIVERSITY OF MINNESOTA—On February 24, Mr. Fred G. Dustin, city electrical inspector for Minneapolis, Minn., gave a lecture before the Society of Engineers of the University of Minnesota, on "Safety in Electrical Installation." After describing the development of the present insurance rules Mr. Dustin took up the city ordinance governing electrical installation and operation. He showed interesting samples of defective fittings and construction which had been condemned. Samples of new devices were shown, giving examples of how the new rules were being met. He admonished the young engineers to supplement their theoretical work with practical experience, emphasizing that their ultimate success or failure would depend upon their ability to put into practical use the technical training and knowledge being acquired. On March 10 Mr. W. I. Ely, of the Murphy Iron Works, Detroit, Mich., addressed the society on "Smoke Prevention." On March 17 Mr. C. E. Downton, of the Westinghouse Electric and Manufacturing Company, gave an illustrated lecture on the company's Pittsburg factory and products. On March 24 Mr. Benjamin Waller, resident engineer of the Northwestern Telephone Exchange Company, will lecture upon "Some Novel Features of a Modern Telephone Exchange."

OBITUARY NOTICES.

PAOLI CASTELLI, the inventor of the Castelli coherer, with which Signor Marconi first succeeded in receiving signals across the Atlantic, died recently at his home in Italy. Castelli was corporal in the signal corps of the Italian navy, and was assigned to assist the officers who were making tests with wireless telegraphy. While engaged in this work he invented the coherer which bears his name.

MR. SEABURY BREWSTER WILEY died in Birmingham, Ala., on Saturday, March 11. He was a son of Charles Wiley, vice-president and treasurer of the firm of John Wiley & Sons, scientific publishers, New York city. He was about forty years old. For many years he was connected with the Blauvelt-Wiley Paper Company, of New York, being one of the incorporators and a joint owner. Subsequently he sold out his interest in that concern and became identified with the Toledo Pipe Threading Company, of Toledo, Ohio. The body was brought to East Orange, the residence of his father, for burial.

MR. D. H. CONKLIN, former mayor of Decatur, Ill., and a prominent railroad manager, died at his home in that city, Friday, March 11, at the age of seventy-four years. He was a printer's apprentice in Peekskill in 1848, and later came to New York, where he was employed on the *Tribune*. He was one of the first to learn telegraphing on the old Ezra Cornell line, which was installed by Cornell on the New York & Erie Railroad from Piermont to Goshen. In the winter of 1851 Superintendent Mino, of the Erie, induced Mr. Conklin to leave the printing office to take charge of the telegraph office at Piermont, with a salary of thirty dollars a month, and he thus became the first telegraph operator to receive a salary from a railroad company. He assisted in stringing the first insulated wires under drawbridges on the Paterson & Ramapo and Paterson & Hudson River railroads, and opened several telegraph offices on the Susquehanna & Western divisions of the Erie. In 1866 he became Erie train despatcher at Port Jervis. Early in the seventies he went to Illinois and became president and general manager of the Illinois Central Railroad Company, with headquarters at Decatur. He retired from active railroad service several years ago with a competency, and in 1894 was elected mayor of Decatur. His body was brought to Port Jervis on Monday for interment.

NEW COMPANIES.

TOLEDO, OHIO—The Yost Electric Manufacturing Company has been formed by F. H. Chapman and others. The capital is $200,000.

SPRINGFIELD, ILL.—The American Carbon Battery Company, of St. Louis, Mo., has been incorporated under the laws of Illinois with a capital of $75,000.

CHICAGO, ILL.—The Clark Electric Meter Company has been incorporated with a capital of $2,500, by Eugene J. Clark, Frank W. Robett and Max A. Gorman.

LITTLE ROCK, ARK.—The Treadway Gilman Electric Company has been organized to engage in electrical construction and to do a consulting engineering business.

BOSTON, MASS.—The Monitor Electrical Speed Recorder Company has been formed by James H. Kendall, Newton; Andrew W. Jones, Cambridge, and Edgar B. Champlin, of Boston. The capital is $5,000.

PORTLAND, ME.—The Electro-Radiation Company has been organized with a capital of $100,000, to manufacture electrical apparatus. The officers are: president, H. W. Libby; treasurer, A. H. Burwell.

TRENTON, N. J.—The Porcelain Electrical Manufacturing Company has been organized by Charles A. Secor, New York city; William I. Peacock and Frederic R. Brace, Jr., of Trenton, N. J. The capital is $25,000.

BOSTON, MASS.—A new corporation, known as the Telelectric Company, has been organized in Pittsfield, Mass., to manufacture an automatic electric piano player. The company is capitalized at $400,000. John F. Kelley is at its head.

CINCINNATI, OHIO—The Electrical Appliance Company has been incorporated at Columbus with $10,000 capital, by Kenna Dunham, William C. Pierce, Stanley Matthews, Edna Kennedy and T. Paschen. The company will manufacture a patented device for the transformation of an alternating into a direct current.

NEW YORK, N. Y.—The Beesley, Benn & Lehman Manufacturing Company, of New York, has been incorporated to manufacture mechanical and electrical appliances. The company has a capital of $40,000, and the directors are James Beesley, of Brooklyn; Louis Frederick Benn, of Bayonne, N. J., and Joseph A. Lehman, of Roselle, N. J.

INDUSTRIAL ITEMS.

WILLIAM ROCHE, 52-54 Park place, New York city, manufacturer of dry batteries, coils, etc., has distributed a large calendar. The calendar gives views of a number of points of interest around New York.

PATTERSON, GOTTFRIED & HUNTEE, LIMITED, 146-150 Center street, New York city, have issued catalogue No. 39, describing blacksmiths' tools. The catalogue contains 252 pages and is well illustrated.

THE MONARCH ELECTRIC MANUFACTURING COMPANY, Warren, Ohio, maker of incandescent lamps, has appointed the H. L. Whaley Company, 22 East Twenty-first street, New York, its eastern agent.

THE TRAY PLATE BATTERY COMPANY, Binghamton, N. Y., is calling attention to the storage battery manufactured by it. The company is distributing copies of testimonials received by it as to the worth of the battery.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., is distributing a number of bulletins descriptive of its "Inter-Pole" variable-speed motor. The company will be pleased to send these bulletins upon request to any one interested.

THE UNION SWITCH AND SIGNAL COMPANY, Swissvale, Pa., is sending out bulletin No. 23, describing the electric train staff system, and also errata slips for the first edition of section 3, describing mechanical locking and operating devices.

THE STIRLING COMPANY, Chicago, Ill., will remove its general offices to the new Trinity Building, New York city, next month. This company is a well-known manufacturer of water-tube safety boilers, and has branch offices in all the leading cities, with extensive shops and foundry at Barberton, Ohio. Mr. E. R. Stettinius, the treasurer and active manager of the company, will make his headquarters in New York city in the future.

THE SUMTER TELEPHONE COMPANY, Sumter, S. C., has issued a large wall calendar. A photograph of the company's fac-

Digitized by Google

tory and illustrations of the various type of telephones manufactured by this company are shown on the upper part.

THE ELECTRIC APPLIANCE COMPANY, 92-94 West Van Buren street, Chicago, Ill., is announcing a useful life for the Packard lamp of from 600 to 800 hours. If, at the end of that time, the lamp has not become unfit for service, the company advocates its removal from the circuit.

THE UNITED ELECTRICAL MANUFACTURING COMPANY, 43 Murray street, New York city, has issued a neat catalogue descriptive of "Crescent" dry batteries. This catalogue describes the various forms of "Crescent" dry cell, and, in addition, apparatus for automobile or launch engine ignition.

THE BOROUGH BRONZE COMPANY, New York city, announces the opening of its chandelier showrooms at 130-132 West Twenty-fourth street. This company has gone to great expense and trouble in making its showrooms the finest that can be found in the city. The company held a reception on Wednesday, March 8.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., are calling attention to P. & S. porcelain pendant sockets. These are made both in key and keyless forms, in Edison and Thomson-Houston bases. Special prices are being quoted to the electrical trade. The literature will be sent to any one interested upon request.

THE DE LAVAL STEAM TURBINE COMPANY, Trenton, N. J., has issued a catalogue describing the centrifugal pumps manufactured by it. In addition to the description of the pumps a description of the test made on the pump last year by Professors Kent and Denton, together with the report made by these gentlemen, is given.

THE W. F. DOLL MANUFACTURING COMPANY, 175 Broadway, New York, has put on the market what is termed the "Doll" non-magnetic watch. It has been made specially to meet the wants of electrical engineers in charge of electrical machinery. It is stated that the works are thoroughly non-magnetic, and are of the latest design, superfinished, and are enclosed in strong American gun metal cases.

THE WILLIAMS GAUGE COMPANY, 543-547 Fourth avenue, Pittsburg, Pa., is distributing a catalogue calling attention to the steam specialties manufactured by it. These include feed-water regulators, steam traps, pump governors, water columns, gauge cocks, etc. It is also sending out a pamphlet containing reproductions of some of a large number of orders which it has received for these specialties.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, will be pleased to furnish on application full information concerning "Asbestocel" sectional pipe covering. This consists of several layers of corrugated asbestos paper, placed so that the corrugations run concentrically around the pipe. Each channel forms a closed loop, in which the air is imprisoned and eliminates longitudinal circulation.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36-58 West Jackson Boulevard, Chicago, Ill., announces that the Independent Telephone Company, of Topeka, Kan., recently ordered an additional equipment of private branch exchange switchboards. The Topeka company has secured a contract for equipping nearly all of the hotels with this class of service. The American Electric Telephone Company has furnished all of the apparatus needed for the hotel equipments, including switchboards and telephones.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West Thirty-fourth street, New York city, will be pleased to mail its bulletin No. 309, descriptive of electric fans. The bulletin shows the standard line of Sprague fan apparatus which has become so popular during the many years it has been upon the market. The Sprague company was one of the pioneers in the development of electrical fan apparatus, and has maintained this popularity, notwithstanding the excellent apparatus which is now available for selection.

THE AMERICAN ARC LAMP COMPANY, Elwood, Ind., announces that it has purchased the patents and factory of the Lea Electric Manufacturing Company, Elwood, Ind., and will continue the business, maintaining the high standard of lamps, and developing and increasing the company's operations by the addition of facilities. The factory of the Lea company will remain in active operation in Elwood, Ind., until about May 15, when it will be removed to the American Arc Lamp Company's new buildings now being erected in Kalamazoo, Mich.

THE CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY, Baltimore, Md., is distributing a booklet entitled "Powerful Aids in Manufacturing." This is one of a series of booklets which is published monthly by the company. The booklet under discussion deals particularly with notes on electric service and the availability of electric power throughout Baltimore. Illustrations are given showing the application of the electric drive to machine tools and other manufacturing appurtenances, and data are included showing the costs of power and the availability of service.

THE HOLOPHANE GLASS COMPANY, Glackner Building, New York city, is distributing a handsome pamphlet entitled "The Lighting of Large Buildings, Offices and Stores." This pamphlet is one of a series which the Holophane Glass Company has been distributing for some time. The frontispiece is a reproduction of the rotunda of the Rookery, Chicago, showing the application of Holophane glass globes. The text describes the applications of modern illumination to secure the most brilliant and attractive effect. Numerous illustrations are given, to which reference is made in the text, showing the extremely effective range of light distribution which is possessed by the Holophane products.

THE AMERICAN ELECTRICAL SUPPLY COMPANY, Chicago, Ill., has purchased the supply department of Henry Newgard & Company, and has opened up for business at 83-87 Fifth avenue, where it will carry a complete line of all kinds of electrical supplies and material. Charles Edward Brown, the president of this new company, has been associated with the electrical business for a great many years, and has for the past eight years filled the position of secretary and manager of Henry Newgard & Company. The management of the business will be under the personal supervision of Mr. F. D. Phillips who for a number of years was with the Electric Appliance Company, and for the past year as treasurer and manager of the Crescent Company.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that the South Shore Electric Company has ordered from it one heavy duty 24 by 48 engine for direct-connection to a 425-kilowatt, alternating-current generator, to be installed in its power plant at Hammond, Ind., whose capacity is proving inadequate to take care of the heavy demands now made upon it. The People's Power Company, of Moline, Ill., has awarded the Allis-Chalmers Company the contract for one horizontal compound Reynolds-Corliss engine, 24 by 50 by 48, for direct-connection to a generator. This engine will be practically a duplicate of one previously made by the same company which has been giving excellent satisfaction. An interesting novelty in its construction is the fact that the cylinders have valves in their heads.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is building for the People's Power Company, of Moline, Ill., two engine-type generators to be installed in its power station. The company is an old one in that section of the country, and has built up an extensive business in lighting and power work. The addition to its present equipment will be a 1,100-kilowatt, two-phase alternator of the revolving field type, operating at 2,400 and 4,800 volts, and a 600-kilowatt, 600-volt, direct-current machine. The alternating-current generator is a duplicate of a machine which the company put into service about a year ago. An order for three 300-kilowatt, alternating-current generators has also been placed with the Westinghouse company by the Barber Lumber Company, of Boise, Ida. These machines will generate current at 440 volts, which will be transformed to 23,000 volts for transmission. The necessary transformers, switchboards and lightning arresters are included in the apparatus to be furnished. The Mammoth Copper Mining Company, of Salt Lake City, has just placed an order with the Westinghouse company for a large addition to its electrical equipment. A total of nearly 800 horse-power in induction motors of different sizes, together with a motor-generator set, transformers, switchboard and three mining locomotives, is included in the order. The motors, two of which have a rated capacity of 200 horse-power each and five of fifty horse-power each, will operate on three-phase, 2,000-volt circuits.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 12. NEW YORK, SATURDAY, MARCH 25, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Interference in Wireless Telegraphy 487
Retrogressive Telephone Legislation 487
Municipal Plants and Rates for Electric Supply 488
City Noises 488
Short-Sighted 489
Change Carried by the Alpha Rays from Radium 490
Report on Methods for Increasing the Capacity and Reducing the Noise of the Union Elevated Loop, Chicago, Ill. 491
The Difficulty with the Commutator, by Stanley S. Seyfert 492
The Possibilities of the Small Central Station 493
The Conclusions of the Niagara Power Commissioners Regarding Niagara 496
Some Points on the Selection of Electric Cables, by L. B. Atkinson and C. J. Beaver 497
Electrical Distribution in Paris in the Future 501
American Institute of Electrical Engineers 501
Interference in Wireless Telegraphy, by John Stone Stone 502
Electrical Tests in the Valtellina Railway 507
Planning New York Telephone Service for Twenty Years 508
New York Electrical Society 509
Iowa Telephone Association 509
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 510
Wireless Telegraphy in England 511
Meeting of the Electrical Section of the Franklin Institute 512
INDUSTRIAL SECTION:
Changes in the Arnold Electric Power Station Company 513
4000-Kilowatt Alternators for Chicago Sanitary District 513
High-Tension Strain Insulators 514
Quick Deliveries to Mexico from the Schenectady Works of the General Electric Company 514
Portable Photometer 515
Fort Wayne Integrating Wattmeters 515
Burke Electric Company—Fire Not Serious 516
Winking Sign Specialties 516
A Thirty-five-Ton Induction Motor-Driven Crane 516
CURRENT ELECTRICAL NEWS 517

INTERFERENCE IN WIRELESS TELEGRAPHY.

On another page of this issue we publish an important paper upon wireless telegraphy, which was read by Dr. John Stone Stone before the electrical section of the Canadian Society of Civil Engineers on March 9. In this paper Dr. Stone discusses the conditions necessary for selective or non-interfering wireless telegraphy, and shows how the different elements of the system should be constructed in order that this end may be attained. The theory by which these conclusions have been reached is not easy to follow, unless one has made a special study of electrical oscillations. The results of the analysis, however, have been confirmed by experimental investigations, and it would seem feasible to obtain the conditions necessary for practical selectivity. Having attained selectivity, and with a range of frequency which will permit fifty or sixty stations to be operated within sending distance of each other, there would seem to be a wide field for the use of this system of communication. There is no question that messages can be sent great distances and received, provided the conditions are favorable; but unless any station can get into communication with any receiving station within its zone at any time, the use of the system must be rather limited. This condition can only be attained by selective operation, and it is in this direction that many workers have been striving. Dr. Stone has made noticeable advances in selective action by thorough and painstaking study into the complex theory and by elaborate experimental work. In his paper he points out not only the theoretical conditions most suitable for the receiving circuits, but he shows how the various devices themselves should be constructed so as to approach these conditions most nearly.

RETROGRESSIVE TELEPHONE LEGISLATION.

Telephone rates in New York city, in one form or another, have come in for considerable discussion in the last few weeks, and at the present time there is under consideration at Albany a plan to abolish telephone tolls for talks from one borough to another. This apparently simple proposition involves some large and serious questions.

It is generally agreed that the advanced condition of the telephone industry in this city is largely due to a plan of rates, which, in a word, provides that each subscriber shall pay for what he gets, measured by the number of messages he sends and the amount of investment used in carrying such messages. The advantages and equities of such a plan over that of charging a lump sum per telephone, regardless of the number of messages sent, or the distance they are carried, are now very generally recognized. Even those well-meaning people who only a few years ago worked industriously for legislative action fixing so-called "flat" rates for the various communities which to-day constitute New York city, now perceive that had their advice been taken a serious mistake would have been made.

The bill now under consideration at Albany presents the "flat" rate idea in another form. It deals with areas instead of the number of calls, and only in this way differs from other flat-rate measures. The present city of New York was formed by incorporating into one municipality a number of separate communities. The plan of Senator Keenan, who fathers the bill in question, is to treat the vast area covered by New York city as one telephone district. There are to be no rates for service within any area less than the whole of this great city. Such rates, varying with the privileges offered, and in some cases as low as twenty-four dollars per year, have been the means of bringing the inestimable benefits of the telephone to a large number of people, but the advocates of Senator Keenan's

Digitized by Google

bill would change all this. No such rates are to be allowed, however much they may be desired by the public. It is to be unlawful to charge any regular subscriber an additional fee for a talk from one borough to another. Practically all must be on the same basis, and then it seems to follow as a matter of course that all regular subscribers must pay the same rates; otherwise there would be unlawful discrimination. The Keenan bill means all this if it means anything. A moment's reflection will show that, from the standpoint of the public, it is not a desirable measure. The lawmakers would do well to look at it twice before acting.

MUNICIPAL PLANTS AND RATES FOR ELECTRICAL SUPPLY.

The outlook for electrical development in London is not very hopeful, for matters have been considerably confused by the number of requests made of Parliament for power to erect electrical supply stations, and by the stand taken by the municipal authorities there. The latter object to all bills which would enable private companies to extend their systems or erect new stations, although they themselves are not in a position to carry out the much needed development. This position taken by the municipal authorities leads one to examine the conditions of their plants in London, thus bringing to light some interesting facts.

It seems that the private companies in London have, on the whole, done a fairly successful business, although one or two of them have not done so well. On the other hand, the municipal systems have not done as well as the private systems. Indeed, on the whole they make a very poor showing. They have been able to add but little to their reserve and depreciation funds and, indeed, in some cases have been forced to draw upon these funds in order to pay running expenses. The report of the London County Council for the year 1902-1903 showed that, of thirteen municipal plants, there was but one which was able to make a reduction in the tax-rate. Four found it necessary to draw upon the taxes. Only three of these companies paid anything toward depreciation. Four payments were made to the reserve fund.

This condition leads one to enquire why, as a rule, the London municipal plants should be unsuccessful, while the private plants generally do a good business. Four reasons occur which may be suggested, any one of which might explain this result: first, the officers in charge of the municipal plants may be incompetent; second, the men who are responsible for the running of the plant may be dishonest; third, the men in charge, while both competent and honest, may unintentionally not devote as much attention to the details of operation and to keeping down the expenses as they should; fourth, the rates charged for the supply may be too low.

Taking up these four reasons, we may at once dismiss the first two, because we have no reason either to attribute to the officers incompetence or dishonesty; and, moreover, in attempting to draw any lesson from the London experience, these reasons could not be urged, since the reply could always be made that competent and honest men can be found. As for the third reason, it is not improbable that it will account, in part, for the unprofitable operation of municipal plants. Experience teaches us that we can not expect men whose positions are secure, and who gain nothing by improving the operation of their plant, to take as great pains and to devote as much time to improving every little detail as would men whose positions depend upon the results which they obtained, or who are financially interested in the system. This is a condition which may be expected in every municipal undertaking, and it should be reckoned with. It is not to be inferred that the men in charge are intentionally negligent. They probably do not realize that they are negligent.

The fourth reason suggested for the poor results shown by municipal plants seems to us to be the most important one. The only excuse for a municipal plant is that it reduces the expense of lighting the city or it supplies citizens at a lower rate than would be offered by a private company. Both of these excuses are apt to be urged, and for this reason the municipal authorities are likely to make the rates as low as they dare. If those who decide upon the charges which shall be made do not realize fully what it costs to operate a system, or how much they should charge against depreciation and maintenance, these rates are apt to be too low. An examination of the rates charged by the private and municipal companies in London would seem to show that this fourth explanation is the true one. The latest figures we have been able to obtain for the private companies are for the year 1903. The average of the rates made by eleven private companies operating in London was 9.44 cents per kilowatt-hour for private use. Six companies furnished some public lighting at an average rate of 4.74 cents per kilowatt-hour. The average of fourteen companies for both public and private supply was 7.94 cents. Compare these rates with those charged by the municipal authorities. The latest figures obtainable are for the year 1904, and these are for twelve London municipal plants. The rate for private supply is 6.9 cents per kilowatt-hour. The different municipalities charged themselves for public lighting at the rate of 4.62 cents, while the average charge for both public and private service was 6.21 cents per kilowatt-hour. This latter figure is nearly twenty-seven per cent less than the charge made by the private companies. If this rate were not less than that made by the private companies, the municipal authorities would save money by closing their plants and buying their supply. On the other hand, is it not chiefly because their rate is so much lower than that of the private companies that their financial showing is so poor? While the private companies have, as a rule, done a good business, it does not appear that they have made extraordinary profits. The city plants are not doing much more than paying their operating expenses, and are saving but little to be used toward paying for new machinery when it becomes necessary. The advocates of municipal ownership in this country are always telling us to look at what has been done in England, but we can not see that the results which we have quoted strengthen their position.

Digitized by Google

CITY NOISES.

In his second report on the Chicago traction systems, Mr. B. J. Arnold takes up the question of reducing the noise of the elevated. He examines the causes of the present noise, suggests methods which, it is thought, will reduce them, and outlines a set of experiments for determining the best method of changing the structure of the elevated lines so as to reduce the noise as much as possible.

Briefly, the causes of the noise and the methods of reducing it suggested are as follows: first, there is the noise of the train itself; second, there is the noise due to the structure when it is set in vibration by the trains; third, there is the noise due to the special work and joints of the rail, where the passing of the wheels causes a blow on the track. To reduce these noises, first, the running gear of the trains should be in first-class order; second, it should be enclosed. To reduce the noise due to the structure, this should be modified so as to prevent its being set in vibration, and, to this end, something must be interposed between the rails and the structure which will absorb the vibrations, and not transmit them to the structure. The most satisfactory method of doing this is to interpose a stone ballast between the rails and the structure. This must be carried on a suitable floor. The ties rest upon the ballast. To reduce the noise of the track, a joint should be used which will not cause the hammering which is now universal. The noise due to special work should be reduced by removing all such work as is not absolutely necessary.

It is only recently that we have turned our attention toward reducing city noises. Heretofore we have been practically free to make all the noise we wished, if we did it at our work. A halt has been called only when we made a noise for amusement. It is, however, a good thing that this problem is receiving attention, although it has been taken up in but few cities as yet. There is altogether too much unnecessary noise in cities. Much of it might be reduced by using better methods and approved apparatus. A good deal could be reduced at but little expense. Mr. Arnold advises enclosing the running gear of the elevated cars. The same method might be used on surface cars. There is no doubt that it would greatly lessen the noise which these vehicles cause at present.

It is out of the question to reconstruct elevated systems. In fact, we are looking forward to the day when they will come down entirely—in New York, at least. But if Chicago finds it practical to reduce the noise at a not too prohibitive expense, other cities will probably follow it. Having done this, they may direct their attention to other sources of disturbance. While it is true that enclosing the running gear of an electric car might prevent the free movement of air through the trucks, it would not be difficult nor expensive to add suitable ventilating devices which would produce the desired effect, at the same time reducing the noise.

But our surface and elevated lines are not the only offenders in this matter. One of the most annoying is the early wagon or truck running over a stone pavement. These vehicles are most annoying in the early morning hours, when most of us are, or would like to be, asleep. There are the baker's wagon, the milk wagon, and those other vehicles which must make early morning trips. Why should not these vehicles use rubber tires? In fact, why should not all city vehicles use such tires? They would cost more, it is true, but they would reduce the noise wonderfully. They would make hauling easier for the horses, and they would greatly lessen the wear on the street paving. Practically all mechanically driven trucks use rubber tires, and we hope it will not be long before some such tire becomes universal on all city vehicles.

SHORT-SIGHTED.

It was not very long ago that a fire broke out in a New York tenement, which resulted in a number of deaths because painters had been at work upon the house, and finding the fire-escape ladders in their way, had temporarily removed them. The result was a demand for instant inspection of all fire-escapes, to see that they were entirely adequate, in order that a similar accident might not occur again.

Some time later the awful accident happened in Chicago. As a result, all cities examined their theatres to see whether such an occurrence were possible at any of them.

Still later, disaster overtook New York in another direction. The *General Slocum* was burned, with a terrible loss of life. As a result of this accident, all our excursion steamers were overhauled, and, we hope, put in good condition.

Now again the to-be-expected has happened unexpectedly. A fire in a New York tenement caused several deaths; the fire-escapes were boarded up or so blocked with furniture as to make it impossible for the victims to escape by means of them. The result of this will probably be that all cities will see to it that fire-escapes are kept free and available for the purpose for which they are erected.

One of the most depressing things about these accidents is the fact that they concentrate attention upon one possible danger, and draw it away from others. We lock the particular door from which the horse is stolen, and leave all the others open. In other words, we are short-sighted, and we do not realize all that the lesson should teach us. We are like the school boy who learns his lesson by rote, and who can work out perfectly the particular example given in his text-book, but can not apply the principle involved to any other example. Eternal vigilance is the price of safety as well as of liberty, and we must learn that it is not enough to correct faults after they have proved their existence, but we must hunt for faults and make them right before they punish us for our negligence. If those whose business is to look out for such matters can not do all that should be done, they should have help. If the laws are not sufficient, they should be made so. Doubtless, it will be some time before this ideal condition can be reached, but we should aim toward it, and we ought to be nearer to it than we are to-day.

Digitized by Google

Charge Carried by the α Rays from Radium.

The following interesting communication from Professor E. Rutherford, McGill University, Montreal, is reprinted from *Nature* (London).

No special difficulty has been experienced in showing that the β particles (electrons), expelled from radium, carry with them a negative charge of electricity. The positive charge left behind on the vessel containing the radioactive material is simply and strikingly illustrated in the arrangement devised by Strutt, which is now popularly known as the "radium clock."

Since the α particles are deflected by a magnet as if they carried a positive charge, it is to be expected that this charge should be easily detected; but all the initial experiments made for this purpose resulted in failure. Since there are four products in radium which give out α particles, and only one which gives out β particles, it is theoretically to be expected that four α particles should be expelled from radium for each β particle.

In the Bakerian lecture (Phil. Trans., series A, vol. cciv, p. 212, 1904) I described some experiments that were made to determine the charge carried by the α particles. About half a milligramme of radium bromide was dissolved in water, and spread uniformly over a metal plate and evaporated to dryness. With a plate of twenty square centimetres in area, the absorption of the α rays in the thin film of radium bromide is negligible. The solution of the radium released the emanation, and, several hours after removal, the activity of the radium fell to about one-quarter of its maximum value, and the β and γ rays from it practically disappeared. The experiments were made with the radium film at this minimum activity, in order to avoid the complication which would ensue if the β particles were present. An insulated plate was placed parallel to the radium plate and about three millimetres away from it. The apparatus was enclosed in an air-tight vessel, which was exhausted to a very low vacuum. The current between the plates was measured by an electrometer. The saturation current between the plates rapidly fell with decrease of pressure, but soon reached a limiting value—about one one-thousandth of the initial—which could not be reduced further, however good a vacuum was obtained. No certain evidence that the α particles carried a positive charge could be obtained. It was thought possible that the inability to reduce the current below this value might be due to a strong secondary radiation, consisting of slow-moving electrons, which were liberated by the impact of the α particles on matter. Strutt (*Phil. Mag.*, August, 1904) has also observed a very similar effect, using a plate of radiotellurium, which is well suited for this purpose, as it gives out only α rays.

J. J. Thomson (Proc. Camb. Phil. Soc., November 14, 1904; see *Nature*, December 15) has recently shown in a striking manner that a large number of slow-moving electrons are liberated from a plate of radiotellurium, although this substance is supposed to emit only α particles. These electrons could be readily bent back to the plate from which they came by the action of a magnetic field. No indication, however, that the α particles carried a charge was obtained.

I have recently attacked this problem again, using the methods and apparatus previously described, but, in addition, employing a strong magnetic field to remove the slow-moving electrons present with the α particles. The apparatus was placed between the pole-pieces of an electromagnet, so that the field was parallel to the plane of the plates. In such a case, most of the escaping electrons describe curved paths and return to the plate from which they set out. On application of the magnetic field, a very striking alteration was observed in the magnitude of the current. The positive and negative currents for a given voltage were greatly reduced. The upper plate, into which the α particles were fired, rapidly gained a positive charge. In a good vacuum, this was the case whether the lower plate was charged positively, or negatively, or connected to earth. The magnitude of the charge, deduced from these experiments, was found to be practically independent of the voltage between zero and eight volts. When once a magnetic field had been applied, of sufficient strength to stop all the slow-moving electrons, a large increase in its value had no effect on the magnitude of the positive charge. I think these experiments undoubtedly show that the α particles do carry a positive charge, and that the previous failures to detect this charge were due to the masking action of the large number of slow-moving electrons emitted from the plates.

Observations were made under different experimental conditions, and with very concordant results. In one set of experiments a weight of 0.19 milligramme of radium bromide was used, spread on a glass plate, which was covered with a thin sheet of aluminum foil; in the other 0.48 milligramme, spread on an aluminum plate. The saturation current due to the latter plate, measured between parallel plates 3.5 centimetres apart by means of a galvanometer, was found to be 7.8×10^{-8} amperes. It is possible the failure of Professor Thomson to detect the positive charge carried by the α rays from radiotellurium was due to the smallness of the effect to be measured; for with the plate of radiotellurium in my possession, the current was only about one-fortieth of the above value.

Since the film of radium bromide is so thin that all the α particles escape from its surface, it is easy to deduce from the observed charge from a known weight of radium the total number of α particles expelled per second from one gramme of radium bromide. Taking into consideration that half of the α particles were projected into the radium plate, and assuming that the α particle carries the same charge as a gaseous ion, it was deduced that one gramme of radium bromide emits 3.5×10^{10} particles per second. Now the activity of radium bromide in radioactive equilibrium is four times this minimum, and contains four products which emit α particles at the same rate. It is thus probable that one gramme of radium bromide in radioactive equilibrium emits 1.4×10^{11} particles per second. I had previously deduced (*loc. cit.*), from indirect data, the value about 1.1×10^{11}, so that the theoretical and experimental numbers are in very good agreement.

I have also made experiments, by a special method, to determine the total number of β particles emitted from one gramme of radium bromide in radioactive equilibrium, and have found a value about the same as the number of α particles emitted at its minimum activity. It is thus seen that four α particles are expelled from radium for each β particle. The number of β particles obtained by Wien was much smaller than this, but, in his experiments, a large proportion of the more slowly moving β particles was absorbed in the radium itself and in the envelop enclosing it.

The number of α particles expelled per second from one gramme of radium is a most important constant, for on it depends all calculations to determine the volume of the emanation, and of helium, the heat emission of radium, and also the probable life of radium and the other radio elements.

Digitized by Google

Report on Methods for Increasing the Capacity and Reducing the Noise of the Union Elevated Loop, Chicago, Ill.

The second part on the rapid transit situation of Chicago, Ill., has been made to the committee on local transportation of the Chicago city council, by Mr. Bion J. Arnold. This report consists of two parts, the first dealing with the problem of increasing the capacity of the present elevated loop. Four plans are suggested. A more extended study of the problem shows that an increase in capacity can not be obtained by the method of through-routing, as suggested in the first report. At the present time the capacity of the loop is limited by the station platforms, and not by the junctions, although the latter limit the number of trains which can be operated over the road. The first plan suggests a new system of through-routing which calls for some changes in the present structure. This plan provides for through-routing of any trains from any of the three main divisions of the city to any other division. It is thought, however, that this plan is not altogether desirable, and a second plan is suggested, which provides for a limited through-routing. This will increase the capacity of the loop about twenty-five per cent, but it will necessitate some passengers changing cars.

The third plan contemplates what is thought to be the best solution of the problem. It eliminates grade crossings by elevating the tracks of the inner loop over those of the outer loop at certain points, and allows the routing proposed in the second plan to be adopted, and it increases the capacity of the system 100 per cent.

The fourth plan suggested contemplates increasing the loop by removing the present Van Buren street structure to Polk street.

The estimated cost of the first plan is $97,000; of the second, $80,000; of the third, $500,000.

The following are the recommendations made: first, to reconstruct and elevate the system, according to the third plan; extend the platforms so that each will accommodate two trains, and develop auxiliary terminals. If it is impracticable to elevate the inner loop, it is recommended that plan No. 2 be adopted, platforms extended and auxiliary terminals developed. If this plan proves impracticable, then the loop should be left as it now is, but power mechanism should be installed for operating the signals and the switches, platforms should be extended and auxiliary terminals adopted.

The second part of the report deals with the problem of reducing the noise. Mr. Arnold first describes the various plans for deadening the sound, which have been proposed, and, in some cases, tried. The first experiments for this purpose were made in 1871 by the Manhattan Railway Company, of New York. The rail was packed with some sound-absorbing material, but the results were not satisfactory. When the New York Central & Hudson River Railroad Company completed its steel viaduct from the Harlem river to 110th street, New York city, in 1897, the rails, which had at first been bolted directly to the steel structure, were raised and placed on wooden ties which were then ballasted with crushed stone. This had the effect of reducing greatly the noise.

In 1893 the Liverpool Overhead Railway, of Liverpool, England, used a steel arch construction, which carried the ballast on which the ties were laid.

The latest attempt in this direction was made on the elevated electric railroad of Berlin. Here the ties are imbedded in ballast. On the outer sections of the road, the ties are placed directly on the I-beams of the structure. The use of ballast has greatly deadened the sound of the trains.

Were the present loop structure not in place, Mr. Arnold is of the opinion that a concrete structure could be designed, which would prevent, to a large degree, the noise now arising from the steel structure, and that the cost for the concrete structure would not be greatly in excess of the cost of the present structure. However, the fact must not be lost sight of, that the noise comes primarily from the trains, and a large part of this noise can not be eliminated entirely, no matter how good the design of the structure. As the noise due to the track arises principally from joints and special work, it is suggested that a mitred joint or a scarfed joint be adopted, and all special work not absolutely necessary for the proper operation of the trains be removed.

Since a large part of the noise proceeds from the running gear of the trains, it is important to apply some corrective for this, either on the cars or on the structure. Some method of enclosing the entire truck, including the wheels, with a light casing of sound-deadening, non-combustible material, such as asbestos sheeting, should be tried. This casing should come as close to the guard rails as practicable, and clear the third rails, so as to intercept as much of the noise from the wheels as possible. On one of the Chicago systems the trains are operated by means of a single motor car. It is suggested that this plan be abandoned and the multiple unit system be adopted, so as to reduce the duty on the individual gears, and thus reduce noise. All future cars should be equipped with trucks having as few parts as possible. Such cars as have no sound-deadening material in them should have hollow spaces filled with mineral wool or other light, non-combustible material. The relief openings of the triple valves of air brakes should be muffled. The cars should be inspected regularly, and all defective and worn parts promptly renewed.

Several methods by which the roadbed might be ballasted are considered. A wooden-ballasted floor is now in use on a section of the Boston Elevated Railway, with a marked effect in deadening the noise. Ballasted steel floors are objectionable, because they add to the amount of metal in the structure. This not only increases the noise due to the steel in the structure itself, but adds to the cost of painting and maintenance. A concrete floor, on the other hand, is free from these objections, but it calls for reenforcing the present structure. It is practically inelastic, therefore almost noiseless, and is proof against deterioration. It could be made up in sections in any convenient shop near the site, and erected in place as required. This would avoid all work in the field, except placing and setting. An objection to the solid floor is that it collects snow, but this is not thought to be serious. It also shuts off more light from the street, than does the present open structure. If a concrete floor should be adopted, it is suggested that concrete sides be extended up above the car truck, so as to enclose the running gear completely. This would aid greatly in reducing the noise.

It is recommended that if an elevated structure which would remove cross-overs and special work can not be adopted, that the structure be reconstructed according to a proposed plan, that it be reenforced at all junctions, and each junction provided with a solid floor ballasted with crushed stone or slag; that if this plan be impracticable, the junctions should be floored and ballasted; that sections of 300 feet each of the Market street terminal be equipped with different floors, and that trains be operated over these sections until the relative merits of the different types can be determined. When this has been done, the loop structure between junctions should be reenforced and the type of floor selected applied. In any event, it is recommended that the track and special work be reconstructed in accordance with suggestions contained in the report, and that the rolling stock and special work be maintained in first-class condition under rigid city inspection.

Digitized by Google

THE DIFFICULTY WITH THE COMMUTATOR.

BY STANLEY S. SEYFERT.

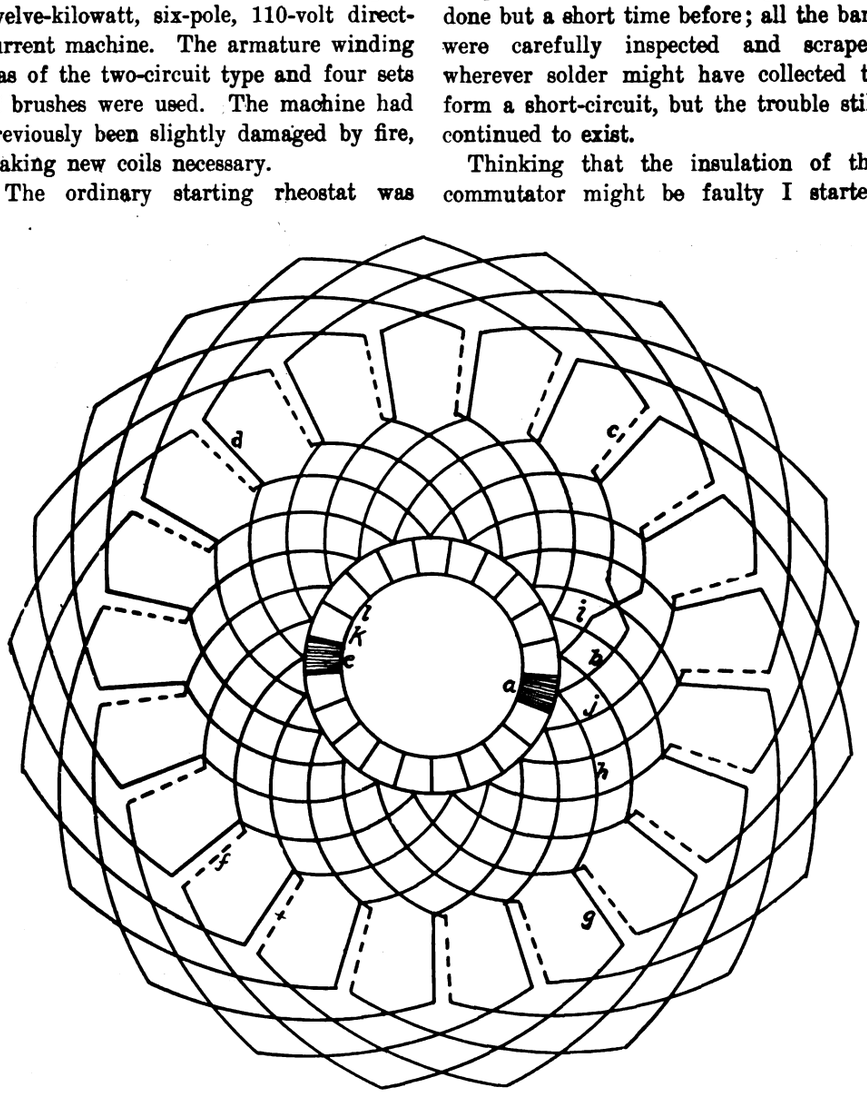
The following is an example of the nasty difficulties which we meet with from time to time. I take opportunity to write about it because its solution has been very instructive.

We had just finished rewinding a twelve-kilowatt, six-pole, 110-volt direct-current machine. The armature winding was of the two-circuit type and four sets of brushes were used. The machine had previously been slightly damaged by fire, making new coils necessary.

The ordinary starting rheostat was connected in the armature circuit for the trial run. On the first stud of the rheostat the motor ran slowly, but a bright spark was noticed to occur periodically at the edges of the brushes. Shifting the latter did not remedy this. Thinking that the sparking might disappear with increase of speed, I began to cut out the rheostat. The sparking neither increased nor diminished, but when the next to the last stud was reached the remaining coil of the rheostat became red hot, although the motor was running light and was no longer accelerating. Something, evidently, was wrong. Upon stopping the machine certain coils were found roasting. After marking the heated coils with chalk it was found that one course around the armature, consisting of three coils (six-pole wave windings), was the seat of the trouble.

At this stage I was almost certain that the fault consisted in the short-circuiting of two adjacent commutator bars by a lump of solder. The soldering had been done but a short time before; all the bars were carefully inspected and scraped wherever solder might have collected to form a short-circuit, but the trouble still continued to exist.

Thinking that the insulation of the commutator might be faulty I started out to locate the offending segments. I connected a rheostat and ammeter in series with 133-cycle, alternating-current mains and applied the two terminals to adjacent commutator bars. The comparatively low impedance offered to the flow of current by a pair of short-circuited segments would have been betrayed by a corresponding rise in the current. The ammeter gave a uniform deflection of eighteen amperes for each pair of segments until a faulty one was reached when the current dropped, accompanied by a flash across the insulation between the two segments. Although three segments, approximately 120 degrees apart, showed by their being burned and pitted during the previous run that they shared in the effects of the fault, the flashing before mentioned occurred between one and its two neighbors only. Furthermore, the flash occurred when the circuit was made, not when it was broken.



METHOD OF DISCOVERING FAULT IN COMMUTATOR.

I now ordered the commutator to be turned off, but before this took place I tried the same test once more, when I found that the flash could no longer be produced and no current at all would flow when the terminals of the power-circuit were touched to a faulty segment and its neighbor, although eighteen amperes passed between any two normal adjacent segments. No other results were obtained by using direct current. In this way it was found that three segments with the corresponding armature coils were entirely insulated from the rest of the winding. Now there dawned on me a great light. Some coil must have been wrongly connected by the winder, but which one, and how?

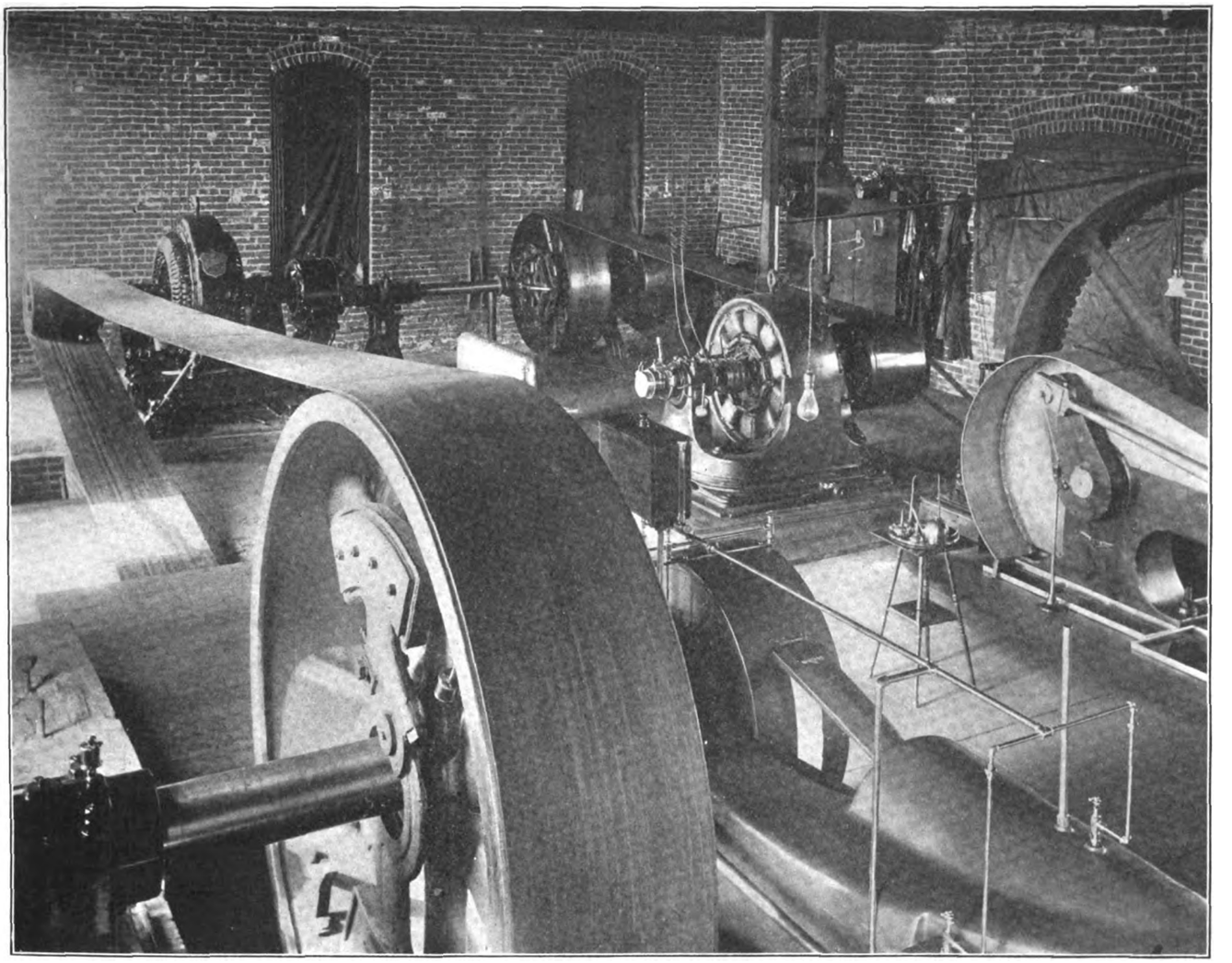
The trouble had to be sought for in the lower layer of leads which were entirely out of reach and out of view. The mistake most liable to be made by the winder in this case would have been to interchange two adjacent leads. After making a diagram, something like the accompanying figure, I found that such an error would produce the effects before mentioned. The figure shows a wave winding for a four-pole machine in which the two leads *b* and *i* have been crossed. It is seen that this insulates segment *a*, segment *e*, and conductors *c*, *d*, *f* and *g* from the rest of the winding entirely, while the remaining coils form an ordinary closed wave winding. Of course, in case of the six-pole machine, there were three segments in the isolated circuit.

It now remained to determine at which segment the mistake had been made. After counting the number of segments between the faulty ones, the intervals were found to contain twenty-five, twenty-three and twenty-two segments, respectively. The segment dividing the block of twenty-five from that of twenty-two was evidently the one sought. The upper lead going to this segment and the two adjacent ones were disconnected. The exact location of the fault was now determined by means of the magneto. The method may best be explained by means of the figure. If leads *i*, *b* and *j* be disconnected and one terminal of the magneto connected to *i*, the former will ring when the other terminal reaches *k*, nine segments ahead. In like manner, *b* will ring on *e*, eleven segments ahead; and *j* on *l* ten segments ahead. From this it is evident that *i* and *b* have been crossed and not *b* and *j*. We were able to recross the wrongly connected leads without disturbing any other part of the winding. The machine is now working perfectly.

Digitized by Google

The Possibilities of the Small Central Station.

THERE are probably many small central stations scattered over the country that are only partially developed, and with a little study on the part of the management they could undoubtedly be vastly improved and their earning capacity increased to a very large degree. As an example of what this means, the developments of the central station at Mount Carmel, Ill., are of peculiar interest.



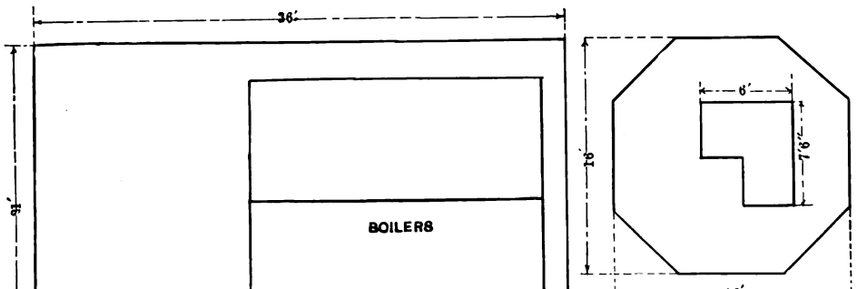
A View of the Power Plant of the New Electric Company, Mount Carmel, Ill.

This station was opened for business in 1893, and from that period up to 1902 the load was represented by 800 sixteen-candle-power incandescent lamps. In the early part of 1902, a new concern was formed under the style of the New Electric Company. This organization took over the old installation and immediately erected a new and up-to-date electric station. In the short period of two years, the load has been increased to 5,036 sixteen-candle-power incandescent lamps and a complete Helios-Upton series arc system supplying fifty-eight lamps for city lighting, with a day load consisting largely of single-phase motors of approximately 150 horse-power. The aggressive management of this new organization was not slow to further discover the inefficient operation of the city pumping station. Overtures were then made to the city council which resulted in its taking under its supervision January 1, 1903, for a period of twenty years, the duties formerly devolving upon this plant.

The old pumping plant consisted of a battery of two 42 inches by 16 feet tubular boilers supplying steam to two 8 by 12 by 8½ by 10 inch compound Deane pumps. During the first six months, the old steam plant was operated, and pumped 31,156,950 gallons of water at a cost of 6.6 cents per thousand gallons. Some decided changes were made in the operation of the plant, which enabled a reduction in pumping cost during the second six months to four cents per thousand gallons, 34,272,645 gallons being pumped during this period. During the third six months' period, the output was still further increased to 37,388,340, and the cost reduced to three cents per thousand gallons. At this point it found that it had reached the minimum cost possible with the steam pumping system as installed. The cost of slack coal delivered at this station was $1.40 per ton. This was due to the fact that the nearest railroad station is fully half a mile from the plant, and that coal must be hauled in wagons over roads that were almost impassable during the spring season. Realizing that the only way by which a greater economy could be effected in the operation of the pumping station was by the installation of new machinery, the old pumping plant was abandoned and a new pumping outfit installed, consisting of a 9 by 10 inch triplex

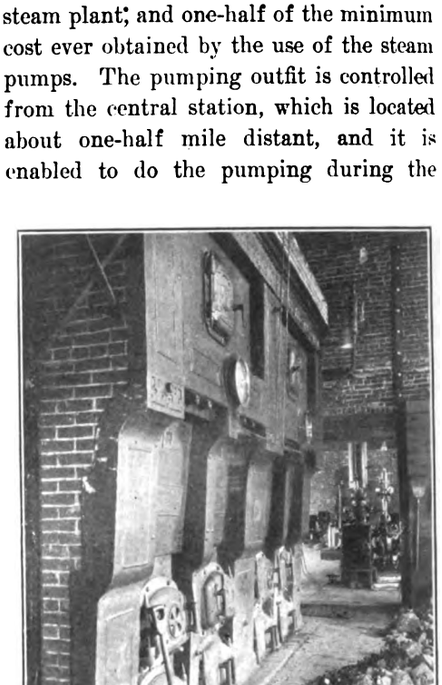
Digitized by Google

Deane pump, to which is directly geared a twenty-five-horse-power Wagner single-phase motor, operating from a 220-volt, sixty-cycle circuit, arranged to be practically operated automatically. The cost of this new outfit complete, including the motor, buildings, pumps, piping, etc., was $2,204.32. This new pumping outfit was installed in a pit underneath a new pump house, the diameter of the pit being sixteen feet. The walls are constructed of twelve inches of solid concrete, and owing to the difficulties periodically experienced from high water of the Wabash river, it was extended approximately ten feet above the bank of the river and about two feet above the highest recorded rise of the water in the river. One of the illustrations herewith shows the striking contrast between this new pump house and the older structure which required approximately five times the ground area occupied by the electric outfit.

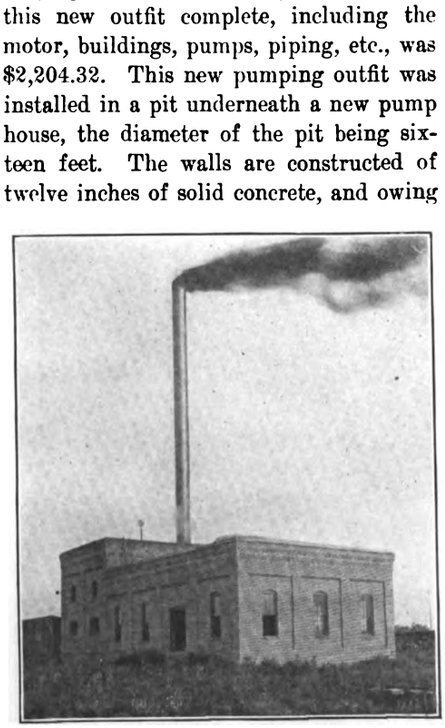


A Comparison of the Space Occupied by Steam and Electric Pumping Plant of Similar Capacity.

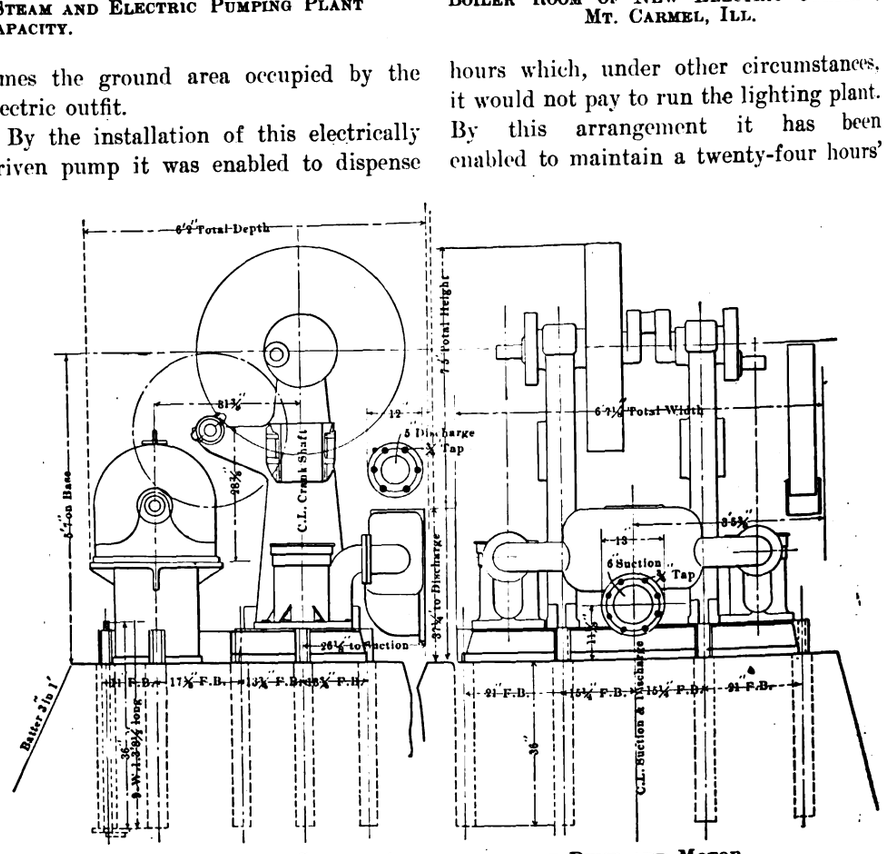
By the installation of this electrically driven pump it was enabled to dispense entirely with the keeping of a man at the pumping station and to further reduce the cost of pumping to 1.6 cents per thousand gallons, or practically twenty-five per cent of the cost per thousand gallons during the first six months of operation of the steam plant, and one-half of the minimum cost ever obtained by the use of the steam pumps. The pumping outfit is controlled from the central station, which is located about one-half mile distant, and it is enabled to do the pumping during the hours which, under other circumstances, it would not pay to run the lighting plant. By this arrangement it has been enabled to maintain a twenty-four hours' service and have a profitable day circuit during the entire year. Inspections of the plant are made daily, although it is capable of being operated over a considerable period of time without any further



Boiler Room of New Electric Company, Mt. Carmel, Ill.



Exterior View of Power Plant of the New Electric Company, Mt. Carmel, Ill.

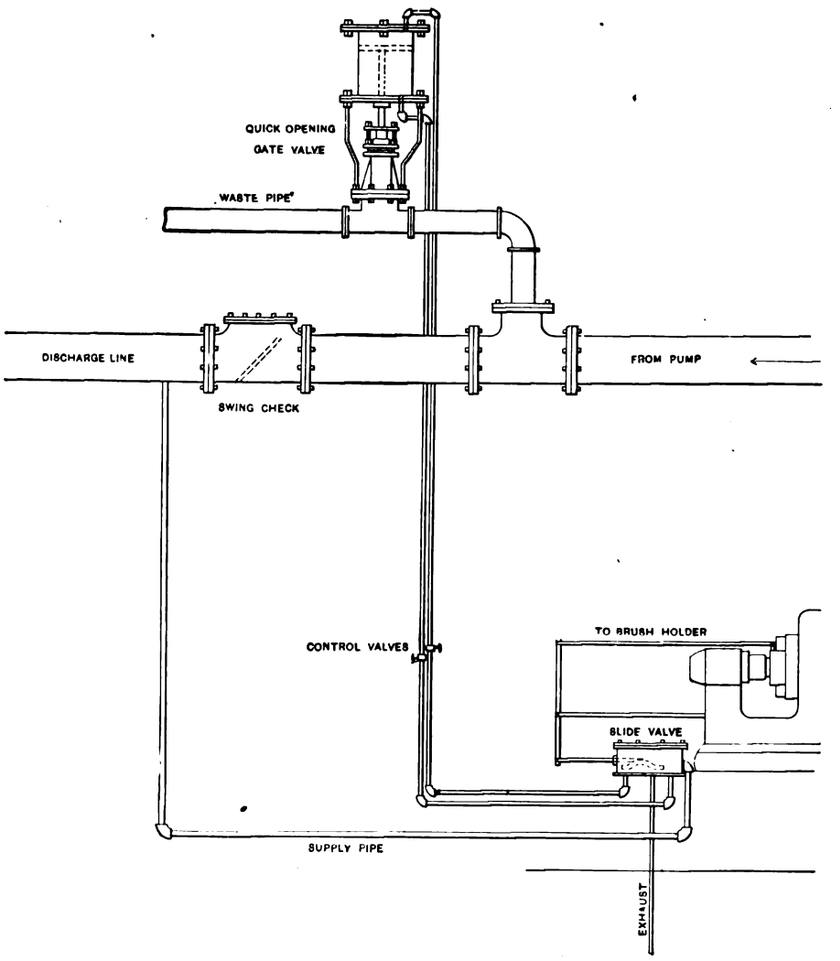


Dimensions and Setting Arrangements of Pump and Motor.

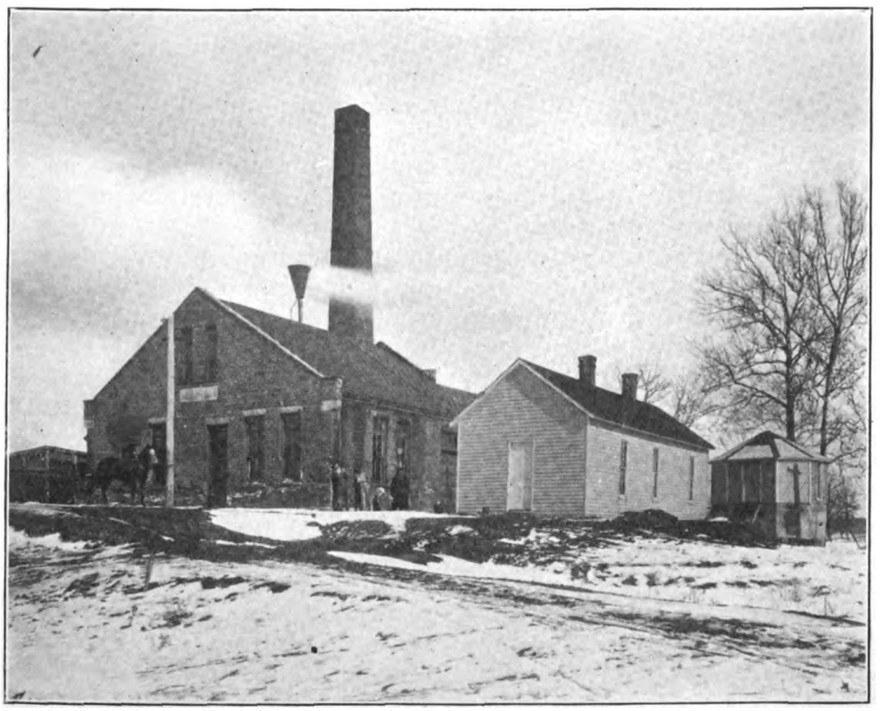
Digitized by Google

attention than that required for refilling of the various oil reservoirs.

The details of this pumping installation are shown in the accompanying diagram. The apparatus was designed to allow the single-phase motor to start without full load. Advantage was taken of the brush throw, which is peculiar to the Wagner motor design, to operate a small slide valve which in its turn admits water to either end of the hydraulic cylinder, controlling a quick opening by-pass valve. The operation of this mechanism is quite simple. Normally at rest, the brushes of the motor connect with the commutator of the machine, but as soon as the motor reaches its operating speed, the brushes are thrown out and it is by this action that the small auxiliary valve is opened through the medium of the lever referred to, which in turn operates hydraulically the valve in the main pipe to the reservoir. On stopping the pump, the valve is so arranged that the by-pass is open and remains open until the pump is started and gets well up to speed, at which time the by-pass slowly closes and remains closed until the pump is shut down. The speed of the closing of the by-pass valve is governed by the two small controlling valves placed in the pipes leading to either end of the hydraulic cylinder. This arrangement is clearly shown in the line drawings herewith. These drawings are not made to scale, the slide valve being shown proportionally much larger than it really is, the actual length being but six inches. The connecting pipes used to operate the valves are one-quarter inch, except the supply pipe, which is three-eighths inch. The



CONTROLLING DEVICE FOR MOTOR-DRIVEN PUMP.



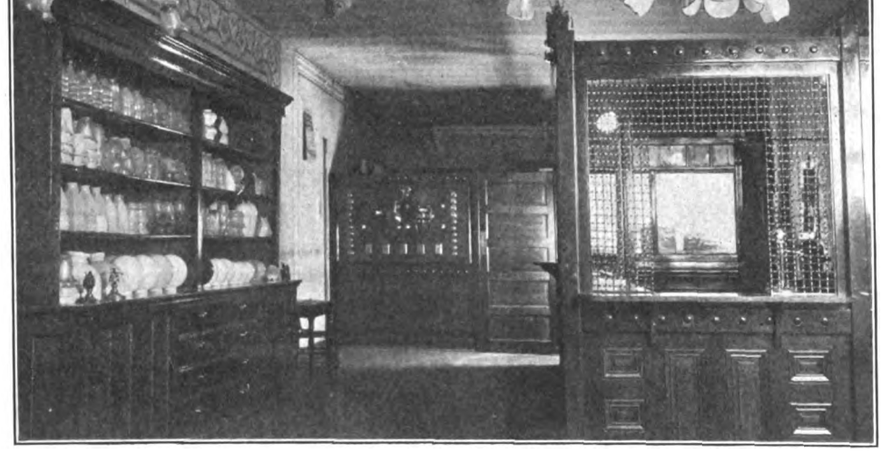
THE OLD AND THE NEW PUMPING PLANT, MT. CARMEL, ILL. THE OLD PLANT THE FRAME BUILDING IN CENTRE. THE NEW PLANT AT EXTREME RIGHT.

company states that the arrangement has never given a moment's trouble, having worked perfectly at all times notwithstanding that it has been overloaded to the extent of more than twenty-five per cent. The distance from the pump to the reservoir is something over a mile, and the head against which the pump must operate is 185 feet.

To again revert to the new central station, the main building is of brick thirty feet wide and eighty feet long, and is located on the tracks of the Big Four railroad, a siding extending directly to the boiler room. Two 150-horse-power Stirling boilers supply steam at 150 pounds pressure. The boiler room auxiliaries consist of one 300-horse-power Cochrane feedwater heater and two National boiler feeders 7 by 4 by 9 feet. The coal used is Illinois pea and slack, ranging in price from eighty cents to $1.10 per ton delivered in the boiler room, which has a siding connected with the main line of the Big Four tracks. The power units consist of a Lane & Bodley 14 by 42 Corliss

Digitized by Google

engine, operating at eighty revolutions, which is belted to a jack shaft, from which in turn a ninety-kilowatt Westinghouse, single-phase, sixty-cycle generator is operated at 780 revolutions per minute. A Russell 18 by 18 automatic engine, operating at 900 revolutions per minute, is direct-belted to a Bullock 150-kilowatt, two-phase, sixty-cycle generator operating at 900 revolutions per minute. The primary voltage of the line is 2,200. The switchboard is made up of three panels, one being a combined arc and generating panel, one motor panel and one main generating panel, so arranged that any part of the load, or all of it, can be thrown on either generator, or any part on each generator, thus enabling the company to operate arcs, motors and incandescent lamps from the same machine, or to shift any part of the load to balance the two-phase circuit of the Bullock generator. Wagner volt and ammeters and G. I. oil switches are used in controlling the circuits.



OFFICE OF THE NEW ELECTRIC COMPANY, MT. CARMEL, ILL. METER TEST BOARD IN BACKGROUND.

Two of the Helios-Upton regulators are used, one of twenty-five and the other of thirty-five-light capacity. The city lighting is accomplished at the present time by fifty-eight 6.6-ampere series enclosed street lamps of the Helios-Upton type. The maintenance cost of these lamps, including carbons, inner globes and trimming after 120 hours burning, has averaged $1.89 per lamp. The interior of the power-house throughout is a model of neatness and speaks volumes for both the management and the operating engineer. Eighty-five per cent of the total load of the station is sold on a meter basis, while fifteen per cent is still disposed of on a flat rate basis, which was in vogue under the old management, and contracts for which have not yet expired.

Among the various industries served by the day circuit are a brick-yard one mile distant from the plant, using a thirty-five-horse-power motor for driving a pug mill; a packing house one and one-half miles distant from the plant, whose machinery is driven by a twenty-horse-power single-phase motor; a printing plant one-half mile distant from the station, driven by a three-horse-power motor, and an ice cream factory three-quarters mile distant, operated by a three-horse-power motor. Besides these installations, there are ten other concerns using motors ranging from one-half to two-horse-power. All of these machines are the product of the Wagner Electric Manufacturing Company, of St. Louis, Mo., and are said to be extremely satisfactory both as regards their efficiency and the lack of disturbance of the line voltage. Upward of 100 desk and ceiling fans are supplied in the business district of the city.

The good business methods of the New Electric Company are further reflected in the office of the company, a view of which is also shown herewith, and in the systems employed in its accounting department.

The panel-board shown in the background of the photograph of the office, is for the purpose of testing meters. This is a great convenience, as the work of testing a meter has been so simplified that it can be done by an inexperienced person after a few moments' instruction, and in this particular instance, the work is done by one of the stenographers in the office. A meter constant sheet is mounted upon the board, from which all of the necessary data for quick computation can be obtained. The work of the accounting department has been brought to a very accurate and simple basis, and this system has effected a great saving in time and also increased the accuracy of the work of the office force.

The Conclusions of the Niagara Power Commissioners Regarding Niagara.

The Ontario Power Commission, in a statement recently issued, estimates the total available power at Niagara as 5,500,000 horse-power. The total amount of chartered power is 675,000 horse-power, or twelve and one-half per cent of the total available. The 375,000 horse-power already in process of development by the three Canadian corporations was considered to be largely in excess of all demands in Ontario for some years to come. The city of Toronto consumes in its lighting, electric railway and manufacturing plants only about 30,000 horse-power. If the average cost of power to consumers in Ontario is placed at, say, thirty-five dollars per horse-power per annum, the saving due to the use of electric power generated by different water-power companies may be taken at twenty dollars per horse-power per annum. With a consumption of 150,000 horse-power, the net annual value to Ontario consumers of power developed and sold at cost is $3,000,000, which, capitalized at four per cent per annum, represents a capital value of $75,000,000.

The possible courses open to municipalities in relation to power development are: first, independent development at Niagara Falls and elsewhere, to satisfy the needs of communities; second, acquisition of some one of the three existing undertakings at Niagara Falls; third, the purchase from existing corporations of power (*a*, delivered to consumers; *b*, delivered at sender's power-house subject to transmission at the cost and risk of the municipalities); fourth, the acquisition of available power sites to hold against future contingencies.

Digitized by Google

SOME POINTS ON THE SELECTION OF ELECTRIC CABLES.[1]

BY L. B. ATKINSON AND C. J. BEAVER.

The specification of any standard conductor should state the effective sectional area of the whole conductor, *i. e.*, the area of a solid wire having the same conductivity, and the number of wires in the strand, or alternatively, as is common in the case of small conductors, the gauge number, or diameter in mils of the wire, and the number of wires in the strand.

It should further define the minimum conductivity allowable. In the case of tinned wires, it should also state the percentage permissible departure from the standard of conductivity produced by the tinning.

Every engineer knows the enormous difference in conductivity between pure copper and copper containing small percentages of impurity, but in few cases, especially with the smaller conductors bought commercially, is this tested, and there are copper conductors on the market of not more than eighty per cent (Matthiessen's standard) conductivity, and these are accepted and used for house wiring and other purposes without discovery. It can not be claimed that such wire is bought by the manufacturer as high conductivity copper, for there is no difficulty in obtaining electrolytic copper of from ninety-nine per cent to 102 per cent conductivity.

Cases have been known in practice, where imperfect conditions in the tinning process have resulted in a variation of as much as twelve per cent in the conductivity of 20 S. W. G. wire.

Rubber-insulated cables were the first cables used and their use to-day is still very large for all purposes where high insulation and easy fixing and manipulation are primary considerations. Speaking generally there is hardly any article of general commerce in which the buyer places himself so largely in the hands of the seller, as he does in the matter of india-rubber; and although large buyers often have facilities for the analysis of goods, there are difficulties in the analysis of india-rubber articles which are hardly paralleled in other general analytical work.

Conductors—In rubber cables the copper conductors should always be tinned. It is a matter of common knowledge to those who are at all familiar with rubber goods, that oxidation is the form of deterioration to which rubber is most liable; and to a greater extent with pure than with vulcanized rubber. Now the chief office of the pure rubber layer in a vulcanized rubber cable is to prevent the sulphur in the compound rubber from attacking the conductor. It is a chemical fact that copper is a powerful carrier of oxygen, and that it will readily part with its oxygen to a substance which has a great affinity for it.

Thus we have (for certain electrical reasons) in close proximity in a rubber cable two substances, rubber and copper, which for chemical reasons should be kept apart. The coating of tin on the wire acts as the necessary separating medium, and it is obvious that its efficient application is of the greatest importance.

Until recently, specifications hardly referred to this matter at all. There is now a marked tendency to ensure reasonable efficiency and uniformity, by specifying a definite test of the tin coating. The standard test, which is known as Glover's test, is now being used by the largest makers of tinned wire in this country and abroad; it was devised by one of us in 1897, and has been in daily use for the past seven years.

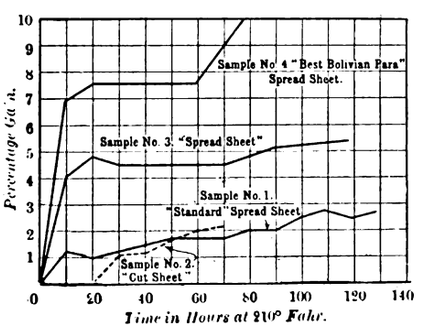


FIG. 1.—DIAGRAM SHOWING RATE OF OXIDATION OF VARIOUS PURE SHEET RUBBERS.

Pure Rubber—This should consist of absolutely pure rubber, without admixture of any kind. Pure hard fine Para rubber sheet is chiefly prepared by what is known as the "spreading method," in which the requisite mechanical and other properties are attained by "ageing" (hanging in dark rooms at a certain temperature) for several months. With raw rubber in the neighborhood of five shillings and threepence per pound, the cost to the cable-maker will be about eight shillings and sixpence per pound, though at the present time rubber strip, purporting to be pure Para, is being offered at five shillings and ninepence per pound. There is, therefore, little occasion for surprise to find that in foreign cables, and in cables made by firms with little or no reputation to support, the pure rubber, as above described, is replaced by a lower grade rubber, in which the requisite elasticity and mechanical properties are obtained by vulcanizing by what is known as the "cold cure" method. This consists of treating the surface with chloride of sulphur in carbon bisulphide. Apart from the fact that this rubber contains sulphur, contrary to the essentials of its functions in the cable, it nearly always contains traces of hydrochloric acid as an after result of the chemical treatment. The danger of using such rubber hardly needs emphasis, but the temptation to the small maker lies in the fact that it can be produced at something like forty per cent less cost than pure Para strip, made by the best method.

In some cases of cheap cables the pure rubber may be found to contain a proportion of "rubber substitute," which usually consists of oxidized or vulcanized oil, sometimes with an addition of wax. Such adulteration is not only fraudulent, but almost as harmful as the low-grade chemically treated rubber referred to above.

Where no attempt is made to adulterate, it is sometimes found that makers attempt to imitate the hard non-adhesive surface of correctly "aged" strip, by coating with a film of soapy composition. Wires coated with such rubber will blacken before vulcanizing if traces of free alkali are present.

Even in pure rubber strip, made solely from fine Para rubber, appreciable differences in the tendency to oxidize may be noticed.

The diagram shown in Fig. 1 illustrates the rate of oxidation of various makes of pure rubber strip. The curves show the results of ageing tests, which were carried out by exposing weighed quantities of the finely divided pure rubber to the atmosphere continuously at a temperature of 210 degrees Fahrenheit; precautions were taken to expel all traces of residual solvent and surface moisture before the actual experiments were commenced.

It will be seen that sample No. 4 oxidized most rapidly, and after eighty hours' exposure the finely divided particles were sufficiently oxidized to form a magma.

The same thing occurred with sample No. 2 at seventy hours, while samples 1 and 3 remained unaltered at 120 and 130 hours respectively.

It was found that the proportion of rubber resins in the various samples bore a well-defined ratio to the rate of oxidation observed.

Compound or Vulcanizing Rubbers—

[1] Abstract of paper read before the Institution of Electrical Engineers of Great Britain, January 31, 1905.

Digitized by Google

These are generally applied in two layers, that next the pure rubber being usually drab in color and the outer one, gray. They should have for their basis hard fine Para rubber, and should be vulcanized with a minimum proportion of pure sulphur, and mixed with mineral matter only to the extent required for the particular grade of cable which it is intended to produce.

The addition of rubber substitute, referred to under "pure rubber," should never be allowed; and the expression, "containing no organic matter other than rubber," is in some specifications intended to prohibit such materials.

In few cases are analyses made to check this important matter; even when the specification is framed to bar substitutes, large contracts are frequently placed without reference to anything of the kind, and the first-class firm has to be passed and orders given to possibly, a foreign competitor, who does not scruple to put in his "mixings," five per cent, ten per cent, or even more of a material costing anything from fourpence to one shilling per pound, in place of the hard fine Para costing from six shillings to seven shillings and sixpence per pound, according to the state of the market.

Such substitutes are invariably prejudicial to the life of rubber cables or any other rubber goods. They increase the liability to oxidation, because they only form mechanical mixtures, and neither combine chemically nor cohere physically; in fact, they subdivide the particles of rubber when ground up with it, and this means imperfect results as regards durability, from mechanical and from electrical points of view.

The admiralty moist heat test of 320 degrees Fahrenheit for four hours was designed to indicate roughly the presence of this class of adulterant, the substitute becoming partially saponified by the steam. Though only a rough test, it has answered its purpose fairly well.

Specifications frequently state the permissible percentage of mineral loading matter, or conversely the minimum proportion of Para rubber; but it will be readily seen that, in spite of specifications, the due performance of them is difficult of verification.

Consider, as an example, a specification issued not long ago for high and low-tension cables, involving some thousands of pounds; and note, notwithstanding its apparent exactitude, the loopholes that existed for variation therefrom. The specifications, as regards materials, ran as follows:

Low-Tension Cables—"Conductors to be of high conductivity copper, well tinned. The insulation to consist of pure and vulcanized rubber, the latter to contain not less than (X) per cent pure Para rubber, and the insulation to be not less than 1,250 megohms per mile."

The specification for extra high-tension cables was worded in a similar manner, with the difference that the insulation resistance was not specified.

The contract for these cables was sent abroad, British prices being far higher than those of foreign competitors. Analysis of samples of the dielectric supplied under the contract showed directly the reason of the discrepancies in the tender.

The general analytical results were as follows:

Pure Rubber—These contained "rubber substitutes," and the proportion of them varied from thirteen per cent in the best, to forty per cent in the worst sample. There were also indications that even the pure rubber which was present, was not fine Para, which those who draughted the specification no doubt wanted. One sample of so-called pure rubber contained over one per cent of sulphur.

Vulcanized Compound Rubbers—These contained rubber substitutes varying in quantity from five per cent in the best, to fifteen per cent in the worst, and although the results showed that the makers had kept within five per cent of the letter of the specification as regards the proportion of rubber to be used, there were signs that a rubber inferior to fine Para had been used, though, no doubt, the expression "pure Para" in the specification was intended to mean "fine Para," and not a rubber at little more than half the price (in the raw state).

Insulation Resistance—From the analytical results, it was plain to the authors that the specified insulation resistance could not have been obtained on some of the larger sizes of cable. It was ultimately found that difficulties in this direction had been evaded by the makers of these cables by taking the galvanometer readings after three minutes' electrification, instead of after one minute, which in the absence of anything stated to the contrary, is the accepted standard, and the difference in test at these two intervals would correspond with an approximate difference of insulation resistance in such cables in the ratio of one to three.

Extra High-Tension Rubber Cables—The specifications issued by engineers for extra high-tension rubber cables, usually state the proportion of Para rubber which the vulcanized rubber shall contain, the pressure test to which the cable shall be subjected in water (usually two or three times the working pressure), the insulation resistance per mile, and sometimes the radial thickness of the dielectric. Much greater care is necessary in making extra high-tension cables than in ordinary low-tension cables, because the working conditions have a tendency to create effects (such as electrolytic dissociation in the dielectric, and static discharge from the outer coverings of the cable and the consequent ozonizing effect) which are almost negligible at ordinary low pressures.

The former depends to a very great extent on the treatment of the rubber, and the selection and preparation of the loading materials which are used in conjunction with it.

The latter may be avoided to a very great extent by metallic braiding or lead covering. Otherwise there is always risk of a static discharge occurring from the usual fibrous outer coverings at local places which afford convenient paths for the same and which may cause local oxidation of the rubber and ultimately a breakdown.

Fire-Resisting Cables—Fire-resisting coverings are usually applied to "rubber cables," for the simple reason that rubber cables are chiefly used in situations where measures for the prevention of fires are most required. However, they may be just as efficiently applied to other types of insulation, such as V. P. or G. P., where the volatilization of the combustible constituents would cause fire to spread rapidly.

The fire-resisting properties can not practically be secured through any modification of the dielectric and must be attained by special treatment of the tapes, braidings, or lappings which form the usual mechanical protection to such cables. These fibrous materials may be chemically treated, so as to be absolutely incapable of supporting flame, and this treatment (under the process devised by one of us, used by Messrs. W. T. Glover & Company, Limited) is preferable, and for the sake of efficiency is applied to the yarns or fabrics before applying them to the cable.

Tanned jute is found to be the most suitable fibrous material for this purpose (though cotton, hemp, or flax may be used), and has at the same time the advantage of being mechanically strong, and

Digitized by Google

therefore not liable (as asbestos is) to succumb to vibration or rough handling.

During and after the process of lapping, braiding, etc., a suitable fire-resisting compound is served on to the coverings. Any degree of fireproofness can be attained by adding to the number of braidings or lappings. In practice, these are proportioned to the volume of inflammable material (*i. e.*, dielectric proper) in the cable, to the sizes of the cable, and to the particular class of work for which the cable is intended.

Imagine such a cable to be subject to the heat of a fierce flame externally for a prolonged period. After a lapse of time, dependent on the proportion of fire-resisting coverings to volatilizable materials (dielectric), the latter becomes softened by the heat, and ultimately decomposes and assumes the gaseous state. When the gases thus formed have accumulated sufficient pressure inside the cable, they force their way through the fire-resisting coverings, and burn on the exterior of the cable. But when the cause of the volatilization is taken away (*i. e.*, the external flame), the flame on the cable quickly disappears, and does not spread along the cable, as would be the case if the ordinary preservative compounds were used.

In the same way, if the source of heat applied to the cable is internal (an arc due to a breakdown of the dielectric, for instance), volatilization will proceed at the point of breakdown so long as the arc is kept up, but the resultant flame will disappear almost immediately the arc is stopped, because there is nothing on which the flame can feed.

Moreover, the flame due to the combustion of the volatilization products is not hot enough to ignite any adjacent cable having similar coverings, so that in every way the fire-resisting coverings tend to keep flame, arising from any cause, purely local.

Dielectric from Cable.	Specific Gravity.	Ash. Per Cent.	Saponifiable Matter. Per Cent.	Unsaponifiable Matter (Org.). Per Cent.	Total Sulphur. Per Cent.
A	1.076	7.0	76.2	12.7	4.0
B	1.31	34.7	18.0	45.1	2.1
C	1.15	18.27	30.0	47.5	4.2

Consider for a moment the behavior of an ordinary cable under similar circumstances. The preservative compounds burn readily, and the flame will rapidly travel along the exterior of the cable, thus continuously and increasingly causing the volatilization of the dielectric, the gases from which add considerably to the conflagration. Contrary to the case of the fire-resisting cable, the flames due to the preservative compound alone will readily ignite a similarly served adjacent cable.

Vulcanized Bitumen Cables—The early bitumen cables consisted of a wire coated with pure bitumen, but these cables were found to decentralize with more or less

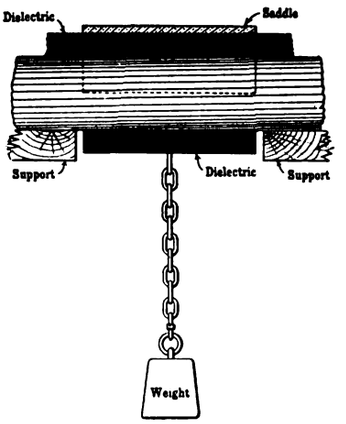


FIG. 2.—DECENTRALIZING TEST.

rapidity. Later, a cable was introduced by Messrs. Callender's Cable Company, under the name of "vulcanized bitumen," insulated with a material produced by sulphurizing a product of the distillation of certain oils, which has been very extensively used, and which alone or with other compounds forms the basis of several well-known insulating compounds.

The properties of some such cables may be considered by taking three examples of cables made by well-known cable-making firms, which will be referred to as

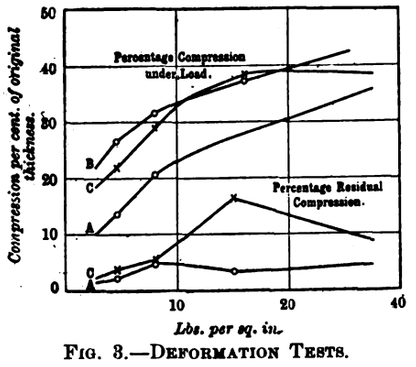


FIG. 3.—DEFORMATION TESTS.

A, B and C, of which the compositions were shown in the table in the previous column.

In order to find out how this class of cable behaves under various circumstances, a series of experiments was carried out by Mr. Bertram Blount at his laboratories in London, after consultation with the authors, and an examination of the lines of research carried out by one of them. The results are here incorporated.

In order to determine the tendency to decentralize in cables of this class, particularly at a moderately high temperature, short lengths of cable were loaded, the bare ends of the conductor being supported. The load was carried by a saddle across the cable, equivalent to one pound per lineal inch of cable as shown in Fig. 2.

The following table (2) shows the amount of decentralization which occurred after six hours in an air-bath at a temperature of ninety degrees centigrade equals 194 degrees Fahrenheit.

Specimen.	Size of Cable.	Before Test. Thickness of Dielectric.	After Test.	
			Thickness. Upper Side.	Thickness. Lower Side.
A	Not tested	....	....	....
B	19/16	.121	.115	.12
C	19/16	.125	.12	.13

To determine more exactly the action of such compounds under load, bearing in mind that considerable weights of cable are often supported in a manner which concentrates the weight at one point, experiments were carried out to measure the deformation of samples of the material under definite loads, and the results are shown in Fig. 3. The upper lines show the percentage compression of the samples A, B and C under the various loads given by the abscissæ. The lower lines show for the same loads the residual deformation on removal of the load.

Sample B buckled when the load was removed, hence the permanent distortion could not be measured. These results show that with loads capable of very largely compressing the material, the elasticity is good; but they point out that with such materials some care must be exercised, by judicious design of methods of support, to avoid the localizing of supporting and other stresses.

The authors then took up the question of testing paper. The insulating material of the paper is extracted by some solvent, such as benzine. The paper is boiled in a weak alkaline solution, washed with water, and the fibres teased out with needles. These are then examined under the microscope. Several illustrations are given, showing the different character of various kinds of paper.

The materials used for impregnating the paper differ, but they should have the following characteristics: they should have the highest possible dielectric strength and specific insulation; the

Digitized by Google

specific inductive capacity should approach, as nearly as possible, that of the fibrous material; the compound should be plastic, but not fluid. The common test for this latter quality consists in cutting a piece of cable and suspending it vertically for a time, observing whether any of

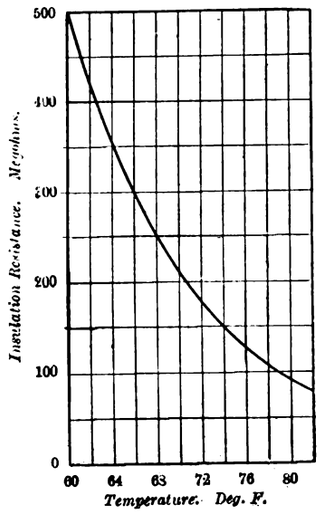


FIG. 4.—RELATION BETWEEN INSULATION RESISTANCE AND TEMPERATURE FOR PAPER-INSULATED CABLES.

the material flows back. The compound that will run out in this test will drain away from the cable at junction boxes.

As the final insulating property of these dielectrics depends upon the exclusion of moisture, a lead envelope is very important. In theory, the thinnest covering would suffice. Practice has enabled a certain thickness to be arrived at, which prevents any addition for protection against damage in handling and external corrosion. These thicknesses are shown diagrammatically in the accompanying figure. The thicknesses given there are taken as the minimum thicknesses, and, under certain conditions of soil and surroundings, it is advisable to increase them.

The lead is put on such cables in a plastic state by hydraulic pressure. This is an operation requiring such care to avoid minute cracks and damage from particles of oxide being forced in with the lead, that there are engineers who still advocate the older system of drawing the cable into a lead pipe which has already been tested by water pressure, or of putting on double sheaths of lead. W. T. Glover & Company, Limited, have, however, met the question by the use of hydraulic pressure up to 100 pounds per square inch applied externally after the cable is finished. Such pressure invariably detects a fault if such exists in the lead. The ordinary tank test is practically useless, and it may take many months or even years for water to enter the very fine seams which such faults occasion, but eventually it will do so.

Causes of corrosion due to impurities in lead, causing local galvanic action, are very rare. The total proportion of impurity shown by analysis of practically any brand of new soft English pig lead will not average more than 0.5 per cent. The only accidental impurity likely to get into the lead is oxide of lead, but the chances of this are very remote owing to improvements in the design of the melting-pot arrangements.

Galvanic action between lead and adjacent metal is also seldom met with, though one or two bad cases have come under our notice in concentric cables in which the lead has been applied directly over the outer conductor, and galvanic action has been set up between the tinned copper wires and the lead in presence of atmospheric moisture. The lead coverings were corroded through in about two years.

Corrosion by chemical action is fairly common, and may occur in certain soils or where organic acids are produced as the result of the decomposition of wood

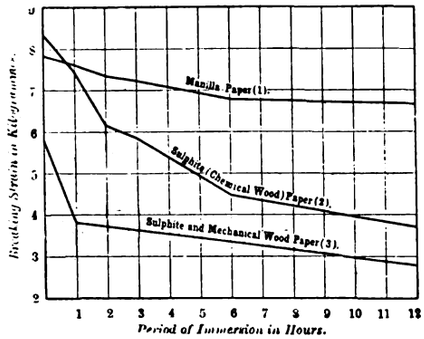

Manilla Paper (1).
Sulphite (Chemical Wood) Paper (2).
Sulphite and Mechanical Wood Paper (3).
1 2 3 4 5 6 7 8 9 10 11 12
Period of Immersion in Hours.

FIG. 5.—EFFECT OF HEATING ON STRENGTH OF PAPERS OF VARIOUS COMPOSITION—IN OIL AT 310 DEGREES FAHRENHEIT.

or vegetable matter, or where cables are laid through made-up ground, especially where ashes or clinkers are abundant. Most pit waters have an appreciably corrosive effect on lead, some being extremely severe in their action, though we have known several cases where the water has been wrongfully blamed for damages really due to electrolysis.

Electrolysis is by far the most serious form of lead corrosion. Taking the word electrolysis in its broad sense—(*i. e.*, as the electrochemical action due to the passage—*via* an electrolyte—of current to or from the lead, which is in turn due to difference of potential between the lead and its surroundings from any cause)—it is also the most common form, though this is not usually appreciated.

So much has been heard for years past of the electrolytic corrosion of water and gas mains where electric tramways have been installed in various towns, that there is a tendency to disregard the fact that it may occur under conducive conditions even in isolated house wiring installations where lead-covered wires are used, neither tramway nor heavy lighting cables being near. The effect of the existence of a difference of potential between the lead covering of a wire or cable and its surroundings, depends on the degree of difference of potential, the current density in the electrolyte and the character of the electrolyte, *i. e.*, its conductivity, decomposition products, etc.

The character of the corrosion may vary from small holes which gradually penetrate the lead covering, converting the lead into various oxides of lead, and only make themselves apparent when the rubber dielectric becomes oxidized to a sufficient extent to break down, or the paper dielectric sufficiently exposed to absorb moisture and fail (which may take many months) to very extensive action and a high degree of oxidation (where there is a free and continuous supply of the electrolytic medium and a small difference of potential) or a limited amount of general corrosion, followed soon by fusion (where the supply of the electrolytic medium is small or not continuous, and the difference of potential is comparatively high).

To give instances of these varied conditions, and the varied character of the corrosion resulting from them, we may state in a general way that the first described result is most common in small and medium-sized lead-covered cables laid or fixed in wood casing (as occurs sometimes in large isolated installations) or

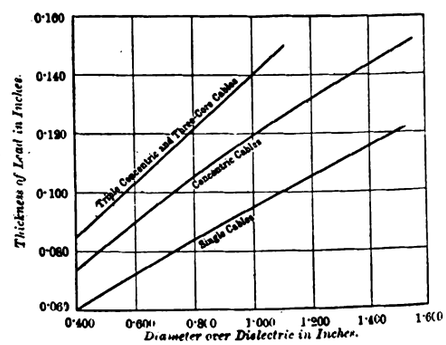


FIG. 11.—CABLE CHARACTERISTICS.

in conduits which are fairly dry or which do not actually have water running through them. The lead covering in such cases is only in intimate contact with the wood casing or conduit intermittently, and the corrosion naturally takes place chiefly at such places which are the paths of least

Digitized by Google

resistance. If such corroded points are carefully examined at various stages of the corrosion it will usually be found that a cone-shaped hole is eaten away and that the lead is converted into oxides, the various colors characterizing the degrees of oxidation being clearly distinguishable, the extreme outer layer becoming converted into the white carbonate by exposure to the moist atmosphere. In rubber cables the rubber usually fails quickly when the lead is finally penetrated, owing to oxidation of the rubber; but in the case of paper cables, if undisturbed, the oxides into which the lead is converted will keep out atmospheric moisture for, possibly, years, and the effect of the liberated oxygen on the paper (if made of pure manila only and well impregnated) will be negligible.

The second described action (where there is a continual supply of the electrolyte and small potential difference) chiefly occurs in conduits where water is continually trickling through; and in such cases the degree of oxidation is high and fairly uniform throughout the thickness and along the surface of the lead. The corrosion is practically confined to the bottom of the cable. The potential difference being low, and the surface exposed to the electrolytic medium being large, the current density will be very small, and therefore the final failure of the cable may take a year or two. The slowness of the action and the fact that the surface affected is more or less continuously covered with the electrolytic medium, accounts for the high degree of oxidation and the comparative absence of carbonate on the surface in such cases.

The third case, where a limited amount of corrosion is followed by fusion of the lead, generally occurs on large networks carrying heavy currents or on electric tramway and railway systems, where bonds may be fused by heavy leakage currents resulting from a short-circuit, whereby the lead coverings of cables may be raised to a potential difference of, say, ten to twenty volts. There may, under such circumstances, of course, be immediate breakdowns of other lead-covered cables, but in some cases the whole of the resultant damage may not be at once ascertained, and the consequent leakage currents may go on for some time, causing corrosion wherever lead coverings are even only partially exposed. (For instance, in the case of cables laid on the solid system imperfectly, or where the ends emerge into manholes, etc.) Supposing in such a case the electrolytic medium to be entirely decomposed and dried up by the passage of heavy leakage current (obviously at a high current density) sparking from the lead and fusion of the same may easily ensue.

It is not proposed here to touch further on the diagnosis of breakdowns due to lead corrosion. Enough has been written to indicate the extreme care necessary to avoid conditions which tend to produce lead faults, and incidentally to indicate that the use of lead-covered cables on large networks carrying heavy currents will probably be limited in the future, or that elaborate and costly precautions will have to be taken. It is obvious that bonding and earthing judiciously and sufficiently is the remedy for electrolytic faults, but in the first class of electrolytic faults, roughly and generally described above, bonding is frequently neglected. In the second class it is worthy of note that bonding and earthing, even if in accordance with Board of Trade regulations, is probably not a sufficient protection to prevent lead corrosion under the conditions referred to. In the third class it is fairly common for conditions to arise under which bonding and earthing arrangements, designed with a large margin of safety, are unavailing; and where very large currents return by earth paths as the result of breakdowns, it is almost impossible to forecast or predetermine what will happen on various parts of the network.

As a preventive measure against leakages of current from conductor to lead covering at connections in paper cables, where sealing boxes or terminals are difficult to fix, a waterproof non-fibrous sealing tape should be used, the tape being lapped over the trim from thimble to lead covering. Pure rubber, or even proofed tape, is often used on small cables by contractors, but is of little use under damp conditions, as either will absorb moisture in course of time, apart from the fact that they do not form a homogeneous covering. Instead of a covering of lead, a waterproof envelope of non-metallic material may be provided.

(To be concluded.)

Electrical Distribution in Paris in the Future.

The technical commission appointed to consider the conditions affecting electrical distribution in Paris, and to draw up plans for future development, has made its final report. This is a long and detailed discussion of the various factors affecting electrical work in that city. The following, in brief, are the conclusions reached:

The most convenient plan for the distribution of electricity in Paris is one in which polyphase currents of high tension, at a frequency of fifty cycles per second, are produced in a number of stations placed in the outskirts of the city near the river Seine. This high-tension current will be transformed in substations, each serving a district. The distribution at the centre of the city will be by means of direct current on a 110 to 220-volt three-wire system. In sections less densely populated, alternating current at 110 volts will be distributed. Where special conditions obtain, and where the power consumed is large, or where it is very irregular, a direct transformation will be made.

The method of charging for the supply, which it is thought to be the only logical one, consists in adopting a formula which will make the price to every consumer directly proportional to the cost of furnishing him with the power. These rates will be based upon meter readings.

In carrying out this work it is necessary to adopt a plan which will provide for a period of transition extending over several years. The industrial sections must be looked out for first, and then other sections, according to their importance and the demand for power. During the transition the price must be regulated so as not to cause too great an increase in the demand.

The method of fixing rates consists of charging at a maximum rate of ten and one-half cents per kilowatt-hour for the first 400 hours. All over that will be charged for at the rate of 2.2 cents.

American Institute of Electrical Engineers.

The next Institute meeting will be held on April 28, in the chapter room, Carnegie Hall, 154 West Fifty-seventh street, New York city. The following papers will be presented: "Polyphase Metering," J. D. Nies; "Notes on the Use of Instruments on Switchboards," F. P. Cox; "The Oscillograph and Its Uses," Louis T. Robinson; "Maintenance of Meters," W. J. Mowbray.

The annual meeting of the Institute will be held in the chapter room, Carnegie Hall, on May 16. The following programme is announced: Annual reports and election announcements; "Relays," George F. Chellis; "Circuit-Breakers and Oil Switches," E. M. Hewlett; "The Proper Limit of Duplication to Secure Reliability of Service," H. W. Buck.

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., June 19 to June 23, 1905. Arrangements have been made for the presentation of the following partial list of papers: "Appalachian Water Powers," F. A. C. Perrine; "Three-Phase Traction," F. N. Waterman; "Coil Reactances," D. B. Rushmore; "Limits of Injurious Sparking in Direct-Current Commutation," Thorburn Reid; "A Study in the Design of Induction Motors," C. A. Adams; "Choice of Motors in Steam and Electric Practice," William McLellan; "High-Potential Oscillations of High Power in Large Power Distribution Systems," Charles P. Steinmetz; "Theoretical and Experimental Investigations on the Disruptive Strength of Air at Very High Voltages," Charles P. Steinmetz.

Digitized by Google

INTERFERENCE IN WIRELESS TELEGRAPHY.[1]

BY JOHN STONE STONE.

INTRODUCTION.

Of the various problems which have been presented in the course of the development of the new art of wireless telegraphy, none is of greater interest to the engineer and none is of more far-reaching importance from the industrial and commercial standpoint than that of rendering the receiving instruments of wireless telegraph stations immune from interference.

There are two principal kinds of interference.

1. Interference which arises from electrical charges which accumulate upon the vertical oscillator under various conditions of weather, provided the vertical oscillator has no adequate electrical connection to the earth.

2. Interference which arises from such stray electromagnetic waves as are produced by lightning, by magnetic storms, by sparks in neighboring circuits, such for instance as occur in trolley circuits, and also from the electromagnetic waves emanating from wireless telegraph stations other than that with which communication is desired.

INTERFERENCE DUE TO STATIC CHARGES.

The interference which results from the first of these two sources is readily overcome since the oscillator of a wireless receiving station may always be given a metallic connection to the earth sufficient to maintain it clear of statical charges without in any appreciable degree interfering with its operation as a receiving oscillator.

Thus, for instance, if the vertical oscillator includes a condenser insulating a portion of the vertical oscillator from the earth, the condenser may be shunted by a coil of inductance so large that for the high frequencies employed in wireless telegraphy it shall operate practically as an open circuit, while affording a ready path to earth for the electrical charges which, in its absence, would accumulate upon the vertical oscillator and produce disruptive discharges to earth.

Again, if a highly sensitive detector or receiving device be included directly in the vertical receiving oscillator, such an inductance coil may be placed in shunt to the receiver without appreciably affecting its apparent sensitiveness. The coil will then serve as a by-path for the currents due to the passage of the charges of the vertical oscillator to the earth.

Another device which may serve to still further protect the receiver under these conditions is that illustrated in Fig. 1, in which V and V are portions of the vertical oscillator system, L is a coil of large inductance, R is the receiving device, and C is a condenser of capacity so large as not to impede appreciably the passage

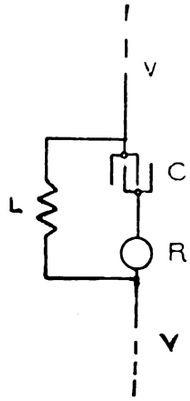


FIG. 1.—PROTECTIVE ARRANGEMENTS.

of the high-frequency oscillations of wireless telegraphy while acting practically as an open circuit for the more slowly varying currents by which the vertical oscillator is maintained free of static charges.

The greatest security from this form of interference is however obtained by providing the vertical receiving oscillator with an adequate conductive connection to earth and by placing the receiving device in a local circuit made resonant by a coil and a condenser to the frequency of the electrical oscillations to which the receiver is intended to respond.

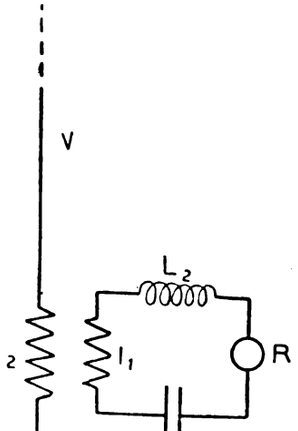


FIG. 2.—PROTECTIVE ARRANGEMENTS.

An example of such an arrangement is shown in Fig. 2, in which VI_2E is the vertical receiving oscillator, I_1 and I_2 are the two coils of a high-frequency transformer, R is the receiver, C_2 is a condenser and L_2 is an inductance coil.

The manner in which the local circuit containing the receiver is made resonant to the frequency of the oscillations to which it is intended to respond will be considered later in this paper. It is sufficient here to note that the local circuit being resonant to a frequency sufficiently high for the purposes of wireless telegraphy will not be appreciably affected by the more slowly varying currents in the vertical oscillator by which the latter is maintained free from static charges.

INTERFERENCE DUE TO ELECTROMAGNETIC WAVES.

Coming now to the prevention of interference by electromagnetic waves such as emanate from other wireless stations than that with which it is desired to hold communication, and to the prevention of interference by stray electromagnetic waves, we find that the solution of the problem depends upon the character of the message-bearing waves, the energy of which it is desired to convey to the receiving device, and also upon the character of the disturbing waves the energy of which it is desired to exclude or divert from the receiving device.

We can control the character of the waves whose energy we wish to receive, by suitably designing the apparatus to be used at the transmitting station, but we have no control over the character of the disturbing waves except in so far as these arise from wireless stations within operative range of the receiving station.

The simplest solution of this problem is to cause each transmitter to send out its signals by means of persistent trains of simple harmonic waves of a frequency materially different from that employed by any other transmitter within operative range of the receiving station with which communication is to be maintained and to make each receiver responsive only to persistent trains of simple harmonic waves of the frequency employed by the transmitter with which it is in communication. By this means the system is rendered selective and becomes a multiple system of telegraphy, permitting the operator at each station to select the station with which he wishes to hold communication to the exclusion of all the other stations, and by which a number of messages may be transmitted simultaneously in a given region without interfering with one another.

Since the stray electromagnetic waves arising from lightning, etc., are not persistent trains of simple harmonic waves, but partake more of the character of isolated impulses, the receiver in such a sys-

[1] Read before the electrical section of the Canadian Society of Civil Engineers, Montreal, Canada, March 9, 1905.

Digitized by Google

tem does not respond to such stray electromagnetic waves and it is therefore also freed from interference which would otherwise arise from such sources.

The manner in which a transmitting station is made to develop persistent trains of simple harmonic electromagnetic waves of one frequency to the exclusion of waves

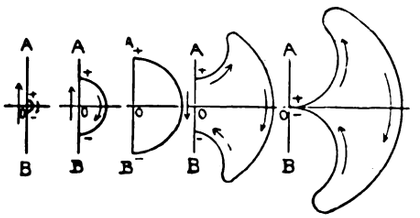


FIG. 3.—FREE ELECTRICAL OSCILLATION.

of other frequencies, though simple in itself, in practice requires the strictest attention to certain details, and these may be best understood by the consideration of a concrete case, this being the manner in which such problems are usually presented to the engineer if not to the inventor.

TRANSMITTER.

In modern wireless telegraphy the messages are transmitted by electromagnetic waves which are horizontally polarized at the earth's surface, and which are developed by electrical oscillations set up in an electrical oscillator whose axis is normal to the surface of the earth and which is connected to the earth at its lower extremity.

The reason for employing waves of this type and so developed, is that such waves have, at the earth's surface, no component of electric force parallel to the surface and no component of the magnetic force normal to or cutting that surface, except in the immediate neighborhood of the base of the transmitting oscillator. As a result they do not tend to induce currents in the surface of the earth as they travel away from the transmitter except where the surface of the earth deviates from the plane of polarization of the waves at that surface. The energy which would otherwise be rapidly dissipated through the production of induced currents in the earth is therefore conserved in the waves. Moreover, when a deviation occurs between the plane of the earth's surface and the plane of polarization of the waves at the earth's surface, the currents induced in the surface of the earth are such as to bend the wave front into a position normal to the surface with the result that the waves travel over and around mountains and in fact follow the earth's surface whatever be its contour, instead of tending to travel in straight lines like ordinary light waves and as would be the case with vertically polarized electromagnetic waves.

For a more complete exposition of these points see a paper read by the author at the International Electrical Congress, held at St. Louis, September 12 to 17, 1904, and reprinted in the ELECTRICAL REVIEW, New York, October 15, 1904.

There is not space in this paper to discuss in detail the development of the waves described above, but their genesis and mode of propagation are clearly suggested by Figs. 3 to 8. Fig. 3 and Fig. 4 illustrate the development of a wave by free electrical oscillations in a straight wire AoB, the curve lines indicating a line of electric force in its various phases from $t=0$ to $t=\frac{5}{8}T$, where T is the time of a complete free electrical oscillation in the wire. In Figs. 5 and 6 the genesis of a wave from a vertical linear oscillator. AO earthed at its lower extremity is illustrated, and in Figs. 7 and 8 the effect of an elevation and depression

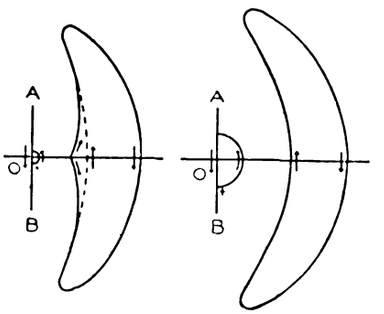


FIG. 4.—FREE ELECTRICAL OSCILLATION.

in the surface of the earth upon the wave fronts at that surface is indicated.

We may next consider the earth connection of the transmitting oscillator and the nature of the supports for the oscillator.

Although, by the use of such waves as are described above, normally the current density in the surface of the earth at a distance from the transmitting oscillator is rendered excessively small, nevertheless at and in the immediate neighborhood of the base of the vertical oscillator, the current density is in general very great. Moreover, since the current is of high frequency, it tends to flow only on the surface of the earth. For this reason the usual specifications for obtaining a good earth connection which involve burying a conductor of large area so deep in the ground that it shall be in permanently moist earth are no longer advantageous, and in a properly constructed wireless telegraph station the conductivity of the surface of the earth in the immediate neighborhood of the base of the oscillator is artificially increased by a superficial ground-plate composed of sheet metal, or of wire netting, extending radially from the base of the oscillator and covering as large an area about the base of the oscillator as is available for the purpose and consistent with reasonable economy.

Since the waves are horizontally polarized, the supports for the vertical oscillator, such as masts and guy ropes, should either be of insulating material, or if of metal, they should be divided by insulation into sections short compared to one-half the wave-length of any of the waves to be employed. The reason for this is that the fundamental free period of vibration of a linear conductor is such as to cause it to respond most energetically to waves of twice its own length. For such wave-lengths, therefore, the linear conductor would absorb an undue amount of the energy of the waves and moreover because of the rise of potential which occurs at the ends of the conductor for waves of such length it would be difficult to insulate the conductor from the earth or adjacent portions of the support of the vertical oscillator.

We come now to the vertical oscillator itself. This in general consists of two parts, the elevated conductor *per se* and the devices through which it is connected with the earth.

We shall here consider the relative simple case in which the elevated conductor is a straight, cylindrical copper wire of length a and radius ρ.

Both theory and practice show that the electrical vibrations in such a wire connected directly to the earth at its lower extremity correspond very closely to the transverse vibrations of a heavily damped stretched string.

If such a wire be charged to a high potential and be then permitted to discharge to earth, the electrical oscillations developed in it, and therefore also the electromagnetic waves radiated by it, will not be simple harmonic in type and will not be

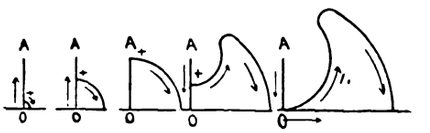


FIG. 5.—WAVE WITH VERTICAL LINEAR OSCILLATOR.

persistent. These waves will not, therefore, correspond to the sound waves given out by a tuning-fork, but will be of the character of those given out by a heavily damped violin string plucked at its centre.

The fundamental of the waves given out by such an oscillator has a wave-length which very closely approximates four times the length of the wire, and this is accompanied by all the odd harmonics.

Digitized by Google

The oscillations are so much damped by the energy drawn off from the oscillator by radiation as to make the resulting waves more nearly the equivalent of an impulse than of a sustained or persistent train of waves.

If, however, the elevated conductor be not directly connected to the earth, but be connected to it through an inductance coil, both theory and practice show that its electrical vibrations correspond to the transverse vibrations of a heavily damped stretched string with a mass attached to its centre.

The effect of the load at the centre of the stretched string and of the inductance at the base of the vertical wire is to increase the persistency of the vibrations, to minimize the importance of the harmonics and to lower the frequency of the fundamental. It might, therefore, seem that in order to cause the vertical oscillator in question to radiate a persistent train of simple harmonic waves of a predetermined frequency, it would be sufficient to charge the vertical wire to a high potential and permit it to discharge to earth through an inductance coil of suitable dimensions.

This, indeed, was the plan adopted in the first crude attempts to produce a selective system of wireless telegraphy. This method necessitates the use of waves of much lower frequency than that normally produced by natural vibrations in the vertical wire *per se*.

The degree of persistency of oscillations so obtained, however, is not as great as is required in practice. Such persistency as is obtained is gained at the expense of the amplitude of the current oscillations in the vertical and at the expense of the radiating power of the oscillator, the latter being *caeteris paribus* less for low than for high frequencies. Moreover, the spark in the vertical oscillator which normally dissipates an undue amount of the energy of the oscillations, has its resistance enhanced by the reduction of the amplitude of the current oscillations due to the presence of the inductance coil.

This latter difficulty may in a measure be overcome at the expense of any increase of the energy supplied to the oscillator, by shunting the spark gap by a condenser of large capacity. The discharge of the condenser across the spark gap increases the current through the spark and thereby reduces its resistance and damping effect upon the oscillations. The damping effect of the radiation still remains and the persistency is still too much limited for practical purposes.

So far we have considered only the natural oscillations of the vertical oscillator which are produced by charging the elevated conductor to a high potential and then permitting it to discharge to earth. When, however, a high degree of persistency, a pure sine wave and a great amplitude of oscillation are desired, the spark gap is removed from the vertical oscillating circuit and a simple harmonic electromotive force is impressed upon the vertical oscillator in its place. The resulting vibrations in the vertical oscillator are then forced simple harmonic vibrations. In order that they may be of great amplitude, the frequency of the impressed force is made to correspond to the fundamental of the vertical oscillator or to one of its harmonics, in which cases the reactance of the vertical oscillator is nil.

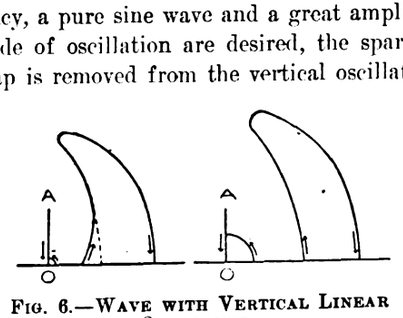


FIG. 6.—WAVE WITH VERTICAL LINEAR OSCILLATOR.

A simple arrangement for producing forced, simple harmonic vibrations in the vertical oscillator is shown in Fig. 9 in which G is an alternating-current generator, K is a key, P shows the connection to the terminals of the primary of a spark coil, S is a spark gap between the terminals of the secondary of the spark coil, C_1 is a condenser, L_1 is an inductance, I_1 and I_2 are the primary and secondary coils of a high-frequency transformer, V is the vertical wire and E is the earth.

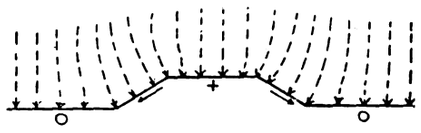


FIG. 7.—EFFECT OF ELEVATION.

There is a variety of ways in which substantially the same result may be accomplished, but there is not space in this paper to consider more than one arrangement.

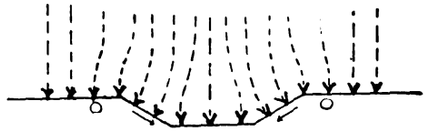


FIG. 8.—EFFECT OF DEPRESSION.

For the type of elevated conductor which we are here considering, *i. e.*, a cylindrical copper wire of length a and radius ρ, the reactance of the elevated conductor *per se* is given with a degree of approximation ample for engineering calculations by the expression:

$$Z = -Lv \cot \frac{na}{v}$$

where $$L = 2 \log_\epsilon \frac{4a}{p} - k$$

and where $$k = 5.584 - 3.169 \left(\frac{na}{v}\right)^2 + 0.3269 \left(\frac{na}{v}\right)^4$$ for values of a between 0 and $\frac{\pi v}{2n}$. (1)

In these expressions, v is the velocity of light and n is the periodicity of the impressed force or $\frac{2\pi}{T}$, where T is the time of a complete oscillation.

The reactance Z therefore vanishes when $n = \frac{2\pi}{T} = m \frac{\pi v}{2a}$, where m is an odd integer. The wave-lengths corresponding to this condition are therefore $\lambda = v\,T = \frac{4a}{m}$. The wave-length of the fundamental is therefore $4a$ and the harmonics are all odd.

For frequencies lower than that of the fundamental, the reactance is negative or a capacity reactance. For frequencies between that of the fundamental and its first harmonic the reactance is positive or an inductance reactance. For frequencies between that of the first even harmonic and the first odd harmonic the reactance is again negative or a capacity reactance. In other words, the reactance of the vertical wire measured at the source or driving point of the system is either that of a condenser of capacity $S' = \frac{1}{Lvn} \tan \frac{na}{v}$ or of an inductance $L' = \frac{Lv}{n} \cot \frac{na}{v}$ depending upon whether $\cot \frac{na}{v}$ is positive or negative.

The condition for zero reactance in the vertical oscillator system is obviously $Z + Z_0 = 0$ where Z_0 is the reactance of the apparatus connected between the vertical wire and the earth. Z_0 must therefore be an inductance reactance for frequencies which make the reactance of the vertical wire a capacity reactance and conversely it must be a capacity reactance for frequencies which make the reactance of the vertical wire an inductance reactance.

The curve shown in Fig. 10 gives the observed apparent capacity of vertical wires 0.08 inch in diameter varying from

(1) The value of k here given has been determined empirically, the remainder of the formula being based upon a theoretically deduced working theory described in the paper referred to. A more complete expression for L will be given elsewhere.

Digitized by Google

40 to 180 feet in length, when the periodicity of the impressed force is 9.78×10^6. In other words, it gives the observed apparent capacity of vertical wires for values the angle of $\frac{na}{v}$ from 0.3976 to 1.790 and for values of the ratio $\frac{4a}{\rho}$ from 47,520 to 213,800.

The reactance Z_0 of the apparatus through which the vertical wire is connected to ground may most simply be made negative, when this is necessary, by the insertion of a condenser in series with the coil I_2, but this result may be accomplished in a variety of ways, for the description of which there is not space in this paper.

It will seem that by making $Z_0 + Z = 0$ or Z_0 equal but opposite in sign to the reactance of the elevated conductor, powerful oscillations of any desired frequency may be developed in the vertical oscillator by means of forced vibrations, whereas when the natural oscillations of

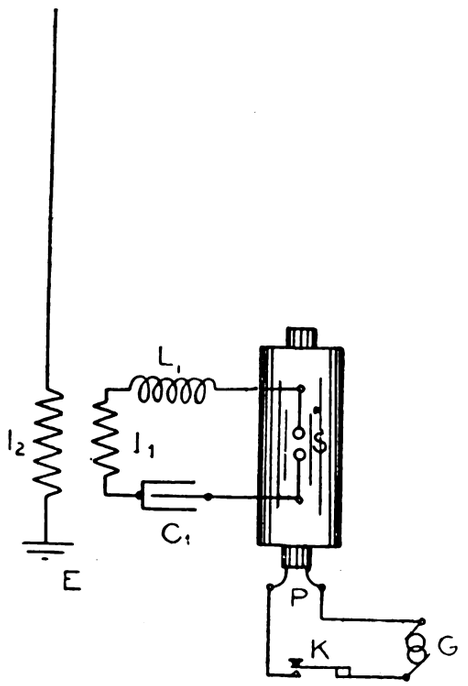


FIG. 9.—ARRANGEMENT FOR PRODUCING FORCED SIMPLE HARMONIC OSCILLATION.

the vertical oscillator are resorted to the frequency must necessarily be less than that of the fundamental of the oscillator.

Concerning the arrangement illustrated in Fig. 9, there is much of detail which requires attention in order that the apparatus shall satisfactorily fulfil the requirements of radiating a persistent train of simple harmonic waves. For instance, if a dielectric having considerable electrostatic hysteresis be employed in the condenser, a surprisingly large amount of energy will be dissipated in this dielectric. The magnitude of this loss is due to the fact that the energy dissipated increases both with the potential difference employed at the terminals of the condenser and also with the frequency. Since potential differences developed at the terminals of the condenser

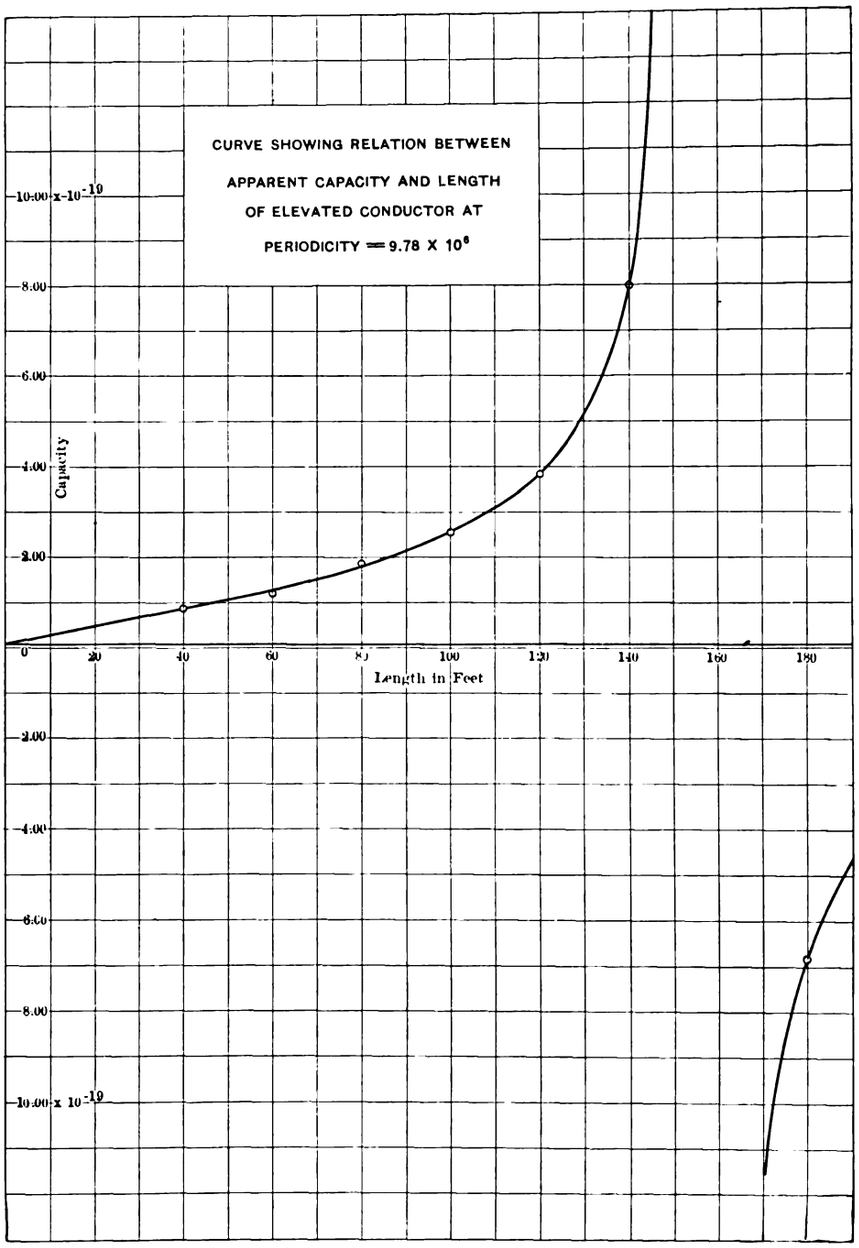


FIG. 10.—RELATION BETWEEN APPARENT CAPACITY AND LENGTH OF CONDUCTOR.

amounting to 50,000 volts and oscillations having frequencies of 5,000,000 are not unusual in wireless telegraphy, it is easy to see that the losses in the dielectric of a condenser in a wireless telegraph circuit are of a far greater order than that in the dielectric of condensers employed in the usual power or lighting circuits.

Moreover, the specific inductive capacity of most dielectrics is a function of the density of the displacement current in the dielectric, and when such dielectrics are employed in the condenser in an oscillating circuit the resulting oscillations are not simple harmonic in form and are not isochronous throughout the train.

Air condensers should therefore be used in wireless telegraphy to the exclusion of any other type pending the publication of the results of certain investigations which are being conducted with the view of supplying a dielectric of high dielectric strength and constant specific inductive capacity.

The coils used in wireless telegraphy should not have iron cores except the iron be very finely comminuted and imbedded in a non-hygroscopic dielectric matrix. It has even been found by the author that coils wound on a wooden cylinder do not operate satisfactorily when used in the oscillating circuits of wireless teleg-

Digitized by Google

raphy. The coils for this purpose are best constructed by winding a few turns of bare copper wire in a single layer on a skeleton frame made of ebonite, care being taken to separate the turns by such an amount that the sum of the air spaces between the wires of the turns is equal to or slightly greater than the sparking distance in air corresponding to the greatest potential difference liable to occur at the terminals of the coil when the apparatus is in operation.

If the local oscillating circuit $C_1I_1L_1S$ of the arrangement shown in Fig. 9 were isolated, its oscillations would be expressed by

$$i = \frac{e}{L}\left(\frac{1}{\sqrt{\frac{1}{LS} - \frac{R^2}{4L^2}}}\right)\epsilon^{-\frac{R}{2L}t}\left(\sin\sqrt{\frac{1}{RS} - \frac{R^2}{4L^2}}\right)t$$

where i is the current, e is the potential to which the condenser C_1 is charged at the time when the spark occurs at S, L is the inductance of the circuit, R is the resistance and S is the permittance or electrostatic capacity of the condenser.

If the oscillator is at all persistent $\frac{R^2}{4L^2}$ is negligible compared to $\frac{1}{LS}$, and the expression reduces to

$$i = e\sqrt{\frac{S}{L}}\epsilon^{-\frac{R}{2L}t} \cdot \sin\frac{t}{\sqrt{LS}}$$

The time required to fall to $\frac{1}{\epsilon}$ of their initial amplitude is therefore $t = \frac{2L}{R}$

The number of oscillations per unit of time is $\frac{1}{2\pi\sqrt{LS}}$.

For a given frequency, $Ln = \frac{1}{Sn}$ so that the persistency for a given frequency is proportional to

$\frac{Ln}{R}$, where n is 2π times the frequency.

The measure of the persistency of the circuit is therefore proportional to $\sqrt{\frac{L}{R^2S}}$.

An isolated circuit of this type may be made to give extremely persistent simple harmonic oscillations, but if it be given a large coefficient of mutual inductance with another oscillator of relatively low persistency, such as the vertical oscillator VI_2E of the arrangement shown in Fig. 9, two things happen. In the first place the oscillations of the circuit are in general no longer simple harmonic, but are broken up into two simple harmonic oscillations of different frequencies, and in the second place the persistency is greatly reduced.

To overcome this difficulty it is necessary either to make the magnetic leakage of the high frequency transformer, connecting the local oscillating circuit with the vertical oscillator, unusually large, or else to add to the local oscillating circuit an inductance coil L_1 with sufficient inductance to swamp by its effect the reaction from the secondary circuit.

When intense radiation is desired, it is necessary to make the capacity S of the condenser C_1 in the local oscillating circuit large compared to S[1], the apparent capacity of the elevated conductor *per se*, for the frequency employed.

RECEIVER.

Since the electromagnetic waves to be received at a wireless telegraph receiving

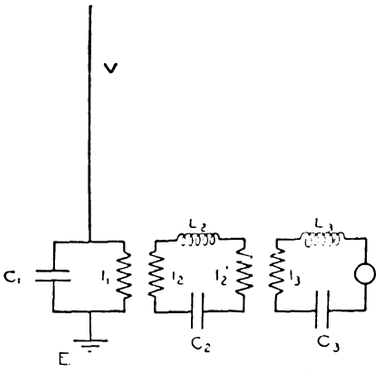


FIG. 11.—SELECTIVE RECEIVING CIRCUIT.

station are horizontally polarized at the earth's surface, an electrical oscillator whose axis is normal to the earth's surface is employed at the receiving station. This oscillator may either be connected to earth at its lower extremity or it may be connected to a device having reactance equal for all frequencies to the reactance of the vertical oscillator. It is to be remembered in this regard that at the receiving station we are not concerned with what becomes of the energy which is dissipated by the reradiation of the energy from the receiving vertical oscillator.

We shall consider again a simple concrete case, and shall assume the elevated conductor to be a cylindrical copper wire of length a and radius ρ as in the case of the transmitter, though it must by no means be assumed that the elevated conductor at the receiving station must necessarily be similar to that at the transmitting station, or, in fact, that it must bear any resemblance to that at the transmitting station except in so far as its axis is preferably normal to the surface of the earth.

As in the case of the transmitting station, only one simple arrangement of the apparatus sufficient to give the desired result will here be considered. By this arrangement messages transmitted by means of persistent trains of simple harmonic electromagnetic waves of a predetermined frequency may be received to the exclusion of messages transmitted by similar waves of materially different frequencies, and without interference by impulsive waves. Such an arrangement of the circuits and apparatus is shown in the diagram, Fig. 11. In this arrangement the receiving device which is indicated at R is placed in a local circuit C_3I_3 L_3R_3 which is made resonant to the frequency of the waves to which the station is intended to respond, and a second resonant circuit C_2I_1 L_2I^2 resonant to the same frequency and called a "weeding-out circuit," is interposed between the first mentioned circuit and the vertical oscillator.

The branch circuit, consisting of the coil I_1 and the condenser C_1, is not, when taken by itself, resonant to the same frequency as the other local circuits, but is so proportioned that when connected as a branch circuit, forming a part of the vertical oscillator system, the latter shall respond most energetically to persistent trains of waves of that frequency falling upon the vertical wire.

The way in which this is accomplished is perhaps more easily seen by a graphical demonstration than by the use of the analytical solution, though the latter is by no means difficult.

The curves in Fig. 12 illustrate the point in question. Curve 1 represents the reactance of the vertical wire measured at its point of attachment to the loop circuit, for varying periodicities of the impressed force. It will be seen that the periodicity of the fundamental of the vertical wire is at the point n_1'', where the reactance first vanishes. The first even harmonic is at n_2'', and the periodicity of its first odd harmonic is at n_3'', where the reactance again vanishes. Normally, therefore, curve 3, which is the current curve for varying periodicities of the impressed force on the vertical wire, would show maxima at n_1'' and at n_3''. The reactance of the loop circuit for varying periodicities of the impressed force, measured across the points of its attachment to the vertical wire and earth connection, is shown in curve 2.

Digitized by Google

The total reactance of the vertical oscillator measured at the earthed terminal is the algebraic sum of the two reactances shown in curves 1 and 2, and as a result the current curve 3 shows maxima, not at n_1'' and n_3'', but at periodicities n, n'' and at a periodicity slightly higher than n_3''.

These are the points at which the reactance of the loop circuit is equal, but opposite in sign, to that of the vertical wire.

The periodicity of the local loop circuit *per se* is n_1' and for this periodicity the current in the vertical wire is practically nil.

The "weeding-out circuit" and the circuit containing the receiver are both resonant to the periodicity n, so that for persistent trains of waves of that periodicity the energy of the oscillations set up in the vertical oscillator is transmitted directly to the receiver, but persistent trains of waves of other frequencies, either produce but slight response in the vertical oscillator or else produce oscillations of the periodicity n'', or of a periodicity slightly higher than n_3''. To such periodicity the "weeding-out circuit" and the circuit containing the receiver are extremely irresponsive so that the receiving device receives but an inappreciable amount of the energy of the waves.

In the case of impulsive waves the vertical wire tends to respond only to its own natural rates of vibration as affected by the loop circuit, that is to say, it tends to oscillate at periodicity n'' and to upper harmonics. Such waves acting on the vertical wire, have little tendency to develop oscillations of the natural period of the loop circuit as affected by its connection with the vertical wire, namely n, and the receiver is therefore also protected from the effects of such impulsive waves.

All that has been said regarding the effects of electrostatic and magnetic hysteresis in the description of the transmitting station applies with added force to the apparatus at the receiving station. It is, in fact, much more important to exclude the effects of hysteresis from the receiving circuits than from the transmitting circuits, and it may be laid down as an important rule that under no circumstances shall solid or liquid dielectrics be used in the receiving circuits.

Moreover, the injunction in regard to making the mutual inductance small between oscillators at the transmitting station applies in the case of the resonant circuits at the receiving station, since if the mutual energies of the related resonant circuits be not small compared to their self energies, the resonant circuits will modify one another's natural periods and each circuit will respond to more than one periodicity.

Finally, it may be said that the measure of the selectivity of a resonant circuit is proportional to that $\sqrt{\frac{L}{R^2 S}}$, this expression being the same as that found in connection with the persistency of an oscillating circuit. For a given periodicity, therefore, the selectivity is proportional to $\frac{L N}{R}$.

So great is the selectivity of resonant circuits constructed of air condensers and properly designed inductance coils that there is no difficulty in adjusting such

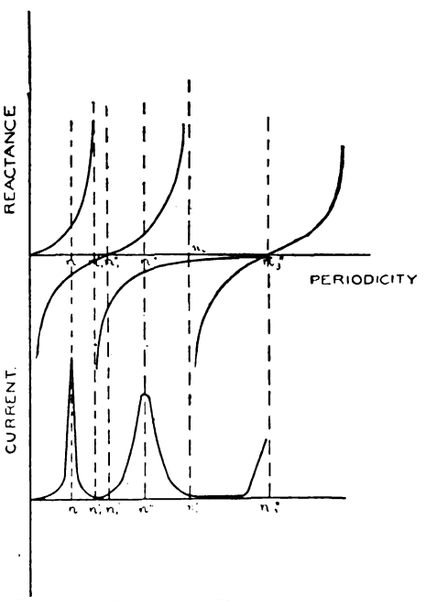


FIG. 12.—GRAPHICAL DEMONSTRATION OF SELECTIVITY.

circuits to resonance for a given frequency with an error of less than one part in 3,000.

The importance of the "weeding-out circuit" at the receiving station becomes apparent when we observe that the selectivity of the receiving vertical oscillator is greatly diminished by the dissipation of energy, which results from the reradiation of energy by that oscillator and that the selectivity of the resonant circuit containing the receiver may be greatly diminished by the energy absorbed by the receiver and utilized in its operation.

Electrical Tests on the Valtellina Railway.

At the recent congress of the Italian Institution of Electrical Engineers, Signors M. Novi and A. Danoti presented a paper giving the results of interesting tests relating to the consumption of energy on the three-phase Valtellina Railway. It was found that the average consumption of energy required by a train running between Lecco and Sondrio, and between Colico and Chiavenna, ranged from seventy-seven to fifty watt-hours per ton-mile. The higher figure is for the consumption of a single motor car only. The lower figure is that obtained with a train which consisted of a motor car weighing fifty-four tons, and four or five trailer cars weighing from sixty to seventy tons. The stopping and starting points on these trial runs were made at the same altitude. A single motor car, when running at a speed of about thirty-seven miles per hour on the level, required 28.2 watt-hours per ton-mile. For trains of 110 and 130 tons, running at the same speed, the figures were 21.7 and 21.1 watt-hours per ton-mile, respectively. In accelerating a train up to 37.3 miles per hour, an expenditure of from ninety to 100 watts per ton of train-weight is required. Forty-two watt-hours are used in accelerating the mass, from eighteen to twenty-three watt-hours are used in overcoming train friction, while from thirty to thirty-five watt-hours are expended in the starting resistances or in motor losses. The time required for coming up to full speed is 130 seconds. There are seven stopping places between Lecco and Colico, a distance of twenty-five miles. In making this run about 9.7 watt-hours per ton-mile are wasted in starting resistances and in iron losses. This is about one-fifth of the average consumption per ton-mile. A train of 110 tons runs down a gradient of 0.417 per cent free. On steeper gradients, energy is returned to the line. A train of 120 tons on an incline of two per cent at a speed of twenty and one-half miles per hour, returned about forty-five watt-hours per ton-mile to the line. The motors, during this run, were connected in cascade. On other stretches of the line where the grades were less, though the speed was higher, practically the same energy was returned to the line. For instance, on a grade of 1.49 per cent, running at a speed of thirty-nine miles per hour, twenty-three watt-hours per ton-mile were returned to the line. From measurements of the energy supplied to the line by the power station it was found that, for a whole working day, lasting from four in the morning until twelve at night, 11,550 kilowatt-hours were consumed. The run during this time was 1,356 train-miles, or 161,000 ton-miles. This makes the average consumption per ton-mile seventy watt-hours, measured at the station. This figure covers the energy required for lighting and heating the train and the stations, and for driving the repair shops at Lecco, as well as for operating the trains.

A test of one of the new locomotives, recently acquired, showed that this could draw a train weighing 270 tons at a schedule speed of nearly forty miles per hour. The maximum gradient on this route is one per cent. At these points the locomotive draws from 150 to 160 amperes from the trolley wires. The voltage is 3,000. Trains weighing 460 tons have been run over the same line at about twenty miles an hour. On a two per cent grade it required from 190 to 200 amperes to start a train weighing 250 tons.

Digitized by Google

Planning New York Telephone Service for Twenty Years.

[*From The Sun, March 19, 1905.*]

A phase of the New York Telephone Company's work of which the public knows little is a systematic endeavor to forecast from time to time the probable population in its various telephone centres. These forecasts are scarcely less important to the successful operation of the business than the manufacture of telephones or the laying of wires, for upon their accuracy hinges the financial profit or loss of the company.

In order to lay out the systems of subways properly, to locate the telephone central stations, to decide their number and size and to determine trunk line routes and cable crossings, it is necessary to forecast changes in the population likely to occur, not only in one, two or three years, but as far ahead as twenty years. For this reason the experts employed by the company have studied the development of New York in a way which has probably never been followed either in this country or abroad.

As a result the plans of the telephone company are now being made for the growth to be expected in periods as far ahead as 1925. The basis for most of its building operations now is a forecast for 1920, which was made by its experts in 1902.

Some idea of the material used in arriving at conclusions and of the methods by which the forecasters obtain results was gained the other day by a *Sun* reporter during a talk with the telephone company's chief engineer. Said he:

"We have found, as a rule, that the most reliable statistics concerning the growth of American cities are those given in the reports of the United States Census Bureau, and in making our forecasts these reports have been carefully studied and the past growth of the different cities of the United States analyzed and compared with that of New York. In addition to this the growth of London, Paris, Berlin and Vienna has been compared with that which has taken place in the large cities of this country.

"In figuring out our 1920 forecast we decided to estimate the population of the territory within a radius of eighteen miles from City Hall, even though a considerable part of this territory lies outside the city limits, and for this reason: from the point of view which concerns the telephone company the growth of places like the Oranges, Montclair and Yonkers is practically a growth of New York, and the residents of outlying districts who do business in New York and use a telephone at either end of the line are the same as residents of New York city. In smaller places the city line includes most, if not all, of the population associated with the city limit, but in New York this is not the case.

"Our calculations relative to the population within eighteen miles of City Hall produced these statistics: in 1870 it was 1,880,000; in 1880, 2,450,000, an increase of 30 5-10 per cent; in 1890, 3,278,000, a gain of 33 8-10 per cent; in 1900, 4,538,000, a gain of 38 45-100 per cent.

"In view of these statistics, and after consulting every available source of information, the telephone company made this forecast: within New York city and within a radius of eighteen miles from the City Hall there will be by the year 1920 a population of 9,000,000."

"What proportion of this 9,000,000 do you estimate will be the population of Greater New York?" the expert was asked.

"Our figures for Greater New York indicate a population of 5,900,000 by the year 1920.

"These estimates do not, however, agree with those obtained when the method of forecasting used by the Census Bureau is applied to New York city and its suburbs, and according to which the population in 1920 within the eighteen-mile area would be 7,000,000 and in Greater New York, 5,300,000.

"The difference in the two forecasts represents a problem which the engineers of the telephone company must confront. They must decide the question whether to plan for a population of 7,000,000 or of 9,000,000. If plans are made for 9,000,000 and only a 7,000,000 growth is attained a big error will have been made. In that event the telephone plant would be excessively large for the volume of business to be carried on and enormous losses would be incurred.

"On the other hand, if plans are made for 7,000,000 and a growth of 9,000,000 should be reached it would mean that the plant would not be sufficient to care for the business, necessitating a radical reconstruction and a wasteful expenditure of vast sums of money.

"No, there is no sure way to avoid such losses. The best that can be done is to make an exhaustive study of the situation and then go ahead.

"In view of the numerous fireproof buildings and costly switchboard systems which must be provided for the different central office districts it is obvious that not only must the population be correctly forecasted but also the number of persons who will require telephone service and their location. It is also necessary to predict with some degree of accuracy how many times a day these subscribers will be likely to call up the central office, and also the districts to which their calls will extend. In fact it is only by doing this that the trunk-line equipment and subway system necessary to join the various offices can be planned.

"For example, if the subscribers in the Harlem office should send the principal number of their calls to Broad street, it would naturally mean that in joining these offices there would be required a large number of underground ducts containing many trunk cables. If on the contrary the calls of the Harlem subscribers were principally to Jersey City the necessary duct and cable equipment should extend to that office rather than to Broad street.

"All of this must be determined in advance, as well as at what time of day most of these calls are likely to arise, for the operating force must be adequate to handle at all times a maximum number of calls.

"To one who has not studied the subject it would seem an utter impossibility to meet with any degree of precision these questions and many others even more refined and complicated. Nevertheless so far a fair degree of accuracy has been possible.

"In planning for the underground ducts which will be required between now and 1920 the engineers go into the matter exhaustively. They endeavor in all cases to put down at one time a number sufficient to meet the ultimate requirements, and in this way avoid unnecessary disturbance of the street and needless expenditure of big sums of money. Our underground duct system has already been extended to such a degree that there are now 295,000 miles of telephone wires on Manhattan Island, representing ninety-nine per cent of the total wire mileage. In this respect the showing made in New York is far ahead of that made by any other city in the world.

"A city commercially preeminent is bound to attract to itself business and people to proportions quite unknown to less important places; and that New York is the preeminent city of the United States no one disputes. The only thing which can check its growth is inadequate transportation facilities.

"Naturally if life becomes intolerably uncomfortable in a city the growth of population will be checked. Therefore in forecasting New York's population for 1920 the telephone engineers have carefully studied the effect upon the growth of the population of improved rapid transit and taken into consideration the opening of the subway and of the Williamsburg bridge, which they believe to be forerunners of many subways, bridges and tunnels.

"By 1920 their calculations, although not yet complete, indicate a provision for 1,000,000 telephone stations in the eighteen-mile area and 600,000 telephones in use in Manhattan, as against the 130,000 now used."

Annual Convention of the Ohio Independent Telephone Association.

The annual convention of the Ohio Independent Telephone Association will be held in Columbus, Ohio, March 30. The members of the committee of arrangements are E. L. Barber, Wauseon; Cyrus Huling, Columbus; J. B. Hoge, Cleveland; Dwight E. Sapp, Mount Vernon, and Frank L. Beam, president of the association.

Digitized by Google

New York Electrical Society.

The 249th meeting of the New York Electrical Society was held at 19 West Forty-fourth street, Wednesday, March 15.

In President Sprague's opening remarks, he referred to some experiments he had made ten years ago with an induction furnace for steel-making in New York city. These tests did not lead to any commercial result at that time. Dr. E. F. Roeber gave an address on "Recent Developments in the Electrometallurgy of Iron and Steel." Dr. Roeber dealt mainly with the manufacture of ferro-alloys in the electric furnace and discussed especially those such as ferrotitanium, the manufacture of which requires a very high temperature which is not attainable in the blast furnace. For other alloys which are being made to some extent in blast furnaces (for instance, ferrosilicon) the electric furnace has the advantage of rendering obtainable high percentage alloys. Thus in the electric furnace ferrosilicon is made containing up to seventy-five per cent silicon, while the usual blast-furnace alloy contains only about fifteen per cent silicon. The speaker pointed out the advantages resulting to the steel men from the use of high-percentage alloys. He discussed at some length the different methods which are in use by different companies to produce alloys or metals free from carbon. A large number of alloys of considerable value were exhibited. Some of the most interesting specimens were received from the Goldschmidt Thermit Company, the Niagara Research Laboratories and the Roessler & Hasslacher Company. The use of ferroalloys in steel manufacture has brought about a revolution in recent years in the manufacture of special steels.

Dr. Paul L. T. Héroult spoke on "Making and Refining Steel in the Electric Furnace." He described the construction of his furnace, in which two electrodes are used dipping into a slag on the top of the molten metal. The current enters through one electrode, passes through the slag and the bath, and passes out again through the slag and the other electrode. By varying his artificial slag, he is able to remove all the usual harmful impurities, such as phosphorous and sulphur. The cost of power is insignificant, and the cost of the whole treatment in the electric furnace is below fifty cents per ton of steel if molten steel (from the Bessemer converter or the open hearth furnace) is introduced into the electric furnace. Dr. Héroult did not predict a revolution in the general metallurgical methods of steel-making, but foretold marked improvement in the quality of the steel used for various purposes.

An animated discussion followed in which Messrs. J. T. Moorehead, E. Stütz, L. Ruhl, Drs. Leonard Waldo and C. A. Doremus took part. Dr. Doremus spoke especially on the reduction of pig iron from ores and pointed out that it is simply a question of the relative cost of electric power and fuel. He showed, however, that there are other considerations to be taken into account, for instance, that it is not necessary to use a certain quality of coke in the electric furnace. Dr. Leonard Waldo gave some reminiscences of early electrometallurgical work done in this country, and spoke especially on Mr. Colby's and his own work with the induction furnace.

The following members were elected: Thomas A. Wilkinson, Henry McDonough, H. W. Appleton, F. W. Blasdale, Fred G. Gans, Hugo Fuchs, Stuart Hamill, G. A. Wells, Jr., Richard Lombard, Edward Taylor.

Iowa Telephone Association.

The ninth annual meeting of the Iowa Telephone Association was held in the Chamberlain Hotel at Des Moines, March 14 to 16. The first session was held Tuesday, March 14, in the evening and was devoted to principally organizing.

President J. C. Sullivan, of Creston, read his address, reviewing in a measure the telephone situation in Iowa, and the great need of a closer relationship between the various operating companies in the state.

In the second session, Wednesday, March 15, a paper was read on "The Old Way and the New," by C. H. Judson, the consulting engineer of Council Bluffs. Mr. Judson's paper was in the nature of a brief history of the construction work done by telephone companies from the early days up to the present time, and closed with some remarks on modern all-cable, multiple-tap distribution. The next paper, "A Generator Call Lamp-Line Board," by Oscar Knell, of Perry, was a complete and interesting description of a board of this type installed by the Hawkeye Telephone Company in its Winterset office.

"The Relation That Should Exist between the Farmers' Mutual and Other Independent Telephone Companies" was discussed by C. A. Hollis, of Hudson.

The afternoon session was opened with a debate, "Magneto Multiple *versus* Central Energy Multiple Boards for Small or Medium-Sized Exchanges," by J. M. Plaster, of Fort Dodge, and R. S. Redman, of Newton. This subject and the discussion following it proved one of the most interesting features of the convention, for, although the majority of those who took part in the discussion preferred the central energy board, Mr. Plaster very able defended his side of the cause.

W. L. Barth, of the Sheldon School of Scientific Salesmanship, gave an address on the "Science of Modern Business Building," which was listened to with great interest.

"The Development of Toll Business and Checking of Tolls" was the subject of a paper presented by James H. Shoemaker, of Waterloo.

Thursday, March 16, the session opened with a very able paper on the "Iowa Assessment Law," by N. T. Guernsey, of Des Moines.

The next speech was delivered by James B. Hoge, of Cleveland, Ohio, and his subject was the "National-Interstate Telephone Association." Mr. Hoge explained the work of the Interstate association and the details of the organization and urged his hearers to join. Theodore Gary, of Macon, Mo., followed Mr. Hoge and spoke along the same line. Following these speeches, the association voted to join the National-Interstate association.

The election of officers then followed:

President, S. S. Lichty, Vinton.

Vice-president, P. C. Holdoegel, Rockwell City.

Secretary and treasurer, Charles C. Deering, Boone.

Executive committee—J. C. Sullivan, Creston; George N. Bandy, Des Moines; J. C. Thorne, Fairfield; J. S. Bellamy, Knoxville.

The afternoon was given to visiting the new exchange of the Mutual Telephone Company, and the exhibits and displays of the various manufacturers and supply men.

The banquet Thursday evening was held in the Chamberlain. The speakers were as follows: toastmaster, J. C. Hume, of Des Moines; "General Principles," Frank L. McGillan, Chicago; "The Telephone Troubler," J. H. Shoemaker, Waterloo; "A Square Deal, That's All," J. B. Hoge, Cleveland, Ohio; "Independent Telephone Men," Theodore Gary, Macon, Mo.

Charles E. Wells, of Marion, Kan., who was to have spoken on the Kansas Supreme Court decision, wired that owing to illness in his family he could not be present.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

A New Train-Lighting System.

At the recent Paris automobile show, several train-lighting systems were exhibited. In one of these a flyball governor, attached to the end of the armature shaft, actuates a rheostat arm, and in this way varies the field circuit. A more interesting system, however, is one in which a magneto generator is employed, in which the inherent regulation is sufficient to provide for all changes in speed. In a machine of this kind the intensity of the current is given by the formula $I = \frac{E}{\sqrt{R^2 + \omega^2 L^2}}$; that is to say, the current varies directly as the electromotive force, and inversely as the impedance. If the machine be constructed so as to reduce R to a negligible value, the current is inversely proportional to the reactance. But as the electromotive force and the reactance both vary directly as the speed, the current will remain constant, independent of the generator speed. While this condition can not be exactly maintained in practice, it can be approximated sufficiently for the satisfactory operation of lights. Since the supply is by means of alternating currents, the generator can not be used directly for charging the batteries which supply the lights while the car is standing. To get over this difficulty, the use of electrolytic rectifiers or other similar apparatus for charging the batteries is suggested.—*Translated and abstracted from L'Industrie Électrique (Paris), February 25.*

The Wear of Turbines.

In this communication M. S. P. Yersin describes and shows photographs of a 200-horse-power turbine which exhibits a peculiar condition of wear. This turbine has been in use for six years. It is of the horizontal type, and drives two 100-horse-power generators, each supplying electrical energy to the city of Geneva. The water is supplied under a head of 135 metres to the outside of the wheel, and at this point the size of the jet is limited by a sliding vane. The jet itself is divided into several independent streams by blades in the nozzle. All the blades of the wheel have worn away in the same manner. The extreme ends of the blades are but little affected. Toward the centre there are three deep grooves cut entirely through the blades. The character of the wear indicates that it was not due to sand or foreign matter in the water, but to a peculiar action of the jet. This letter is discussed in another from M. J. Dalemont, who attributes the wear to eddies set up in the jet of water by the nozzle. He calls attention to a peculiar erosion of rocks which is sometimes observed, and which is due to the eddies set up in the stream. A remarkable case is illustrated, it being that which he has found at the bridge of Pon des Oulles on the Valserine river, two kilometres from Bellegrade. He thinks that the action of the nozzle and the distributor is to set the jet of water into harmonic vibration, producing, in this case, several nodes and loops. This would produce the wear which was found to have taken place. —*Translated and abstracted from L'Éclairage Électrique (Paris), February 25.*

Searchlight on Mount Hood.

One of the striking features of the Lewis & Clark Exposition will be, according to Mr. F. L. Merrick, a powerful searchlight on the crest of Mount Hood, Wash. It is planned to place at this point an eighty-inch projector, which will be able from its commanding position to throw a beam 200 miles and illuminate the neighboring peaks. Mount Hood is 11,225 feet above the sea level, and is forty-six miles from Portland. The beam from this searchlight will light up Mount Rainier—100 miles from Mount Hood—and Mount Adams, and will be seen on a clear night by vessels 120 miles off the coast. To place the searchlight on Mount Hood requires a good deal of engineering skill and labor. It will cost about $30,000. A short tower of iron and wood, the upper part of the searchlight, and the base for the apparatus and operators will be built on the summit. The transmission line is to be built down the north side of the mountain to Cooper's Spur, and from there to a point in the neighborhood of Cloud Gap Inn, where a temporary generating plant will be installed. The difficult part of the undertaking will be the delivery of the necessary material and apparatus. It is proposed to overcome this by using a steel hoisting cable with sleds, and all of the material can be delivered on the summit by this means, as the side of the mountain toward Cloud Gap Inn is favorable to this mode of transportation. Part of the transmission line will have to be carried over glaciers, where special construction will be necessary. Iron poles, painted white, so as not to absorb any heat, will be placed in the ice to carry the cables. A flat surface on the summit of the mountain has been selected as the place for the tower. The foundations will be blasted out. The tower will consist of iron poles sunk in the ice, upon which the upper structure of iron, steel and wood will be constructed. To protect the operators from the severe cold of the mountain at night, the transformers and motors will be arranged so that they can be controlled from the operating room. After the sun goes down, everything on Mount Hood freezes solid. In addition to the searchlight effects from the summit, 100 arc lights will be distributed on the sides of the mountain facing Portland, and red fire will be employed during the exposition. It is said to produce a very startling effect. It is anticipated that this work may lead to the establishment of an astronomical observatory.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), March.*

The Future of Railways.

In this section of his series of articles discussing the future of the British railways, Mr. Philip Dawson considers in detail the advantages which may be obtained by electrification. The principal one of these is the increased acceleration which may be secured. Another is the reduction in the dead weight. The electric train carries, in addition to the cars, only its motors. The steam train must carry its motors and its generating system. In the case of suburban trains, the locomotive, on the average, weighs over one-third the useful weight of the passenger coaches hauled. In an electric system the heavy locomotive is replaced by a comparatively light motor-car, and energy is generated under the most economical conditions at a central power station, from which it is transmitted many miles with but slight loss. The wear and tear on the track is reduced, not only by the use of lighter trains, but because the rolling and pitching which occur with steam locomotives are absent with the electric train. The fact that the motors are distributed through-

Digitized by Google

out the train still further tends to reduce the wear on the tracks. A larger proportion of the weight of the train is available for tractive effort with the electric drive, this being from twenty-five per cent to thirty per cent of the maximum load, while with steam locomotives it does not much exceed sixteen per cent. The cost of operating trains may be reduced, since fewer men are required to handle equivalent electric trains. Another important benefit will be the increase in the number of trains which can be handled in the termini. It is thought that an electric train will save at least four minutes at the termini of the five to seven minutes now taken by the steam trains. The author discusses the results of electrification, referring particularly to the conditions and performance of American systems, and lays some stress upon the increase in traffic which could be secured by electrification. This will mean not only an increase in the number of passengers carried, since it would build up the theatre and other traffics, but the faster time would induce people to live further away from London. A comparison of the cost of electric and steam operation is made, based upon the performance of the Mersey Railway. This shows a very decided gain for the electric service. The total working expenses with the steam trains were 82.4 cents per train-mile. With the electric service they were only 36.4 cents.—*Abstracted from the Electrical Review (London), March 3.*

Electric Power Supply in London.

There are a number of bills now before Parliament which are concerned with the supplying of electrical energy to the city of London. The supply of electricity in London at the present time is partly in the hands of private companies, and partly in the hands of local authorities. Some of the private companies have been carried on most successfully and have developed a large and lucrative business. Others have not done so well. The municipal systems, on the other hand, can hardly be said to be thoroughly successful financially. An analysis of their accounts shows, as a rule, that, while the balance may appear to be on the right side at the end of each year, their reserve and depreciation funds have been starved in order to show that balance. In some cases it has been necessary to raise the rates in order to put the finances in a proper condition. The report of the London County Council, published last year, gives an analysis of all the accounts of London electricity undertakings for the year 1902-1903. Of the thirteen municipal undertakings, "only one was able to make a contribution for the alleviation of the rates, while four had to draw upon the rates, the net result being a call upon the rate-payers to the extent of £1,038." At the same time, only three of these undertakings paid anything at all to depreciation, the total reaching only £2,371. Four made payments to reserve fund, while one drew upon that fund, the result being an addition to the reserve fund of £15,390. This is wholly inadequate in relation to the heavy capital expenditures involved. The electrical supply companies in London, both private and municipal, are doing their best to secure a power load for their stations, as distinct from a lighting load, and create a demand for current in the day hours. In all cases the rates charged for power supply are considerably lower than those charged for lighting. One important phase of the development is the ever-increasing cost of land in central London. This makes the fixed charges in any undertaking heavy, and the burden, in some cases, becomes so great that the companies are seeking to obtain powers to erect their stations in outlying areas. It is for this purpose that the greater number of the bills now before Parliament have been introduced. If a power supply to London is to be carried on in the future by a large number of separate authorities, as is now the case, the process of the transfer of stations into less central districts must become even more pronounced. Two ways out of the difficulty are possible: each supply company may erect its own station in some convenient district removed from the centre of the city, or the smaller companies may purchase power from a large company which generates it on a much larger scale. It is thought that the time has now arrived for a full consideration of the question, whether the latter plan may not be of service to lighting authorities. In some cases this step has already been taken, two companies having agreed to make use of a joint station; but if more could combine and erect one large station, the result would be still more favorable. This way out of the difficulty should be followed by the municipal companies as well as by the private companies, but, at the present time, the municipal authorities are raising objections to every one of the private bills now before Parliament. These objections are merely obstructive, since in no case are the municipal authorities in a position to erect a large municipal station. The London County Council holds that it should be the authority for supplying electricity in bulk, although it could not itself carry out any such scheme for many years to come.—*Abstracted from Engineering (London), March 3.*

Wireless Telegraphy in England.

Some details of the arrangement entered into by the British post-office authorities and the Marconi company are given in the *British Trade Review* for March 1. Last year, when a message was to be sent to a vessel, the British post office, which operates the land systems, would receive the message at any office and transmit it to the nearest Marconi station. It would collect a charge for the land service only, and it was therefore necessary for the receiver to pay for sending from the shore to the vessel.

On the first of the year this arrangement was changed. The post office will now receive messages at any office, and will collect the full charge. The message is then sent to a Marconi station, and transmitted to the vessel, the post office paying the Marconi company for its service. When a message is to be sent from a vessel to any land station, the Marconi representative on the vessel collects the full rate. The message is sent to the nearest Marconi station, and from here it is handed to the nearest postal telegraph office, the Marconi company paying the post-office charges. There has thus been established an exchange of traffic between the two systems, and persons who wish to send messages to any vessel can learn from the nearest post office the rates and the hours during which any vessel will be in touch with the Marconi stations. Many shore stations have been erected, which enable the Marconi company to keep in communication with any vessel for a considerable time. This arrangement greatly reduces the uncertainty of messages reaching the vessel for which it is intended. At the present time there are sixty ships fitted with Marconi apparatus, and sixty shore stations from which messages can be transmitted.

As regards the uncertainty of wireless telegraph messages, it is said that when the stations are fixed, such, for example, as between England and Amsterdam, messages are transmitted as regularly and as accurately as by any other telegraph system.

Digitized by Google

Meeting of the Electrical Section of the Franklin Institute.

A meeting of the electrical section of the Franklin Institute was held at the Institute Building, Philadelphia, on the evening of March 16, 1905. The paper of the evening was entitled "Twenty-five Years of the Incandescent Lamp," and was presented by Mr. J. T. Marshall of the General Electric Lamp Works, Harrison, N. J. The paper was illustrated by lantern slides.

The history of manufacture of incandescent lamps from the early stages of the art down to the present time was given. At first all lamp bulbs were blown and no two had the same size or shape. The filaments were of split bamboo and were bent into hair-pin shape and carbonized. The various steps in the manufacture of the bamboo filament were shown, and the faults that developed in them were discussed. After the carbonized bamboo filament had been in use for some time a filament was developed, in which the bamboo was treated with a coating of asphalt. This proved unsatisfactory after a time and the present "squirted" filament was invented. This type of filament is made by pressing a compound through a small hole in a plate. Any amount of filament can be made in this manner, and it can be cut to the proper length to give a certain amount of light. One of the defects in the bamboo filaments was the fact that it was hard to get a length of over ten inches and that after a filament was once formed it could not be shortened.

The various processes followed in making the tube, through which the wires are led into the lamp, were also shown on the screen. In the early lamps four leading-in tubes were made from one piece of glass tubing. The tube was drawn down at each end and in the middle. It was then separated at the thin spot in the middle and two bulbs were blown in each piece between the drawn-down ends. The tube was then cut between the bulbs. The purpose of the bulb was to make a convenient spot for welding on the lamp bulb. The leading-in wires were next threaded through the tube and sealed in by heating the end of the tube and squeezing it with pinchers, and the filament attached. Then the tube was welded into the lamp bulb and the lamp was exhausted.

Platinum has always been used for the leading-in wire. In the first lamps the platinum wire extended entirely through the glass seal, copper wires being attached at the outer ends and the filament at the inner. The length of the platinum wires used was about one-half an inch. This made an expensive construction, and also one that was not very durable, as the platinum was apt to break at the point where it entered the glass. The next step was to shorten the length of the platinum wires to about one-eighth of an inch, and to use copper at each end of the platinum. Thus there were two joints entirely sealed in the glass, and the filament was attached to copper wire. The filament was fastened by bending the copper wire into a hook-shape, clamping it down on the filament and then copper-plating the joint. This construction, however, was somewhat unsatisfactory and changes were made. The present method of construction consists in attaching two copper wires to the platinum wires and sealing the platinum wires and the joint in the tube. The platinum wires project through the glass a short distance and the filament is attached to them by a kind of cement.

All the changes made in the lamp were usually accompanied by the substitution of machinery for hand-labor and also by a division of labor, one workman doing but one operation instead of three or four.

After the leading-in tube and the lamp bulb are welded the lamp is exhausted of air. This was originally done by means of a Sprengel air-pump and the time consumed was anything from one-half an hour to five hours. The results were not uniform with the air-pump however. Good lamps and poor lamps would be produced alternately, due to imperfections in the apparatus, and the bulb contained vapors of mercury. It was discovered that if a preparation of phosphorous was introduced into the bulb and heated, that when a certain point in the exhaustion was reached the preparation combined with the mercuric vapors and oxygen remaining in the bulb, and a practically perfect vacuum was secured. This discovery was embodied in the pumps, and uniform vacua are now obtained. The operator can easily tell when the proper vacuum is obtained, for the heating of the phosphorous preparation produces a blue haze which instantly changes to yellow when the proper degree of vacuum is reached.

The change in the pumps increased the production of a given number of operators. Formerly about four workmen attended to about one hundred pumps. Now each operator has a pump and can exhaust three lamps per minute.

After the lamps are exhausted they are tested for vacuum by means of an induction coil, and lamps which are imperfect will show the same effects as a Geissler tube. They are also tested for candle-power by comparing them with standard lamps in a photometer.

The various changes in the form of the base were shown on the screen. The earliest lamps had the wires soldered to the screw base and to a ring just above it. The various parts of the base were held together by plaster of Paris. The first change made was to place a small cap on the base and fasten one wire to that, the other wire still being attached to the screw portion of the lamp. In the earliest form of base with the ring there was a large circular projection of plaster of Paris around the ring. This projection was retained in the newer form as the moulded bulb had not been developed and the lamp was unsightly without it. When the moulded bulb was introduced the projection was dispensed with and the screw base was made flush with the bulb. The plaster of Paris filling was unsatisfactory, being somewhat hygroscopic and causing a leakage of current between the two wires when it had absorbed a certain amount of moisture. It was finally replaced with molten glass and porcelain.

It was pointed out that the number of parts of the earliest lamps and of the present lamps is exactly the same, with the exception of a small iron wire anchor which is used to help support the filament. This anchor is made necessary by reason of the increased length and the coil-shape of the present filament. Nor have any of the original parts been displaced and others substituted. Every piece that was in the original lamp is in the present one, although more or less modified.

At the conclusion of the paper Mr. W. J. Hammer called attention to the fact that the most remarkable thing about the incandescent lamp was the similarity of the earliest and present lamps. He stated that no other invention had undergone so many modifications without some part being either added or discarded or radically changed. He told of the work that was done before the time taken up in Mr. Marshall's paper (1880-1905) and discussed the difficulties of securing proper filaments. He also discussed the tests made on the very first lamps and said that, although the fall of efficiency of the lamps was known, its importance was not realized. He exhibited a photograph of a collection of lamps and parts of lamps he had made and which were exhibited at the St. Louis exposition. This collection shows every step in the development of the incandescent lamp from its inception, and is probably the most complete in existence.

In reply to a question regarding the substitution of nickel-steel for platinum in the leading-in wires, Mr. Marshall stated that it had been tried and, while in the main it had been satisfactory, enough failures in vacuum had developed with it as to make it unsafe for general use.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Changes in the Arnold Electric Power Station Company.

Announcement is made of the change of the name of the Arnold Electric Power Station Company, of Chicago, Ill., to The Arnold Company. This company was organized in 1886 by its president, Mr. Bion J. Arnold, primarily to build electrical power plants. The scope of its work has greatly increased, until it now includes nearly all that pertains to electrical, civil and mechanical engineering. The company not only acts as consulting engineer for its clients, but it also maintains a complete construction organization capable of actually building the work it designs. At the same time, the company maintains a position independent of any connection with manufacturing companies, and is free to use the best make of apparatus suited to a given set of conditions. The company has well demonstrated its ability, both as consulting and construction engineer, in a number of installations, both in the electric railroad field, in the development of central stations, and in the equipment of modern shops for light, heat and power, air and steam.

One of the latest developments of the Arnold Company is the designing and building of complete hydroelectric plants. An installation of 3,000-kilowatt capacity for the Spring River Power Company is to be put in operation with a 33,000-volt transmission line from the water-power plant, at Lowell, Kan., to the lead and zinc mines in the vicinity of Joplin, Mo.

The company has recently increased its office space to accommodate this growing business, and now occupies suite 1536-1541 Marquette Building, Chicago. The officers of the company are Bion J. Arnold, president; W. L. Arnold, vice-president; Ralph G. Arnold, secretary and treasurer, and George A. Damon, managing engineer. A complete organization, consisting of competent civil, electrical and mechanical engineers, has been developed to handle the growing work of the company which will be carried on along the following lines: electric power stations, complete interurban railways, electrification of steam roads, shops and shop equipment, hydroelectric and transmission plants, investigation and reports, tests and inspections of electric properties, operating and modernizing, modern industrial plants.

From time to time, bulletins have been printed, descriptive of the technical features of various installations under the company's direction. These bulletins contain considerable engineering data, and have been very much in demand. A blueprint book, containing data of interest to the mechanical officials of steam railroads, has been compiled, and a set of blueprint maps showing the growth of the network of interurban electric roads in the western states, and indicating the relative sizes of the cities, as well as lines under construction and proposed, is kept up to date and furnished free to electric railroad officials.

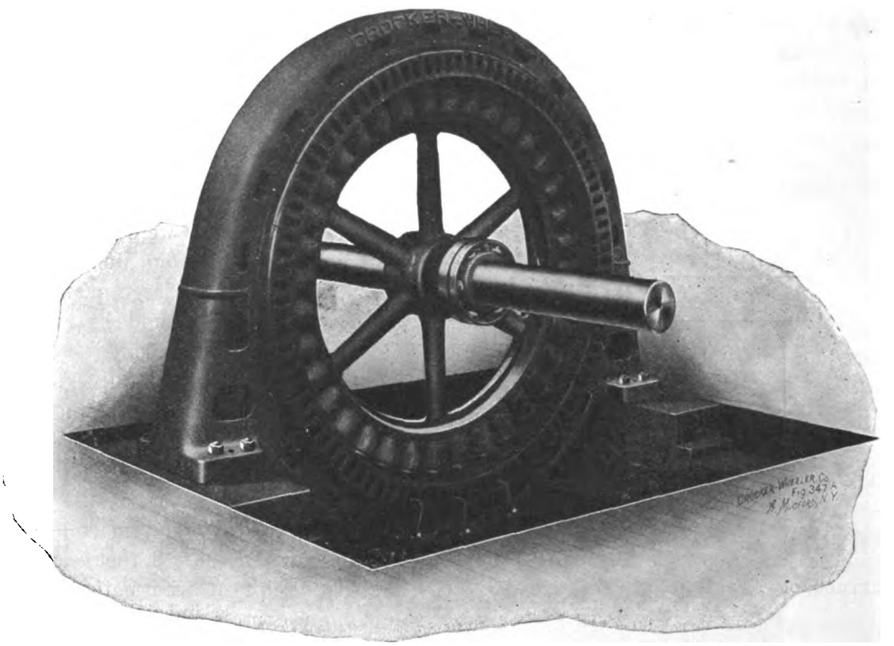
4,000-Kilowatt Alternators for the Chicago Sanitary District.

An order for four 4,000-kilowatt, three-phase, sixty-cycle, 6,600-volt, alternating-current generators, with exciters, has been placed with the Crocker-Wheeler Company, Ampere, N. J., by the trustees of the Sanitary District, of Chicago, Ill. These are to be driven by Wellman-Seaver-Morgan horizontal water-wheels, and will be placed in operation at Lockport, Ill., the western end of the Chicago Sanitary and Ship canal.

The contract was awarded the Crocker-Wheeler Company, the American licensee of the celebrated alternating-current engineers, Brown, Boveri & Company, of Baden, Switzerland, in open competition. Mr. Gano S. Dunn, chief engineer; A. L. Doremus, secretary, and Julian Roe, Chicago manager of the Crocker-Wheeler Company, were active in securing the order.

Six years ago the Chicago Sanitary and Ship canal was opened and filled with water from lake Michigan. Since June, 1893, Mr. Isham Randolph, formerly president of the Western Engineering Association, has had in hand this project of tapping the great lakes at their southern end. His present work is centered at Lockport, where the mean head for water power developed when the present improvement is completed will be thirty-two feet, the net power being 40,000 horsepower. The ultimate discharge of the canal will be 800,000 cubic feet per minute. A structure of concrete and brick construction will house the power. Provision will be made for eight generator units, four of which are now under contract. The power generated at Lockport will be used for municipal lighting in Chicago.

In this connection it is interesting to note that it is less than a year ago that the Crocker-Wheeler Company, long established in the field of direct-current manufacture, began to market a line of alternating-current generators for operation with every description of prime move. A recent notable contract was that for three 4,000-kilovolt-ampere, alternating-current generators to be driven by gas engines to supply current for the street railway system of San Francisco, Cal.

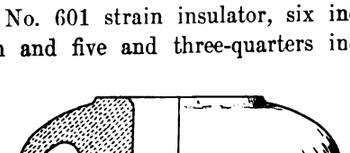


REVOLVING FIELD ENGINE TYPE ALTERNATOR—60-CYCLE, 220-VOLT, 3-PHASE, 200 R. P. M.

Digitized by Google

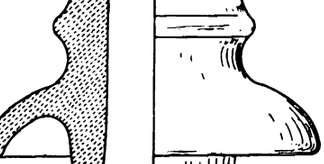
High-Tension Strain Insulators.

The accompanying illustrations show two forms of high-tension strain insulator placed on the market by the Locke Insulator Manufacturing Company, of Victor, N. Y. The increase in the use of high-tension electric railroads will call for insulators capable of withstanding high mechanical and electric strains. The insulator shown is designated as the Victor No. 601 strain insulator, six inches high and five and three-quarters inches



HIGH-TENSION STRAIN INSULATOR.

in diameter, and has been designed for voltages as high as 8,000. The company has also developed a smaller strain insulator of the same general design for voltages of 5,000 and under. This design is very useful in the construction of spans for trolley suspension. The company is manufacturing a complete line of strain insulators for voltages up to 35,000, and



METHOD OF APPLYING HIGH-TENSION STRAIN INSULATOR.

is developing a new design which it will be able to manufacture for voltages of 60,000 or more.

As an indication of the mechanical strength of these insulators, the company reports that it has experimented with these designs considerably, and finds that its larger designs may be relied upon to stand a breakdown test of approximately 12,000 pounds, with the insulator supported by a pin passing through the middle, and the strain applied around the middle wire groove. In connection with these insulators the company has developed a method of using them, whereby almost any strain up to several tons may be applied with entire safety.

These insulators are used for dead-ending, curves or similar use in holding live wires of high voltage under excessive tension, the ordinary pin being too weak. The mechanical efficiency of the construction is apparent. The maximum strength of the pin is obtained. The pin is supported top and bottom, and the pull is transferred directly to the pole. The pin holes are all of largest diameter at top and bottom, having the smallest diameter directly opposite the wire groove, so that the porcelain is always under direct compression only, though the pin flex somewhat under varying loads.

A large line of insulators for all classes of service is described in "The Insulator Book," No. 8, recently issued by the Locke Insulator Manufacturing Company.

Quick Deliveries to Mexico from the Schenectady Works of the General Electric Company.

In order to enable the Mexican Light and Power Company to effect temporary repairs to its generating station in the city of Mexico, which was recently partially destroyed by fire, two express shipments were made from Schenectady on February 8 and 11, which were remarkable both for their size and prompt despatch.

Telegraphic advices were received by the foreign department on Monday, February 6, stating that a large quantity of switchboard material would be required to enable the plant to resume operation, although at the time the full extent of the damage was not known. As a result of further telegrams, and consultations by telephone with the New York representatives of the customer, details of the order were settled Tuesday morning, and on Wednesday, February 8, the second day from the receipt of information of the trouble, an express shipment of thirty thousand pounds of switchboard instruments, switches and supplies left the Schenectady factory for Mexico City.

The shipment constituted a complete switchboard equipment for a 4,000-kilowatt power station, and to collect and despatch the material in this almost incredibly short time taxed every resource of the commercial, engineering and transportation departments of the company. While most of the instruments and switches were available at Schenectady, it was necessary to obtain instrument transformers by express from Lynn, and four large rheostats for generators of German make had to be entirely built from data telegraphed from Mexico. In addition a large quantity of wire and cable, which could not be supplied from the Schenectady stock, had to be borrowed from an installation which the General Electric Company was carrying out in New York city.

The transportation of the heavy reels of wire and cable through New York city for shipment to Schenectady was a task of great difficulty on account of the almost impassable conditions of the streets following a severe snow-storm. In handling the shipment from Schenectady, special arrangements were made with the railroad companies to obviate transshipments in passing from one system to another, and especially in crossing the Mexican frontier, and in addition a special messenger traveled with the car the entire distance to see that no delays occurred at junction points.

The shipment reached Mexico City on Tuesday, February 14, thus placing in the hands of the customer, within seven days from receipt of the first news of the disaster and from a factory over thirty-seven hundred miles away, a complete outfit of the new material necessary to restore the interrupted lighting and power service.

The fire also destroyed two engine-driven sets, imperatively demanding the immediate installation of two 500-kilowatt, Curtis steam turbine generators that were on order at the time, and one of which was due to arrive by freight in a few days. The second turbine had just been loaded on a freight car at the Schenectady factory, but the urgent need of the machine decided the customer to authorize its shipment by express.

Of this shipment the turbine proper, as boxed, weighed 27,000 pounds and occupied a space of eight feet high by eight feet wide by nine and one-half feet long. The doors of the ordinary express car would not admit the entrance of a package of these dimensions, but a special car having large doors was secured and by stripping the boxing to a minimum the loading was effected. The generator and other parts brought the weight up to nearly 43,000 pounds, making one of the heaviest single express shipments ever made.

The total weight of the entire shipments was 73,000 pounds, the express rate on which was over $8,200.

Digitized by Google

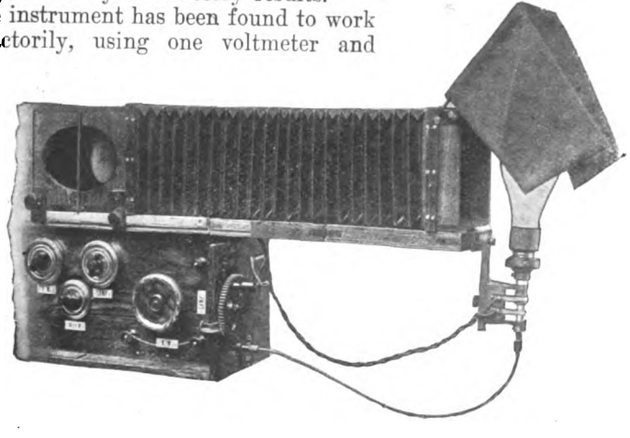
Portable Photometer.

The instrument represented in the accompanying illustration is the well-known Queen portable photometer. A number of important improvements have recently been added to it, which simplify the method of the operation, and give more accurate results.

This photometer, as originally put out, met with decided success and is largely used for measuring the candle-power and efficiency of incandescent lamps. As so many incandescent lamps are now rated in mean horizontal candle-power, Queen & Company have recently added an attachment, by means of which the lamp being tested can be rotated; the device is simple and easily attached; and, as shown in the illustration, consists of a rotating socket connected by means of a flexible shaft to a pair of gear wheels, clamped to the side of the photometer case. The rotating motion given to the large wheel by the hand is multiplied several times and the lamp easily rotated at any desired speed. The device can be removed as there is sufficient room in the photometer case to allow it to be packed for transportation.

The use of the bellows on the photometer, shielding the scale from extraneous light, other than given by the lamps under test, has proved to be of great value, allowing the photometer to be used in a room with ordinary illumination, and securing extremely satisfactory results.

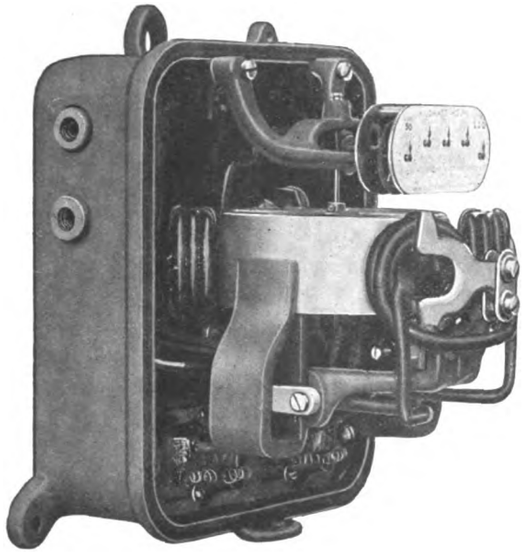
The instrument has been found to work satisfactorily, using one voltmeter and two rheostats, one for adjusting the current on the test lamp, while the other adjusts the current through the standard lamp. The scale is divided from four candle-power to fifty candle-power, which allows a range of measurements as wide as is necessary in practical work.



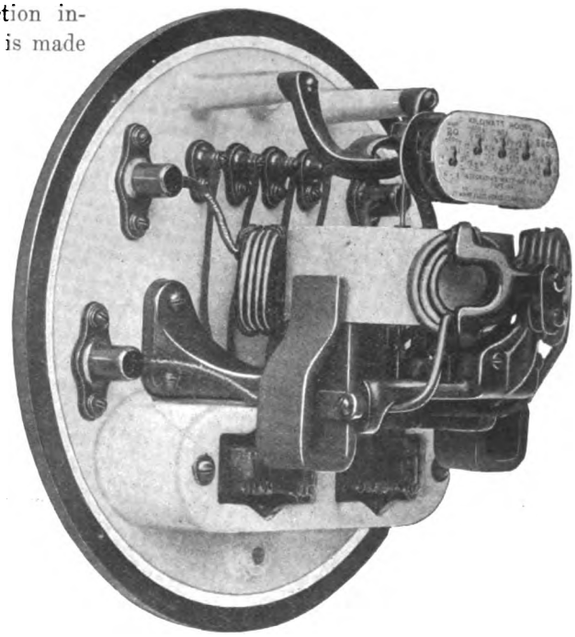
QUEEN PORTABLE PHOTOMETER.

Fort Wayne Integrating Wattmeters.

The Fort Wayne Electric Works, Fort Wayne, Ind., manufactures the multiphase integrating wattmeter shown in the accompanying illustrations. This is known as the multiphase induction integrating type K wattmeter, and is made on the same general principles as the single-phase type K instrument. In addition to the features common to the single and multiphase wattmeters, the multiphase meter has the advantage of higher torque and complete registration of all energy in a multiphase circuit on a single-plate dial. This feature permits the use of a single multiphase meter in place of two single-phase meters on two or three-phase circuits. The working parts of the meter are supported on a cast-iron base, consisting of one piece. The base is provided with three lugs, for attaching the meter to the wall.



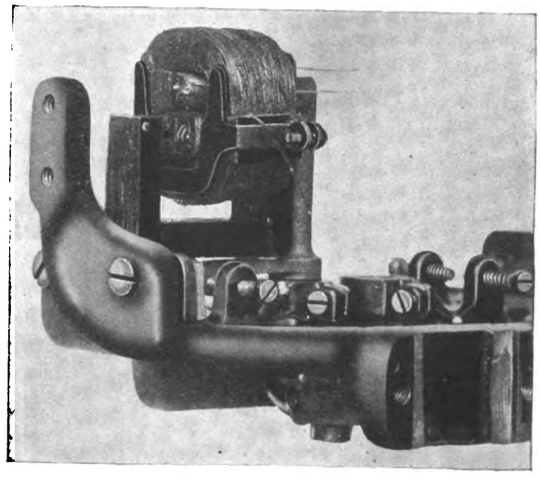
CASE REMOVED, TYPE K, FORM MAA, INDUCTION INTEGRATING WATTMETER.



CASE REMOVED, MULTIPHASE SWITCHBOARD WATTMETER.

The lower bearing consists of a flexibly mounted jewel enclosed in a vertically adjustable screw. By means of a cap screw, the shaft of the rotating element can be raised from the jewel, when necessary. The top bearing stud is simply a guide to the upper end of the shaft, and is rigidly mounted on the dial bracket. The lower bearing is immovable in the magnet bracket.

The retarding force is produced by two permanent magnets. These are mounted on either side of an aluminum cup on the lower bracket, and vertically adjustable in order to vary the drag on the cup. The registering mechanism is mounted in positive alignment on the dial bracket. A worm on the shaft meshes with a change gear which is mounted on a bracket on the back dial plate. The regis-



SHUNT COIL AND CORE, WITH LIGHT LOAD ADJUSTMENT.

Digitized by Google

tering dial gear is driven through this reducing gear.

Two sets of series coils—one on each side of a two-phase, four-wire, or two or three-phase, three-wire circuit—are mounted on arms screwed to the lower brackets. One pair is mounted back of the cup, and the other pair is mounted in front, and each pair is held in a brass spider which gives rigidity to the coils. In the larger sized meters strip copper is used in the coils, but the small capacity meters have wire-wound coils. Duplicate shunt coils are placed opposite and between the series coils of each set. The impedance coils, which correspond to the shunt armature coils, are placed in the bottom of the base, and covered with a cap secured with a bolt passing from the interior of the meter. The light load adjustment coil is on a movable arm inside the shunt armature coil and above the core. The position of the shunt coils and the cores is clearly shown in the accompanying figure. The revolving element consists of the aluminum cup heretofore mentioned.

These multiphase wattmeters are made in three, five, ten, twenty-five, fifty, seventy-five, 100 and 150-ampere capacities without current transformers, except above 600 volts. Larger capacities require current transformers. The standard voltages for which these meters are built are 110, 220, 550, 1,100 and 2,200, with frequencies of twenty-five, forty, sixty and 125-140 cycles.

Burke Electric Company—Fire Not Serious.

On Friday, March 17, fire originating in the forge room destroyed the wing of the works of the Burke Electric Company, lessee of the Keystone Electric Company, at Erie, Pa., in which the finished storeroom for Keystone machines, blacksmith shop, punch department, etc., was housed. This wing was entirely destroyed and a large portion of the contents will be a total loss.

Fortunately, the dies and important fixtures were uninjured so that production will not be interfered with. Immediate steps were taken to ensure deliveries on all current orders, as well as to provide for prompt filling of future contracts. Plans for rebuilding the destroyed portion are being rushed.

The exact loss has not been determined, but appraisement is now in process. The loss will be fully covered by the insurance.

Winking Sign Specialties.

The Phelps Company, Detroit, Mich., is manufacturing a number of winking sign specialties. These include self-flashing bulbs, the "Skedoodle" socket plug, the "Wynk" sign frame, the "Wynk" transparency, and the "Turnip" advertising bulb.

The self-flashing bulbs are made in two sizes, eight and sixteen candle-power, for any ordinary electric circuit between 100 and 120 volts. Each bulb is equipped with a Skedoodle, and operates independently of every other bulb. It is only necessary to screw in a self-flashing bulb and turn on the current. The winking apparatus turns the light up and down from the large to the baby filament.

The Skedoodle socket plug fits into any ordinary socket, and will hold a common bulb and wink it off and on several times a minute. They are made for four, eight or sixteen-candle-power lamps.

The Wynk sign frame is a ring sixteen inches in diameter inside, and twenty-two outside. The sockets are full size. A single winking apparatus on the back of the ring flashes on the eight bulbs altogether. The bulbs are two candle-power, and larger lamps can not be used unless specially ordered. The cardboard sign may be changed as often as desired.

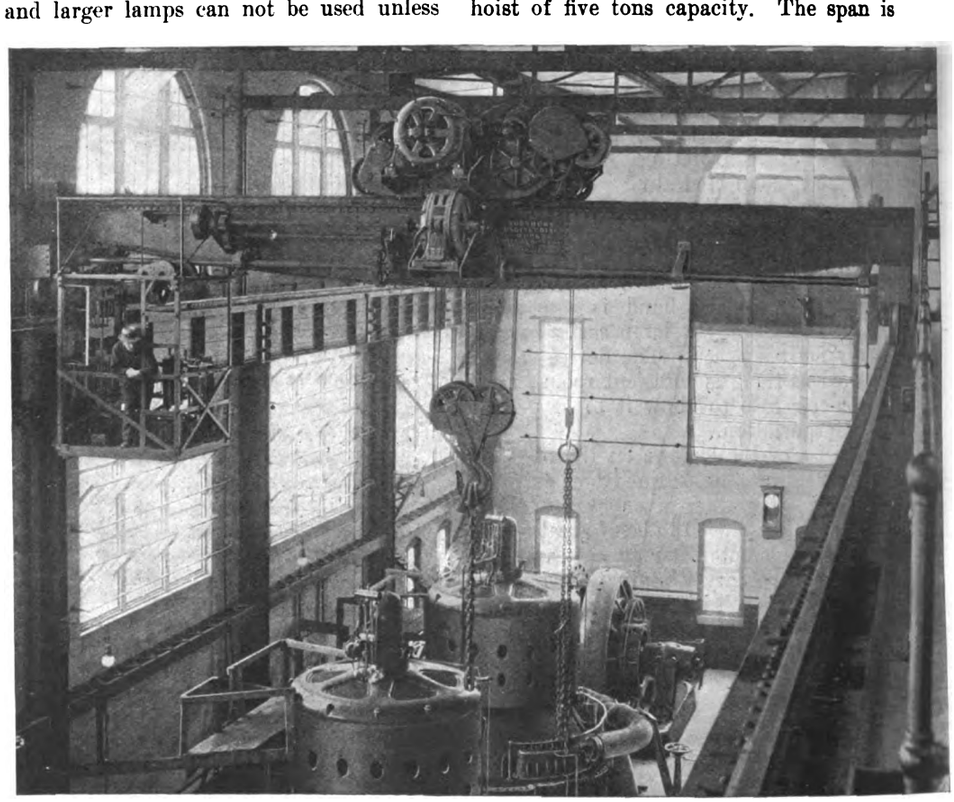
The Wynk transparency is a plain box three and one-half inches deep, with a white frame in front holding a sheet of glass, celluloid or cardboard, nine by seventeen inches in size. Inside the box is one self-flashing bulb. This throws the light through the lettering, which may be made on ground glass, painted on plain glass, or used with perforated cardboard.

The Turnip advertising bulb is three and one-half inches in diameter, and has a winking device complete in the lamp base. There is also a spring which makes it possible to turn the reading right side up in the socket. The winking device turns the light on and off. These lamps, unless otherwise ordered, are furnished plain frosted. Ordinary paint or water color is used in decorating them.

A Thirty-five-Ton Induction Motor-Driven Crane.

The traveling crane shown in the accompanying illustration has been operated almost continuously since March, 1904, during the erection of two 3,000-kilowatt Curtis turbine alternators, a 1,000-kilowatt motor-generator and other machinery in the main generating station of the Edison Illuminating Company, of Detroit, at Delray, Mich., March, 1904. It is equipped with General Electric induction motors and solenoid brakes.

The crane was built by the Northern Engineering Works, of Detroit, and is of the box girder type. It has a capacity of thirty-five tons normal, forty tons test load, and is equipped with an auxiliary hoist of five tons capacity. The span is thirty-three feet two inches and the length of lift twenty-nine feet six inches. All gears are of cast steel or forged steel and the high speed gears are enclosed. The electric equipment of the crane is General Electric Company form M, 220-volt, sixty-cycle, three-phase induction motors and controllers for the following horse-power and crane-speed ratings. Each motor is fitted with a standard General Electric alternating-current solenoid brake.



THIRTY-FIVE-TON CRANE, DRIVEN BY AN INDUCTION MOTOR.

	Feet per Minute.	H. P.
Main hoist	10	35
Auxiliary hoist	20	10
Trolley	100	6.5
Bridge	200	22

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MONTREAL POWER STOCK—It is announced that a number of large holders of stock in the Montreal Light, Heat and Power Company, Montreal, Canada, have transferred to London capitalists 20,000 shares in that company, at the par value of $2,000,000.

THE GROWTH OF ELECTRIC LINES IN MICHIGAN—The Michigan state labor department has compiled some interesting statistics with regard to the growth of electric lines within the state. There are twenty-five different electric railways now being operated in Michigan, having 1,158 miles of single track. The capital stock of the roads is given as $34,000,000, of which $1,600,000 is preferred stock. The actual value of the roads approximates $45,000,000. During the year 151,001,029 passengers were carried, the sum of $6,581,275 being received for carrying passengers alone.

NEW LONG-DISTANCE INDEPENDENT TELEPHONE LINE—A long-distance independent telephone line has been completed between Cleveland, Ohio, and Buffalo, N. Y. This permits service between Cleveland and New York state points, including Rochester, Syracuse and other cities in the territory. The companies participating in the new service are the United States Telephone Company, of Cleveland; the United Telephone Company, of Pennsylvania, and the Frontier Telephone Company, of Buffalo, N. Y. There is now a network of long-distance wires running from Pittsburg, Pa., toward Philadelphia, and some long-distance construction in eastern Pennsylvania. From Columbus a line is being built to Dayton, and connection made with Indianapolis and St. Louis, extending these lines into Kansas City and to Texas.

NEW TELEPHONE COMPANY TO ABSORB NORTHERN IOWA LINES—A $1,000,000 telephone company, which is believed to have absorbed nearly all of the independent telephone companies of northern Iowa, has filed articles of incorporation with the secretary of state. The company is designated as the New State Telephone Company, with its principal office in Sioux City. The officers of the company are: president, Charles G. Cockerill, Jefferson; first vice-president, W. H. Leathers, Mapleton; second vice-president, Joseph Mattes, Odebolt; secretary, T. B. Lutz, Mapleton; treasurer, M. M. Head, Jefferson. The other directors are Ira Conger, Cherokee, and J. C. Hammond, Mapleton. According to the articles of incorporation, the company is authorized to transact a general telephone business in the state of Iowa, Minnesota, Nebraska, South Dakota, North Dakota, Kansas, Missouri and Illinois.

MEXICAN ELECTRICAL NOTES—Negotiations are in progress, it is stated, for the purchase of the Bermejillo interests in Guadalajara by an American company, for some $3,000,000. These interests include the mule traction street railways, the concession for an electric street railway system, an electric lighting plant and a large hydroelectric power plant at Juanacatlan, and a transmission line to Guadalajara. Should the deal for the transfer of the various properties and concessions not be consummated, it is understood that the present owners have made arrangements for securing the money necessary for the rebuilding and electrifying of the street railways, and that work will be commenced very soon. It is said that promoters are at work undertaking the building of an electric railway to run from Guadalajara to the port of Chamela. The Jalisco Exploration Company has been organized for the purpose of building the road. At a meeting of the stockholders of the Mexican Telephone Company, the plan to sell the property to the Mexican Telephone and Telegraph Company was approved. Holders of stock in the old company will receive new stock on a basis of one share of preferred and two shares of common for nine shares of the old stock.

ELECTRIC LIGHTING.

NORFOLK, VA.—The Norfolk Railway and Light Company has awarded a contract of $100,000 for placing all of its electric lighting wires south of Queen street underground.

TEKAMAH, NEB.—At a special election for the issuance of bonds of the city of Tekamah, Neb., in the sum of $10,000, for the purpose of purchasing or installing an electric lighting plant, to be owned and operated by said city, the proposition carried by a vote of 136 to 82.

UNIONTOWN, ALA.—At a regular meeting of the Uniontown city council, a contract was closed with the Hardie, Fynes Manufacturing Company, of Birmingham, for a complete new electric plant outfit, to be installed as soon as possible.

MUSKOGEE, I. T.—The Grand River Power Company has been organized with a capital stock of $10,000. This is a preliminary organization to push the project of building a large dam and power station on Grand river, near Fort Gibson, to furnish electric power for factories in Muskogee and surrounding towns. Wagoner and Fort Gibson are also interested in the project.

SAULT STE. MARIE, MICH.—It is now assured that the Edison-Sault Electric Company will begin the improvement of its plant and the enlargement of the Chandler-Dunbar water-power canal as soon as the snow and ice disappear. The plans of the company are of much magnitude. A new power building equipped with the most modern machinery will be constructed.

SPRINGFIELD, NEV.—At the annual meeting of the stockholders of the Springfield Gas and Electric Company, directors for the year were chosen. They elected the following officers: F. W. Little, Peoria, Ill., president; E. B. Lewis, Chicago, vice-president; N. J. Cunningham, secretary and treasurer. P. A. Bertrand was appointed manager, and H. J. Fox, superintendent.

KNOXVILLE, TENN.—J. E. Durham, Philadelphia, and W. B. Cutter, of Buffalo, N. Y., have, through local counsel, petitioned the Bristol, Va., city council for an electric light franchise. The capitalists who are interested in the proposed erection of an electric power plant on the Holston river near Bristol, have been granted a franchise by the Bristol, Tenn., city council.

PORTLAND, ORE.—J. E. Jerome, W. J. Turner and J. H. Garrett, of Mountainhome, Ida., are organizing a company with capital stock of $500,000, and will build a power plant at Crane Falls, for the purpose of furnishing the towns of Mountainhome and Bruneau with electric power and light. The new company also contemplates the construction of an electric railway through a very fertile section known as the Bruneau valley.

CATASAUQUA, PA.—Among the improvements contemplated to the Lehigh-Northampton Gas and Electric Company, which is now in the hands of a receiver, are the following: one 300-horse-power boiler, one 250-kilowatt and one 150-kilowatt condensing engines, one condenser, one feed-water heater, one feed pump, one oil operator, two water generators, one 250-kilowatt direct-current and one 150-kilowatt direct-current switchboards.

TORONTO, ONT.—The Toronto city engineer has reported to the board of control that the estimated cost of installing a municipal electric lighting plant, with an alternating current sufficient to operate 1,500 arc lights, would be $638,000, which includes buildings, but not land. If power were obtained from Niagara Falls, the cost of lighting to the city would be $475,000. The estimate provides for placing the wires underground in certain districts.

CONNERSVILLE, IND.—George M. Sinks, receiver for the General Gas, Electric and Power plant, sold the property at public sale on March 9 to George B. Markle, of Hazleton, Pa., for $26,200. The property had been appraised at $42,000. Originally the company was composed of eastern capitalists. There was a first mortgage indebtedness of $75,000 on the plant, and stock to the extent of $300,000 more had been issued. Mr. Markle announces that he will spend a considerable sum of money in improvements.

NEWBURGH, N. Y.—An effort is being made to organize an electric light company to light Chester, Monroe, Central Valley and Highland Mills. The company will be affiliated with the Rockland Electric Company, of Hillburn, N. Y. The proposed capital is $30,000. The Rockland Electric Company is now furnishing about 1,200 horse-power, and expects soon to double the capacity of its plant. That company lights Hillburn, Suffern, Manwah, Allendale and Saddle River.

Digitized by Google

ELECTRIC RAILWAYS.

BEDFORD, IND.—The work of surveying the line for the Bedford street railway, which will extend from Bedford to Oolitic, the quarry district, has begun.

WICHITA, KAN.—Work has been begun by the Wichita Street Car Company on improvements which, when entirely completed, will cost in the neighborhood of $15,000.

MONTREAL, QUE.—The by-law granting the Montreal Street Railway in Maisonneuve an extension of thirty years to its contract, expiring in 1924, or making fifty years in all, has been adopted.

MT. STERLING, KY.—It is reported that the recently incorporated Olympian Springs Company, of Lexington, will build an electric car line from the Chesapeake & Ohio road to West Liberty.

BLUFFTON, IND.—A proposed new interurban line, which is backed by Bluffton men, will run from Huntington to Celina, Ohio, by way of Bluffton. The line as proposed will not conflict with any other interurban line.

ANN ARBOR, MICH.—At a meeting of the common council, a franchise was granted to the Toledo, Ann Arbor & Detroit Railroad Company. The road is to be completed within twenty-one months or the company will forfeit $10,000 to the city.

ALTOONA, PA.—The Northern Cambria Street Railway Company is securing rights of way for a trolley line thirteen miles long from Patton, through Carrolltown and Spangler, to Barnesboro. W. H. Denllinger, of Patton, is president.

HARRISBURG, PA.—The Hummelstown & Campbellstown Street Railway Company will extend its system to Campbellstown. Its line at present runs from Hummelstown to Palmyra, a distance of eight miles. The cost is estimated at $225,000.

FITCHBURG, MASS.—A mortgage and note on real estate in Harvard to secure bonds to the amount of $100,000 have been recorded from the Leominster, Shirley & Ayer Street Railway Company, to the Boston Safe Deposit and Trust Company, trustee.

ROCKFORD, ILL.—The Aurora, De Kalb & Rockford Electric Company has sixteen miles of grading finished, which brings the line within a few miles of Maple Park. Two of the six bridges are completed. One is 140 feet long, and the other is 120 feet long.

WATERTOWN, N. Y.—An inspection has been made of the Rome road, from Carthage to Sackett's Harbor, with a view of equipping that road with electricity between the places named. It is more than probable that the thirty-mile stretch will be equipped shortly.

PASS CHRISTIAN, MISS.—The mayor and board of aldermen of Pass Christian have granted to J. T. Jones, of Gulfport, a franchise to construct and operate an electric car system over the streets of Pass Christian in connection with the proposed line from Biloxi and Gulfport.

DENNISON, OHIO—A project is under way, backed by Cadiz people, to build an electric line between Uhrichsville and Martin's Ferry, by way of Cadiz and Harrisville. Another line has been surveyed between Uhrichsville and Wheeling, by way of Stillwater, Freeport, Flushing and Holloway.

WASHINGTON C. H., OHIO—It is thought that a party of Columbus men and men living along the proposed line of the Springfield, Washington C. H. & Chillicothe traction line will arrange to lift the indebtedness of the line, now amounting to $110,000, and proceed with the construction of the road.

ONANCOCK, VA.—Capitalists have begun a movement to build an electric road from Onancock to Wachapreague by way of Onley, with a branch from Onley to Accomac Courthouse. The road will be about sixteen miles in length and connect the bayside with the seaside, running the breadth of the peninsula.

PLATTSBURG, N. Y.—The Schenectady Railway Company, which will extend its trolley line from Ballston Spa to Saratoga Springs, will build a belt line in the latter place. The company, it is stated, will shortly petition the Saratoga Springs authorities for franchises to lay tracks on several streets.

OMAHA, NEB.—J. S. Emerson, of St. James, Neb., has proposed to the Commercial Club, of Sioux City, the construction of an interurban line from Niobrara, Neb., to Sioux City. The towns along the line would be Sioux City, St. James, Wigant, Bow Valley, Crofton, Lime Grove, St. Peter, Daily and Niobrara.

REDDING, CAL.—A plan is being formulated in Redding to build an electric road from Redding to Kennet. The Northern California Power Company is to finance and construct the road and the business men of Redding are to subscribe for $30,000 worth of stock. The road will run direct from Redding to Kennet.

TACOMA, WASH.—Surveying parties are operating between Tacoma and American lake on the line of the proposed trolley road planned by Elmer J. Felt. It is said that a Philadelphia syndicate has purchased Felt's franchise and will construct the road, extending it on to Olympia and running a branch line to Chehalis and Centralia.

MANISTEE, MICH.—The Manistee, Filer City & East Lake Electric Railroad has been sold to Walter H. Trumbull, of Salem, Mass., representing the holders of the first mortgage bonds. A new corporation will probably be organized to manage the road. It is possible that the Sands electric lighting plant will be acquired and operated in connection with the road.

KANSAS CITY, MO.—G. B. Harrison, Sr., president of the Missouri Central Railroad Company, states that the work on the trolley trunk line between Kansas City and St. Louis will begin next spring. The cost of the line will be about $12,000,000. The proposed road will follow the Missouri river, crossing it twice, once near Glasgow and again just west of St. Charles.

SHARON, PA.—It is announced that the Sharon to Cleveland trolley line is to be pushed to rapid completion. The road will run from Sharon to Middlefield, Ohio, and there connect with the Cleveland & Eastern line. The company, which is composed of Cleveland and New York capitalists, has been successful in financing the road, and work is to be resumed next spring. The line will cost about $1,500,000, and will tap one of the richest farming communities in the state of Ohio.

WEST CHESTER, PA.—Permission has been granted to Thomas F. Bayard to sell, after giving five weeks' notice, the West Chester, Kennett & Wilmington Electric Railway, located within the boundaries of Delaware. The price must not be below $60,000. This line is the one built by the Vandegrift Construction Company and for which a receiver was appointed both in Delaware and Chester counties. It is understood that the portion of the line in Chester County will be sold later.

MERIDEN, CT.—The Consolidated Railway Company has completed the purchase of the control of the Hartford street railway, paying $285 cash a share for it, and for the East Hartford & Glastonbury Horse Railway Company's debenture bonds, which were guaranteed by the Hartford company and were convertible into its stock. The stock of the Hartford company is $1,000,000, and the East Hartford & Glastonbury bonds $200,000, so that the stock of the Hartford company is practically $1,200,000.

DAVENPORT, IOWA—The Iowa & Illinois Railway, an electric road, organized with a steam charter and running between Davenport and Clinton, Iowa, is nearly completed, and is being operated. The road runs a distance of thirty-six miles and has traffic agreements for passengers to Rock Island and Moline, Ill. The cost of building the road was about $1,260,000. The bonds are twenty-year five-per-cent first mortgage gold bonds, dated January 1, 1904, and due January 1, 1924. Of the total issue of $2,000,000 bonds, $950,000 are retained in the treasury. Of the authorized $1,575,000 in stock $1,500,000 is outstanding.

SIOUX CITY, IOWA—A new interurban line connecting Sioux City with Niobrara and intermediate points in Nebraska is projected. J. E. Emerson, of St. James, Neb., has interested a number of Sioux City men in the project. He declares that water power can be used, thus greatly reducing the expense of operation. There is a twenty-foot head of water near St. James which can be used, and a sixty-three-foot head of water in the Verdigris river further west. The line would pass through the following Nebraska towns: Dakota City, Hubbard, Allen, Daley, Bow Valley, Crofton and Niobrara. An engineer is to make a survey of the proposed line.

Digitized by Google

PERSONAL MENTION.

MR. WILLIAM MARCONI, of wireless telegraph fame, was married on March 16, in London, England, to the Hon. Beatrice O'Brien, sister of Baron Inchiquin, in the Roman Catholic Church of St. George. A part of the honeymoon will be spent in Ireland, and the couple will sail for New York on March 25.

MR. W. A. STADELMAN has accepted the position of general eastern agent of the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, manufacturer of heavy machinery, cranes, etc. Mr. Stadelman has been for ten years past the eastern agent of the Brown Hoisting Machinery Company, and is very widely known in the machinery and electrical fields. His offices will be at 42 Broadway, New York city, beginning the first of next month.

MR. E. B. BOYE has been appointed manager of the Cleveland office of Manning, Maxwell & Moore, located in the Williamson Block. For the past five years Mr. Boye has been connected with the Chicago branch of the company. He is well versed and thoroughly posted on the various makes of machine tools and their uses. In his new position he will increase his large acquaintance among machine tool users, and his long experience in this line of business will help purchasers of the material in making careful selection of machine tools.

MR. CHARLES S. MELLEN, president of the New York, New Haven & Hartford Railroad Company, appeared before a legislative committee on March 14, in a hearing on a measure to compel the railroad company to make safe the third-rail electric line between Hartford and Bristol, running through New Britain, Newington and Forestville, Ct. President Mellen stated that the company had decided to abandon the third-rail service on July 1 next, and to operate the line entirely by steam; that the third-rail electric service has proved unprofitable, and would be given up.

MR. CHARLES D. KNIGHT has been appointed chief engineer of the American Electric and Controller Company, New York city. Mr. Knight was formerly connected with the engineering departments of the General Electric Company, Schenectady, N. Y., the National Electric Company, Milwaukee, Wis., and the Cutler-Hammer Manufacturing Company, of Milwaukee. Under his supervision the American Electric and Controller Company will manufacture, in addition to the "Rheocrat," a complete line of alternating and direct-current controllers, starters, automatic switches, solenoids, etc. Mr. Knight's headquarters will be at 12 Dey street, New York city.

MR. BION J. ARNOLD, the well-known consulting engineer, and member of the commission undertaking the electrification of the New York Central & Hudson River Railroad Company's lines, addressed the members of the Commercial Club, of Boston, Mass., on the evening of March 16. Mr. Arnold described the plans which had been completed for the two power-houses, of about 60,000 horsepower each. He described the equipment of the substations, and the characteristics of the generating and distributing service. He called attention to the contract which had been made for the electric locomotives, and the tests which are being undertaken to demonstrate the entire usefulness of this apparatus. He described in detail the improvements planned for the Grand Central Station, illustrating the address with numerous lantern slides.

OBITUARY NOTICES.

MR. W. H. DURIN, of Cedar Rapids, Iowa, one of the most popular telephone men in the state, died last week. His funeral service was held at Cedar Rapids on Monday, March 20, and was largely attended by representative telephone men from various parts of Iowa.

MR. EDWARD C. COCKEY, superintendent of supplies of the Western Union Telegraph Company for a number of years, died at his home, No. 225 West 127th street, New York city, on Wednesday evening, March 15, at a quarter-past ten o'clock. Mr. Cockey was very widely and popularly known in telegraph circles. He was a former president of the Magnetic Club, and very prominent in numerous other societies. The funeral service was held in the Mount Morris Baptist Church, New York city, on Saturday evening, March 18, and the interment was in Kensico Cemetery on Sunday, March 19.

ELECTRICAL SECURITIES.

The notable feature of last week's security market was the reactionary turn which came about and persisted more or less throughout each day's session. In many quarters, however, this reactionary development is held as a sign of strength, in that, although there was a considerable selling of the short interest, there is no evidence of a panicky condition, and it will prove a stop to any tendency to wildness in speculation. It must be understood that the stock market retrogression does not in any way reflect a similar condition in industrial circles. Notwithstanding the fall in prices of some securities, reports from every section of the country indicate a continued prosperity. It is a matter of fact that the market has been entirely indifferent to news incidents, even of the greatest importance. The poor showing for the last quarter by the United States Steel Corporation was expected, and it is freely predicted that in spite of this, there will be shown a record business for the whole year. The Northern Securities decision as a matter of financial interest is dwindling in importance, and it is now considered that it will be some time before any further effort is made to bring about a settlement of the ultimate ends of this dispute.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 18.

New York:	*Closing.*
Brooklyn Rapid Transit	67
Consolidated Gas	206
General Electric	188⅞
Interborough Rapid Transit	213
Kings County Electric	200
Manhattan Elevated	169¼
Metropolitan Street Railway	123¾
New York & New Jersey Telephone Company	174
Westinghouse Manufacturing Company	190

Directors of the Interborough Rapid Transit Company have declared a dividend of 1¾ per cent of the capital stock, payable April 4, to holders of voting trust certificates of record on March 20.

General Electric directors have declared the regular quarterly dividend of 2 per cent, payable April 15 to stockholders of record March 23.

Boston:	*Closing.*
American Telephone and Telegraph	144⅜
Edison Electric Illuminating	253
Massachusetts Electric	64½
New England Telephone	138
Western Telephone and Telegraph preferred	102

It is reported that earnings of the Massachusetts Electric Companies are making large gains over a year ago.

A dividend of $1.50 per share will be paid on April 15 to stockholders of record of the American Telephone and Telegraph Company at the close of business March 17. The instrument statement of the company for the month ended February 28 is as follows: gross output, 134,301; returned, 47,577; making the net output 86,724, compared with 47,309 for February, 1904. The total number of instruments now outstanding is 4,660,222. The annual meeting of the American Telephone company will be held in New York city, Tuesday, March 28, at twelve o'clock. Certain changes in the by-laws will be made, and stockholders will act upon the question of conveying certain lines to certain licensee companies.

Philadelphia:	*Closing.*
Electric Company of America	12
Electric Storage Battery common	85½
Electric Storage Battery preferred	85½
Philadelphia Electric	10½
Philadelphia Rapid Transit	30⅝
United Gas Improvement	115¼

The Electric Storage Battery Company's report for the year ended December 31, 1904, is as follows: gross, $1,344,536; expenses, $378,877; net, $965,659; other income, $117,249, making the total income $1,082,908; dividends, $812,435, leaving a surplus of $270,473, as compared with a surplus of $689,156 for the previous year, a deficit of $418,683. The following directors were reelected: P. A. B. Widener, Herbert Lloyd, G. D. Widener, Thomas Dolan, Grant B. Schley, H. P. Whitney, A. N. Brady, Thomas F. Ryan, Rudulph Ellis.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	166
Metropolitan Elevated preferred	65
National Carbon common	45
National Carbon preferred	113
Union Traction common	12½
Union Traction preferred	47

Digitized by Google

NEW INCORPORATIONS.

MAPLE LAKE, MINN.—Maple Lake Telephone Company. $10,000.

LEXINGTON, KY.—Central Kentucky Traction Company. $200,000.

CADIZ, OHIO—Cadiz Electric Company. $12,000. Incorporators: G. B. McGowan, G. D. McFadden, E. W. Long.

SACO, ME.—Saco River Power Company. $250,000. President, E. J. Jones, Everett; treasurer, J. O. Bradbury, Saco.

KITTERY, ME.—Eastern Telegraph and Stock Company. $100,000. Incorporators: H. Mitchell, M. G. Mitchell.

MILWAUKEE, WIS.—Union Light and Power Company. $5,000. Incorporators: A. G. Marks, Charles Tryon and L. B. Budd.

GREENTOWN, IND.—The Greentown Telephone Company. $30,000. Incorporators: J. M. Gleen, W. L. Bott, Art A. Largent.

EUGENE, ORE.—Bethel Telephone Company. $1,000. Incorporators: Mark T. Fleming, Charles K. Kompp and M. A. Bilgood.

DES MOINES, IOWA—Butler & Bremer Mutual Telephone Company, of Plainfield. $10,000. Incorporators: William Sinpan and others.

PERTH AMBOY, N. J.—Citizens' Electric Light, Heat and Power Company. $125,000. Incorporators: Jacob Goldsmith, Fred J. Cox, John K. Sheehy.

SALEM, ORE.—Klamath Light and Power Company, Klamath Falls. $4,000. Incorporators: Rufus S. Moore, Evan R. Reames, N. Baldwin and H. M. Gates.

NASHVILLE, TENN.—Corum Telephone Company. $5,000. Incorporators: J. J. McFarland, J. D. Carvey, J. J. Askew, J. R. Gwymme and W. H. Oldham.

PORTLAND, ME.—Western Water, Light and Traction Company. $10,000. Incorporators: J. W. Anderson, Gray; J. R. Parsons, Yarmouth; W. M. Bradley, Portland.

WILMINGTON, DEL.—Sumter Electric Light, Power, Railway and Telegraph Company. $100,000. Incorporators: J. L. Alnutt, Albert Dehaven, of Sumter, S. C., and others.

MONTGOMERY, ALA.—Long-Distance Telephone and Telegraph Company, of Decatur. $500,000. Incorporators: E. L. Barber, J. V. Monteith, J. C. Monteith and W. S. Isherwood.

WAPAKONETA, OHIO—New Knoxville Telephone Company. $8,750. Incorporators: A. H. Steinecker, George W. Holl, F. H. Fledderjohann, E. K. Meckstroth and George Wellman.

NEWARK, N. J.—The Citizens' Union Telephone Company. To construct telephone and telegraph lines. $150,000. Incorporators: Lester Park, Red Bank, N. J.; Edgar W. Danner, New York; Henry G. Beach, Newark, N. J.

COLUMBUS, OHIO—Ohio Bell Telephone Company. To establish an exchange in West Jefferson. $20,000. Incorporators: L. V. French, of West Jefferson; F. F. Dowds, F. H. Hutsberger and Jackson Underhill, of Mount Vernon.

LOGANSPORT, IND.—The Indianapolis & Chicago Air Line Traction Company. To build a direct line from Indianapolis to Chicago, passing through Jolietville, Kirklin, Michigantown, Flora, Rockfield, Idaville, Buffalo, Francesville, Crownpoint and Indiana Harbor. $100,000.

CLARKSBURG, W. VA.—West Fork & Valley River Railroad Company. To build and operate an electric line from Clarksburg and Grafton. $100,000. Incorporators: Gordon B. Late, Harry F. Armstrong and C. H. Warner, all of Bridgeport, and R. G. Altizer and Philip Steptoe, both of Clarksburg.

TRENTON, N. J.—The Edgewater & Hudson View Construction and Traction Company, Bull's Ferry Road and Palisade Plaza, Hudson Heights, N. J. To construct railroads. $100,000. Incorporators: August Sieber, Hudson Heights, N. J.; Thomas Karrigan, New York; William M. Schultz, West Hoboken, N. J.; Robert N. Sander, North Plainfield, N. J.; Thomas F. Prosser, Guttenburg, N. J.; William Dahm, North Bergen, N. J.; Charles A. Selber.

NEW PUBLICATIONS.

MEDINA AND ITS ELECTRIC POWER PLANT—The A. L. Swett Electric Light and Power Company, Medina, N. Y., has published a handsome bulletin descriptive of the industrial development of Medina, N. Y. The book is handsomely illustrated, and the descriptive matter is complete. The whole system of power plants, including water area and manufacturing sites, covers a total of 200 acres. The combined output of the power-house is 3,000 horse-power. The total head of water used is eighty-eight feet.

PROCEEDINGS OF THE CHAMBER OF DELEGATES OF THE INTERNATIONAL ELECTRICAL CONGRESS—The proceedings of the chamber of delegates appointed by the various governments to the International Electrical Congress, St. Louis, 1904, has been published. This includes the organization of the chamber of government delegates, the announcement of the official representatives appointed to the chamber of government delegates, the proceedings of the chamber of delegates, including minutes of the first, second, third and fourth meetings.

REGISTRATION OF TRADE-MARKS UNDER THE NEW TRADE-MARK ACT—This is a pamphlet by Mr. Arthur P. Greeley. The book points out the character and scope of the new trade-mark act, the purpose of the new act, the common law of trade-marks, and the requirements concerning registration. There is considerable misunderstanding and misapprehension in industrial manufacturing circles regarding the true interpretation of the new trade-mark act. All the difficulties likely to come up in the understanding of this act are taken up, and its possibilities carefully pointed out.

EDUCATIONAL NOTES.

WORCESTER POLYTECHNIC INSTITUTE—The Journal of the Worcester Polytechnic Institute, Worcester, Mass., for March, contains, among a number of interesting articles, one by P. E. Barbour, discussing "The Distribution of Power-House Expense." Mr. Barbour shows how the expense of operating the boiler house and power plant should be distributed among the various departments, in order that each may bear its proper proportion of cost. The particular case considered is that of a copper smelting plant.

THE MICHIGAN COLLEGE OF MINES—The Michigan College of Mines will hold its second annual class-day exercises in Houghton and Hancock, on Saturday, May 5. The principal feature of the event will be the address by William G. Mather, of Cleveland, Ohio, president of the Cleveland-Cliffs Iron Company. The student body of the Michigan College of Mines at present averages approximately 200. The environment is a strictly mining atmosphere, and the principles of mining and metallurgy practised in the Lake Superior iron and copper mining districts represent the highest attainments in these lines of industry.

BULLETIN OF SYRACUSE UNIVERSITY—The Syracuse University, Syracuse, N. Y., has issued bulletin No. 4 of series 4, giving general information regarding the university. A short description of the city of Syracuse is given, and the various colleges and courses are described. The university has five colleges, namely: liberal arts, fine arts, law, medicine and applied science. In the college of applied science three courses are given—civil engineering. electrical engineering and mechanical engineering. There are accommodations for 1,200 students in the engineering courses. The bulletin is well illustrated with views of the city, campus and interiors of the various buildings.

LEHIGH UNIVERSITY REGISTER—The Register of Lehigh University, South Bethlehem, Pa., shows the attendance of 630 students from twenty-four states and eight foreign countries, the largest in the history of the institution. There are fifty-six in the teaching staff. Thirteen four-year courses of instruction are offered at the university: the classical course, the Latin-scientific course, the courses in civil, mechanical, marine, metallurgical, mining. electrical and chemical engineering, analytical chemistry, geology, physics, and electrometallurgy. Ninety-two students are taking the course in electrical engineering. A list of graduates of the university, with their present occupations, 1,399 in number, during the thirty-nine years of its existence, indicates that this institution is exerting a marked influence on the industrial development of the United States and of foreign countries. Provision is made for worthy and needy students, whereby they may postpone payment of tuition until after graduation.

Digitized by Google

TELEPHONE AND TELEGRAPH.

ERIE, PA.—The Albion Telephone Company is extending its lines to Cherry Hill.

ANGOLA, N. Y.—The Evans Center telephone line has been extended to Angola.

YORK, PA.—The York Telephone Company is making extensive improvements between York and Red Lion.

NILES, OHIO—The Bell Telephone Company will extend its lines to Lordstown, Weatherfield and Newton.

SIOUX CITY, IOWA—The Iowa Telephone Company is planning the erection of a new exchange building in Sioux City during the coming summer.

NASHVILLE, ILL.—The Adieville Progressive Telephone Company has organized, electing L. W. Kokesh, president, George Doelling, secretary, and Emil Garlich, treasurer.

EMPORIA, KAN.—The farmers along upper Coal creek in Center township have organized a new telephone line that will extend from Emporia fourteen miles south and southwest.

CONNELLSVILLE, PA.—The Tri-State Telephone Company has enlarged its switchboards at Fairchance and Dawson, to make provision for a number of new subscribers in each of the towns.

NIAGARA FALLS, N. Y.—The Bell Telephone Company is making arrangements to extend its line north from Jeddo to accommodate many of the leading farmers along the county line.

EGG HARBOR CITY, N. J.—The Egg Harbor City Telephone Company is building a line to Gloucester Landing, a distance of five miles. This will connect the old town site with the new.

PINEVILLE, KY.—A new telephone company is being organized by prominent merchants and farmers of Bell County to connect heretofore isolated country districts with Pineville and Middlesboro.

PORTLAND, ORE.—The Estacada Telephone and Telegraph Company has secured a franchise in Estacada, and a contract has been entered into with the Pacific States Telephone Company, whereby each company may use the other's lines.

WHEELING, W. VA.—A large number of farmers living between St. Clairsville and Glencoe have organized a telephone company, and a system will be installed at once. The company will have a toll connection with the Belmont Telephone Company.

COLUMBUS, OHIO—The Cincinnati & Suburban Bell Telephone Company, Cincinnati, has filed a certificate with the secretary of state increasing its capital stock from $4,000,000 to $5,000,000. This is in accordance with a resolution of the directors passed on February 15.

BLOOMFIELD, IOWA—The Mid-Western Electric Company, of Cedar Rapids, has purchased the Davis County telephone system of W. J. Steckel. The buying company also owns the Moulton and Eldon systems and will make improvements and extensions. The consideration was $37,000.

PROVIDENCE, R. I.—The Providence Telephone Company has asked the general assembly to grant an amendment to its charter increasing the capital stock of the company to $5,000,000. The act was accompanied by a petition signed by Dexter B. Potter, president, and by Treasurer Howard.

ST. JOSEPH, MO.—Improvements, which will completely change the present methods of telephoning, are being made to the St. Joseph system of the Missouri & Kansas Telephone Company, at a cost of $200,000. The betterments to the company's properties include a new switchboard, which will accommodate 10,000 subscribers.

GLENWOOD, WIS.—The West Wisconsin Telephone Company has arranged to build a line from Glenwood through the town of Erie to connect with the Hammond independent lines, giving connection with all the independent lines of St. Croix and Pierce counties. This plan will give a second long-distance connection between Glenwood and St. Paul, Minneapolis and Duluth.

CUMBERLAND, MD.—Mayor King, of Cumberland, and Mayor Timanus, of Baltimore, on March 2 formally opened the long-distance telephone connection between Cumberland and Baltimore. The new line is 141 miles long and runs direct. The other lines have been placed to connect with Cumberland, Baltimore and intermediate towns. The opening of the new line gives communication between Philadelphia, Baltimore and Pittsburg.

ORANGE, TEX.—At the annual meeting of the Orange Telephone Company the following directors were elected for the new year: E. L. Bruce, A. L. Ford, A. M. H. Stark, R. H. Bruce, E. R. Webber and A. R. Webber, of Orange, Tex., J. W. Burnside, W. D. Dean and H. M. Shingle, of Kenton, Ohio. The directors then elected the following officers: E. L. Bruce, president; A. R. Webber, vice-president, and E. R. Webber, secretary-treasurer and manager.

TOWANDA, PA.—Fairview Independent Telephone Company has been organized with Daniel Boyce as president; L. C. Burroughs, secretary; I. V. Anderson, treasurer. Directors: L. C. Burroughs, Daniel Boyce and A. Fleming. The proposed line will extend down Granville creek to West Franklin, and there connect with the Canton & LeRoy Farmers' Telephone Company, thence to Burlington, and connect with the independent line coming from Smithfield.

NASHVILLE, ILL.—The Central Union Telephone Company, licensee of the American Bell Telephone Company in Illinois, has absorbed by purchase the entire holdings of the latter company in Washington County. The transfer includes the Nashville and Okawville exchanges and all toll lines. Owen M. Burgess, who was district manager, has resigned, and is succeeded by Edmund Robb, of Mount Vernon. The former has gone to Kansas City, Mo., to assume the vice-superintendency of construction of the Kansas-Missouri line, which embraces Missouri, with the exception of St. Louis, Kansas, Nebraska, Oklahoma and the Indian Territory. The Central Union proposes shortly to improve its entire system in Washington County.

RICHFIELD SPRINGS, N. Y.—At a meeting of the Otsego Home Telephone Company, held at the office of the Utica Home Telephone Company, the following officers were elected: president, H. A. Harrison, Utica; vice-president, George Whitman, Morris; secretary, John A. Losee, Richfield Springs; treasurer, T. Harvey Ferris, Utica; general manager, Charles H. Poole, Utica; engineer, Edward L. Cline, Utica; consulting engineer, F. C. Ward, Cooperstown. The Independent Securities Company, of Utica, recently incorporated with a capital of $800,000, and which is contemplating a $15,000,000 bond issue, has acquired a controlling interest in the Otsego Home Telephone Company and will back this concern in all its operations. The Otsego company now owns practically all of the independent lines in Otsego County.

LEGAL NOTE.

COURT OF APPEALS UPHOLDS RIGHT OF INTERBOROUGH LINES IN THE BRONX—The Interborough Railway Company, of New York city, has secured a decision from the court of appeals, allowing it to construct six new lines in the borough of Bronx. The company originally made application to the state board of railroad commissioners, but this was denied on the ground that public convenience did not require the new lines, the territory being supplied with ample railroad facilities by the Union Railway Company. The appellate division reversed that decision and the court of appeals has affirmed the determination of the appellate division.

NEW COMPANIES.

JERSEY CITY, N. J.—The Electric Heating and Equipment Company has been incorporated with a capital of $100,000, by Louis B. Dailey, H. O. Coughlan and Thomas F. Barrett.

STEUBENVILLE, OHIO—The Ohio Valley Electrical and Construction Company has been organized by H. P. McGowan, O. P. Swords and W. A. Gerber. It has a capital of $50,000.

PERTH AMBOY, N. J.—The Citizens' Electric Light, Heat and Power Company has been incorporated to manufacture machinery, apparatus, and equipment of all kinds for producing electricity. The capital is $125,000, and the incorporators are Jacob Goldsmith, F. J. Cox, John K. Sheehy, Louis Brieys, M. Goldberger, E. M. Kelly, A. P. Kennedy, G. T. Reynolds, C. A. Sexton, Henry McCollugh, C. D. Boynton, N. Roth, J. Goldberger, B. Goldman, Peter Floersch, John P. Hahn and Jesse Sickles.

Digitized by Google

INDUSTRIAL ITEMS.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, is distributing a circular calling attention to "Transite" and asbestos fireproof lumber, which is used for fireproofing buildings.

THE NEWTON MACHINE TOOL WORKS, Philadelphia, Pa., will be pleased to send its catalogue No. 40, describing vertical milling machines, to any one interested upon request.

THE BURKE ELECTRIC COMPANY, Erie, Pa., lessee of the Keystone Electric Company, has moved its New York office from 114 Liberty street to 26 Cortlandt street, where it has on exhibition some of the latest type motors. Mr. H. B. Coho is in charge of the eastern sales office.

THE CHURCHER ELECTRIC AND MANUFACTURING COMPANY, Cincinnati, Ohio, announces that Mr. W. B. Churcher has sold his rectifier patents to the Electrical Appliance Company, Cincinnati, Ohio. Mr. Churcher will manufacture the rectifiers, as heretofore, the Electrical Appliance Company being merely a selling organization, and assuming all the bills.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has shipped, and expects to have running very soon, two motor equipments on large planers, one for the New York Central & Hudson River Railroad Company, and one for the Westinghouse Electric and Manufacturing Company. The company will be pleased to send full information regarding this apparatus upon request.

THE LODGE & SHIPLEY MACHINE TOOL COMPANY, Cincinnati, Ohio, will be pleased to send its illustrated catalogue, descriptive of its patent head lathe. This is a quick-change-gear engine lathe with high-speed qualities. Numerous illustrations are given, showing the various features of this lathe. The lathe is easily adaptable to a motor drive, and illustrations are given, showing a motor-driven equipment.

THE SARCO COMPANY, 906 Sixth avenue, New York city, has prepared several attractive bulletins describing and illustrating its various specialties. As the name of this company signifies, this apparatus is claimed to "save a real cash value." A number of excellent devices for fixture work and decorative interior lighting have been produced by this enterprising company. These bulletins should be secured by any one interested in this kind of work.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, is distributing a new catalogue descriptive of Dewhurst patent slag ladles and cars. These appliances have been extensively adopted in leading plants in Great Britain, and elsewhere, with gratifying success. The catalogue describes the special features which this apparatus possesses. The cars are built side-tipping or end-tipping, as required. The company will furnish full details and submit proposals upon application.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester N. Y., has closed a contract with the Curtis Publishing Company, Philadelphia, Pa., for a central energy switchboard equipped with lamp line signals and double supervisory signals. This board is to be strictly modern in every respect. The company has equipped the new exchange of the Tri-State Telephone Company, of Grand Forks, S. D., which began service on January 27. Contracts have been closed for switchboards for the following places: Fairpont, Ohio; Illinois City, Ill.; Maple Lake, Minn.; Lathrop, Mo.; Granger, Tex.; Toledo, Ohio; Parnell, Iowa; Carmi, Ill., and Philadelphia, Pa.

THE COOPER HEWITT ELECTRIC COMPANY, New York city, has published bulletin No. 6, descriptive of new types of direct-current mercury vapor electric lamps for indoor illumination. Bulletin No. 7, dated February, 1905, describes in detail the mercury vapor electric lamp. This bulletin also gives a number of illustrations of installations of these lamps, which are being installed for general illumination and for photographic purposes with great success. A number of testimonials from prominent companies are published, attesting to the value of the light as a source of illumination. An important feature is displayed in the following quotation, taken from one of these commendatory letters: "We find that the strangeness of the light wears off in a very short time, and the draughtsmen, clerks and workmen are well pleased with the lamps. The light is very easy on the eyes, and owing to the splendid diffusion obtained, no dark shadows are caused, and the ability to see into and under objects by this light is surprisingly satisfactory."

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., reports that the large increase in the sales of "Okonite" and "Manson" tapes indicates a growing demand for these hign-grade tapes. The company emphasizes the fact that these tapes are made only in one quality, the best, and that in order to make a perfect insulation all wire joints should be taped first with "Okonite," rubber tape and second with "Manson" friction tape. "Okonite" tape is thoroughly waterproof and a perfect insulating medium. It is not injured by exposure to weather, does not deteriorate when submitted to extreme changes in temperature, and is not affected by commercial acids or alkalies.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, reports recent sale of special laboratory generator to the Bliss Electrical School, Washington, D. C., and motors to the Massachusetts Institute of Technology, Boston. An installation of thirteen press motors has just been furnished A. I. Root, Incorporated, Omaha, Neb.; an equipment of generator and twelve motors for the School News at Taylorville, Ill. Among orders just secured are for equipping the plant of the Oil City, Pa., Derrick Publishing Company, with a generator and eleven motors; eleven motors for the printing house of Nitschke Brothers, Columbus, Ohio; S. Barker & Sons, printers and stationers, Cleveland, Ohio, six motors, and eleven linotype motors for the Manitoba *Free Press*, Winnipeg, Manitoba.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, announces that the Independent Telephone Company, at Topeka, Kan., has recently ordered a 1,200-line magneto-call switchboard system from it. The equipment consists of two sections, oak cabinets. Each position of this switchboard is fully equipped and arranged for giving service to 200 subscribers' lines. It is made possible to operate so many lines from one operator's position through an efficient training of the operators, and also owing to the equipment provided for handling the entire service throughout the board, the American company's flash-light transfer system having been adopted. The Independent Telephone Exchange, at Hot Springs, Ark., has recently had installed by the American Electric Telephone Company, of Chicago, an increase in its switchboard capacity to a total of 1,320 line terminals, this increase being brought up from 1,000 lines. Since the above installations, the American company has received an additional order for 180 lines, which presents a remarkable increase in the prosperity of the company.

THE ELECTRIC MOTOR AND EQUIPMENT COMPANY, Newark, N. J., engineered and successfully carried out the illumination of the dome of the capitol and the two sides of the shaft of the Washington Monument by means of searchlights, during the inauguration of President Roosevelt in Washington, D. C. Six eighteen-inch and four thirteen-inch government-type searchlight projectors, manufactured by the General Electric Company, were used to produce the illumination. These were located in the most advantageous places to produce the effect desired by the inaugural committee. One eighteen-inch projector was installed at the top of the Washington Monument, the light being directed toward the dome of the capitol, on which it was focused. About 1,500 feet from the monument, on top of the building of the Potomac Electric Power Company, there were located four eighteen-inch projectors. These were so placed and focused that, when the light was projected upon the monument, two sides were sufficiently and satisfactorily illuminated. Projected on the dome of the capitol were the rays from two thirteen-inch projectors, placed upon the roof of the building at the corner of Pennsylvania avenue and First street. These were about 1,200 feet away. At a like distance from the dome of the capitol, on a building on First street, near Maryland avenue, there were located two thirteen-inch projectors, whose rays were concentrated against the black-night sky, producing a very remarkable effect. Surmounting the dome is the tholus, at which place there was located an eighteen-inch projector, its rays directed toward the monument, producing a shaft of light extending a distance of a mile and a quarter across the city. The engineers were highly complimented upon their work by the inaugural committee.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 13. NEW YORK, SATURDAY, APRIL 1, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
A Telephonic Gauger . . . 523
Overhead Construction for Electric Railways . . . 523
Telephone Growth . . . 524
Wireless Telegraphy for Polar Trips . . . 524
Electric Furnaces . . . 524
Progress in Electric Lighting . . . 525
The Convenience of the Small Motor . . . 525
The Murray Type-Printing Telegraph . . . 526
Telephones and Tallow-Candle Methods . . . 527
Some Points on the Selection of Electric Cables, by L. B. Atkinson and C. J. Beaver . . . 527
Electric Crane at the St. Triphon Quarries, Switzerland, by C. L. Durand . . . 529
Tests to Determine the Comparative Heat Conduction and Radiation of Insulating Varnishes, by John C. Dolph . . . 531
National Electrical Conference on Standard Electrical Rules . . . 531
Dallas, Tex . . . 534
The Animas Canal, Reservoir, Water, Power and Investment Company . . . 534
National Electric Light Association Convention . . . 534
Annual Report of the American Telephone and Telegraph Company . . . 535
Line Construction for High-Pressure Electric Railroads, by George A. Damon . . . 537
The New Federal Trade-Mark Law, by James Hamilton . . . 542
American Institute of Electrical Engineers . . . 544
The Constitution of Matter . . . 545
Telephonic Detection of Wine Adulteration . . . 545
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 546
Facilitating Export and Import Business with Austria . . . 547
Railway and Telegraph Rates at Panama . . . 547
INDUSTRIAL SECTION:
The Cooper Hewitt Mercury Vapor Converter . . . 548
Single-Phase Motor for Elevator, Hoist and Traveling Crane Service . . . 549
The Case Controller . . . 550
The Carey-Foster Bridge and Commutator . . . 551
CURRENT ELECTRICAL NEWS . . . 552

A TELEPHONIC GAUGER.

Unexpected uses of every-day instruments are not infrequently announced. One such application comes to us on the authority of the United States consul at Frankfort, Germany. It is to the effect that an ingenious Frenchman has made use of the telephone receiver to detect adulteration of wine. At first thought this seems rather improbable, but there may be something in it. Undoubtedly, the inventor has adapted Kohlrausch's method for measuring the conductivity of solutions to determine the relative conductivity of a standard sample of wine and that of the sample to be judged. It would seem that the indications of the instrument have a relative value only, for pure wines from different localities would surely give different settings of the instrument although the same standard sample be used; this would, of course, limit the usefulness of the device. Moreover, as soon as a man who adulterates his wine learns that it will be tested in this way, he will find some way of bringing the conductivity up to the standard. To prevent this, other tests will be necessary. Used in connection with other methods of judging wine, the device will probably be useful, but one need hardly expect the telephonic wine-taster to throw out of work the entire class of experts which now makes a living by judging wines.

OVERHEAD CONSTRUCTION FOR ELECTRIC RAILWAYS.

The two interesting papers read at the recent meeting of the American Institute of Electrical Engineers describe the types of overhead construction developed primarily for use with alternating, single-phase systems. The most marked change in the new construction from the old is the use of messenger cables, from which the working conductor is suspended. This reduces the sag of the working conductor, though it was not with this object primarily that the messenger cable was employed. Its great advantage is in the greater flexibility of the working conductor when it is suspended from the cable. With the old construction, even when a flexible support of some kind is employed, such as a span across the track or a short span supported from a bracket, there is more or less of a blow when the collecting device passes the point of support. While this causes sparking, its chief disadvantage is the risk that the collecting device may be thrown off the wire at these points when the car is moving at high speed.

Another advantage of the messenger cable is the greater security which it gives. With the higher voltages which are now to be used on alternating-current systems, the risk of having the wire break must be as low as possible. Moreover, as the roads on which such construction will be used are expected to become important lines, it is essential that dangers of interruption due to a break in the overhead system should be made small. Such constructions as are described in the papers are expensive as compared with the older and simpler method, but there can be no doubt that they show progress in the right direction, and that the additional investment required will be well expended.

One of the difficulties brought in by the use of higher voltage is that of insulating the conductor. As a rule, materials which have good insulating properties are mechanically poor. There are some exceptions to this rule, but they are expensive. The use of a messenger cable simplifies the problem by making double insulation possible and by reducing mechanical strain. The point made by Mr. G. A. Damon in this connection, that hardwood is likely to return into favor, is interesting. It would seem from the discussion that European engineers agree with this conclusion.

It is not likely that any system which has been described will remain unaltered, for we have had, as yet, too little experience with them. But the move to secure a better and stronger overhead system is surely in the right direction.

Digitized by Google

TELEPHONE GROWTH.

Although statistics are usually dull reading, figures showing the development of certain industries are interesting when this development is beyond the ordinary, or when the industry is closely identified with our every-day life. Figures showing the development of the telephone industry are interesting from both these points of view, for there has probably never been any invention which has become so widely used in so short a time.

About the first of the year some statistics were published, showing the increase in the use of the telephone for certain sections of this country. At that time complete statistics covering the entire country for the year just closed were not available. In the annual report of the president of the American Telephone and Telegraph Company for the year 1904 some figures are given which show how this great company has grown. These figures convey some idea of the enormous amount of work which has been done. For instance, this company had, at the end of last year, 1,950,000 subscribers. It had in use 3,549,810 miles of wire, and transmitted daily 11,149,063 messages. The total for the year was 3,589,998,000. This one company furnishes means by which 11,000,000 talks per day are conducted. How did people ever manage to get along before the telephone was introduced? Did they write more, or did they talk less? In either case, they surely did not accomplish as much as the average man of to-day.

The figures which were published the first of the year showed that, according to the latest statistics, there was one telephone in Great Britain for every 150 inhabitants only; one in Germany for every 121 inhabitants, and one in France for every 358 inhabitants. The Bell company alone in America has one telephone for every forty-two individuals of the entire country, and in comparing these figures it should be borne in mind that the Bell company is not alone in the field. In spite of the much greater development in this country, the telephone is being introduced at continually increasing rates. What the end will be no one can see. The ideal, of course, will not be attained until every individual has a telephone at his elbow.

WIRELESS TELEGRAPHY FOR POLAR TRIPS.

Wireless telegraphy is to be used by Commander Peary during the polar trip upon which he expects to start early next July. By this means the explorer's party hopes to be able to communicate with New York.

This is a practical and useful application of wireless telegraphy. If we are to continue making polar expeditions, it is important that the loss of life and the danger to the explorers should be reduced as much as possible. Many deaths have occurred in the Arctic regions which would have been prevented had means been at hand for communicating with other parties or ships and asking for assistance. It is important not only that the exploring vessel itself keep in touch with the world, but that, if practicable, the party of men which makes the dash for the pole should keep in touch with the vessel. If this can be done much of the uncertainty of Arctic exploration will be removed. The exploring party will push forward with greater confidence, and will be able to go further, because those on the vessel will know at all times where the party is and where to send additional supplies. It would be an interesting climax of such an expedition if the first work done at the pole were to erect a wireless telegraph mast—we almost said, make use of the pole itself for this purpose.

ELECTRIC FURNACES.

During the discussion provoked by Dr. Paul L. T. Héroult's interesting account of his work with the electric furnace in making steel, he laid emphasis upon the necessity for making a furnace of a practical type. A furnace which prevents any contamination of the metal from the carbons is essential for the production of high-grade steels, but such a furnace will not be satisfactory unless it, at the same time, is so constructed that the molten metal can be worked. For instance, Dr. Héroult said that the induction type of furnace, in which a ring of molten metal forms the secondary of a transformer, while very pretty theoretically, is practically a bad design, because, with such a ring of metal, it is impossible to obtain a uniform mixture and to rake off the slag easily. Another objection to this type, he thought, was the large surface from which heat might be lost by radiation and conduction. This would lower the efficiency of the furnace. In his opinion, the simplest form of furnace is the best. A hollow vessel of a more or less spherical form, containing the molten material, is the most advantageous shape so far as regulating the product and economizing the heat are concerned. This type being determined upon, it is then necessary to use such methods of heating as will prevent the metal from taking up the carbon of the electrodes. The thermal efficiency of a furnace of this type can be easily made eighty per cent. No doubt it could be made higher if desirable.

This opinion of a recognized expert will undoubtedly have considerable weight. No one to-day is expecting a revolution in methods of producing iron and steel, but there seems to be no doubt that, by means of the electric furnace, a quality of steel better suited to different purposes can be produced. But before we can expect steel-makers to adopt the new furnace, we must offer them a furnace as convenient as the apparatus in use at present, and one which will produce the desired product cheaply. Convenience, ease of operation, and the ability to produce a uniform product will undoubtedly be controlling factors. The cost of heating electrically, even though it may be considerably more than the cost of heating by fuel, may really be a small matter. What the electric furnace loses in this respect it more than gains in other directions. Nevertheless, it is desirable, of course, to keep this item as low as possible. Hence, other things being equal, the most efficient furnace will be the best. The situation in this line of work is somewhat similar to that in electric railroading. In certain branches of railway work no system other than electricity would be considered, and the great question to-day is how far the new method of propulsion can be extended. The electric furnace enables us to produce materials which can be made in no other way. When such materials are desired, it must be used. But how far the use of the electric furnace can be extended into metallurgical fields is a question which no one to-day can answer.

Digitized by Google

PROGRESS IN ELECTRIC LIGHTING.

A short while ago the newest form of incandescent lamp—that in which the filament is formed from tantalum wire—was described, and its peculiar characteristics discussed. In the same class should be put the osmium lamp, which has also been referred to from time to time, as progress in its manufacture has been made. The latest information with regard to this lamp was conveyed to the Elektrotechnischer Verein, of Berlin, last January, by Herr Fritz Blau. An abstract of this paper appeared in the issue of the ELECTRICAL REVIEW for March 18. The most interesting point in this paper was the statement that these lamps are now made for 110 volts. About a year ago thirty-seven volts was the limit. This was greatly improved when it was found possible to manufacture the lamps for operation on a fifty-five-volt circuit. Still later, the voltage was raised to seventy-three, and now the very considerable increase to 110 has been accomplished. If the lamps can be manufactured commercially for this voltage, they will at once enter into competition with the ordinary incandescent lamp.

The disadvantages of the osmium lamp are the difficulty of working the metal into the shape of a filament, and the flexibility of the filament when incandescent. Moreover, the material itself is not plentiful, and this is somewhat of a drawback. A thirty-seven-volt, twenty-five-candle-power lamp has a filament 0.087 millimetre in diameter. It is about eleven inches in length, and is thus comparable with that of an incandescent filament. Since the energy consumption per candle is about half that of the incandescent lamp, it follows that the carbon filament must be hotter and "blacker" than the osmium filament—that is to say, it radiates more energy per unit of surface, and the radiations cover a wider range of wave-length. Since the luminous efficiency of an incandescent body increases rapidly with its temperature, it is evident that the higher efficiency of the osmium lamp depends entirely upon its selective radiation.

The dimensions of the filament of the 110-volt osmium lamp are not mentioned in this paper. Assuming the same diameter of filament, and the same energy efficiency, the filament would have to be nine times as long for the higher voltage. This, of course, would be impracticable unless some such method of construction were adopted as has been found necessary for the tantalum lamp. The paper, however, says that it has been possible to reduce the diameter of the filament to 0.03 millimetre. As this is practically one-third the diameter of the filament of the thirty-seven-volt lamp, a filament of this thickness for 110 volts would have practically the same length—that is to say, eleven inches. It is a question whether a filament of this size would be practicable, since even the larger filament has been found weaker than carbon.

As yet, it has not been found possible to draw osmium into wires, and other methods of forming the filament are necessary. This would seem to be a decided disadvantage. It is also probable that in the smaller filaments, at least, and at the high temperatures at which they must be operated, there will be some tendency for the filament to become irregular and draw itself up into drops, on account of the surface tension. This is a phenomenon which is observed in the tantalum lamp, though it is possible that the temperature at which the osmium filament is operated is not sufficient for such action to take place.

While on the subject of improved lamps, it is interesting to note the success which another lamp has attained. The Cooper Hewitt mercury vapor lamp has become universal as the illuminant in the photographic laboratory or other shops where photography plays a considerable part, and is now rapidly making headway as the illuminant for shops, draughting rooms and other large interiors. Its use in this way bears out what was claimed as one of its advantages—that is, the softness of the light, and the less strain thrown by it upon the eyes. When first installed, the peculiar effect of the light is striking, but this soon wears off, and is then no longer noticed. In addition to its high efficiency, the large radiating surface of the lamp gives a very pleasing distribution of light.

THE CONVENIENCE OF THE SMALL MOTOR.

Whichever way one turns in these days of widespread electrical activity, the small motor is seen quietly doing its work at high efficiency and with great reliability and convenience. The store windows of our large cities are full of apparatus silently and steadily operated by an unobtrusive little motor tucked away beneath the shelf, but it is in exhibitions that the full force of these advantages is felt in comparison with the old method of driving apparatus by belting from rigid line shafts, wastefully propelled by belted steam engines and accompanied by an utter lack of flexibility but a plentiful supply of dirt and noise.

An instance of the convenience of the small motor for exhibition purposes was seen in the recently held automobile and power boat show at Boston. Many of the exhibitors desired to illustrate the exact working of the engines, gearing and transmission shafts, reverse levers and clutches of their respective machines. The problem was easily solved by belting a small motor to the mechanism, raising the automobile itself from the floor on a supporting frame or set of blocks and turning on the current. Where the machinery was exposed, either under glass or without covering, the operation was shown with the utmost facility.

Even among the supply exhibits the small motor was kept busy. Sprocket wheels were set up and hung with chains that were kept in motion by a small motor; a special lathe was propelled in a similar way; cyclometers and speed indicators were made to revolve; sign flashes, wheels equipped with different kinds of tires and even lubricator pumps and filters were operated by the same power. Throughout the exhibition it was evident that the ease of installation, compactness, operating safety, simplicity and convenience of the small motor were heartily appreciated, and in the manifold applications of this clean, reliable power the exhibition was full of special suggestion to the central station man, particularly if any kind of a "show" happened to be scheduled for the near future in his own town.

Digitized by Google

The Murray Type-Printing Telegraph.

In a paper describing his type-printing telegraph, which was read before the Institution of Electrical Engineers, of Great Britain, recently, the inventor, Mr. Donald Murray, discussed certain improvements which are thought to be of much importance.

The principle of the Murray type-printing telegraph is that of preparing, by means of a keyboard resembling that of a typewriter, a punched tape, which is then passed through an automatic transmitter. This reproduces at the receiving station a tape similarly punched, which is then passed through a recorder which prints the message in page form.

One of the improvements dwelt upon is the method by which corrections are made. Errors are eliminated without being recorded on the receiving tape. The following excerpt from Mr. Murray's paper describes the manner in which this is accomplished:

While describing the tape, an important point in regard to automatic printing telegraphs may be explained. So far as commercial telegrams are concerned, a serious objection to direct transmitting page-printing telegraphs is that errors show up badly in the printed message, and operators have to work slowly and carefully to avoid making mistakes. Telegraph operators are remarkably accurate, but, in spite of the best care and skill, errors are frequent. Any one who is accustomed to using a typewriter knows how difficult it is to write a page of typewritten matter without striking at least one or two wrong letters. In four cases out of five there is consciousness of the error as soon as it is made, and steps can be taken to correct it. In tape-printing telegraphs, like the Hughes and Baudot, the errors and the succeeding corrections can be cut out of the tape before it is pasted on to the telegraph blank, and there is then nothing to disfigure the telegram, and make the recipient uneasy about its accuracy. With a direct-transmitting page-printing telegraph this can not be done. A wrong key depressed is an error printed at the other end of the line, and the correction following only magnifies the blot. All automatic systems of telegraphic transmission in which there is preparation of the message beforehand, possess the potentiality of correcting an error before transmission. In the Wheatstone automatic system, for instance, this process is known as a "rub-out." When an operator at a Wheatstone puncher makes a mistake he can pull the tape back and punch it full of holes, thereby obliterating the mistake. In this case the mistake is represented by a series of dots on the received tape, and the transcribing clerk passes over it. In automatic telegraph systems, in which a printing machine takes the place of the receiving operator, it is a comparatively simple matter to arrange that the printer shall imitate the action of the operator by remaining inactive when dots only are coming over the line. In this way no trace of the error appears in the printed message. This, for instance, is done in the Buckingham system. In the Buckingham system, however, as with Morse, the groups of letter signals on the transmitting tape are of varying length. It is consequently not possible to pull back the transmitting tape letter by letter in the keyboard perforator. It has to be adjusted by hand, or pulled back unit by unit, a process necessarily involving some loss of time, and many corrections in this way would materially reduce the output of the operator. In the Buckingham system, also, it is necessary to rub out everything as far as the end of the previous line. Hence, to correct a single letter a whole line may have to be rubbed out. With automatic systems like the Murray, using an alphabet in which the letter signals are all of the same length, the transmitting tape, while being prepared in the keyboard perforator, can be pulled back instantly letter by letter by depressing a lever. If an operator strikes a wrong key, all he has to do to rectify his error is to strike the back-spacing lever, the letter-shift key, and the desired letter—the work of a moment. A word of six letters can be blotted out in this way in a few seconds, and no trace of the correction, not even a blank space, will appear in the printed message at the other end of the line. This relieves the operator from the dread of striking a wrong key, the strain on his attention is less, and he can work faster without working harder. One or two automatic type-setting patents have included schemes for correcting errors in the perforated tape; but, as far as I am aware, the Buckingham was the first printing telegraph to adopt a plan for invisible correction, and the Murray system was the first, and, so far, is the only system having the power to correct instantly single letters or words.

The correction is made by striking the letter-shift key (caps). This punches five holes in a letter space, and so blots out all other permutations which may have been previously punched. At the other end of the line this signal leaves the printer unaffected, its function being to shift the action of the printer from figures to letters. The signal may be repeated half a dozen times, so as to blot out a whole word, and there will be no trace of the error in the printed message.

Another improvement in the system is that by which the transmitting and receiving slips are made identical. In the new transmitter there is only one row of message holes in the tape. The signals depend on the relative positions of perforated and non-perforated units of tape. The tape and the transmitter together form the collector. The usual Wheatstone star-wheel feeds the tape forward by means of the central row of holes in the tape, rack-and-pinion fashion. In place of the two small upright rods, as used in the Wheatstone system for entering the holes in the tape, there is a single rod pivoted at one end of a horizontal thrust lever. This vertical lever is kept oscillating steadily by a small eccentric wheel. The result of the oscillations of this lever is to cause the horizontal thrust lever to operate also. The free end of this thrust lever is placed close to the two free ends of two converging thrust bars, which are pivoted one on each side of the pivot of an ordinary Wheatstone contact lever. These converging thrust levers are lightly pressed against a friction roller by two small steel springs. When the machine is in operation, a tape perforated with a message is being fed through in the ordinary Wheatstone manner, and the single small steel rod mentioned above reciprocates regularly against the paper. It makes one reciprocation for each unit of the tape. If there is a message hole in the tape, the tip of the rod enters the hole, and the complete motion of the rod is unobstructed. This permits the thrust lever to move as if it were one piece with the vertical lever, and the oscillation causes its free end to strike the free end of the lower thrust bar, throwing the contact lever over to one of the marking contacts. If the next oscillation of the small upright rod again enters a hole in the tape, the same action is repeated, but the contact lever being already against a marking contact and held there, no change is made in its position, and marking current continues to be sent out to the line. If a non-perforated unit of tape intervenes, the small rod is obstructed by the tape, and oscillation of the vertical lever causes the rod to depress its end of the other thrust lever. This throws the contact lever over, and thereby breaks the marking current, and throws spacing current into the line.

The method of securing unison is interesting and is thus described:

In the Murray system the question of unison is removed from the line to the tape. As with the Wheatstone recorder tape, it is a question of correctly dividing up the signals on the tape. With the five-unit alphabet each letter occupies five units, or one-half inch on the tape. Hence, to divide up the signals properly we have to start at the right unit and then measure five units at a time. The star-wheel does the measuring, and all that is necessary is to place the tape properly on the star-wheel. To enable this to be done with facility, each batch of messages begins with four or five space signals. The space signal is a perforation in the third-unit position. In the star-wheel every fifth tooth is omitted and the vacant tooth positions blackened. The tape is inserted in

Digitized by Google

the machine so that the space holes come opposite the missing teeth of the star-wheel, which show up black through every fifth central hole in the tape. The tape is then in unison. In the event of it not being in unison, it can be put in step by rotating a small unison arm. This bags up and advances the tape on the star-wheel to the extent of one unit. A maximum of four and an average of two revolutions of the unison arm brings the tape into step. The unison arm when not in use is held locked. The missing teeth in the star-wheel and the space signals show at a glance at the beginning of a message whether the tape is in step. If a line interruption causes the unison to fail in the middle of a message two or three revolutions of the unison arm by the attendant set all right again.

Telephones and Tallow Candle Methods.

The remark is often made in varied forms of expression until it becomes an unphrased adage, that the lay mind is the suggestive mind.

Those who are immersed in the operative details of any calling are apt to be blinded by their environment so as not to perceive possible short cuts or to initiate the development of new methods. It is not a premium on ignorance for a bystander to make a valuable suggestion, but it is the action of a mind unhampered by conventionalities of that subject.

In this connection, Frank J. Peaslee, superintendent of schools at Lynn, Mass., sententiously expressed in his annual report the functions of the telephone in this year of grace:

I believe that telephones should be provided for all of the larger school buildings. These to be connected with the office of the school department in City Hall, for the transmission of all kinds of information between the school officials and the schools, but not for the use of the general public. They would annihilate time and distance in the administration of school work and be of incalculable service and value to all parties for whom intended. Superintendent Southworth, of Somerville, said in his school report for 1902, "If I wish to communicate with a school in Chelsea, Malden, Everett, Revere, or almost any city about me I can do so from my office, but if I wish to communicate with one of my own schools I must spoil half a day to do so." The telephone is an instrument of modern business. Is there any other enterprise, involving any considerable fraction of the amount of money expended in this department, that is carried on without this modern instrument? No business man having charge of industries in a dozen different buildings, containing from three hundred to eight hundred persons each and located in all parts of the city, would for a moment depend solely upon going from one building to another for communication with those different buildings. Why should the schools of to-day be doing business after the method of the tallow-candle days?

SOME POINTS ON THE SELECTION OF ELECTRIC CABLES.[1]

BY L. B. ATKINSON AND C. J. BEAVER.

(*Concluded.*)

APPENDIX I.

GLOVER'S TEST FOR TINNED HIGH CONDUCTIVITY COPPER WIRE.

Samples—From the batch of wire to be tested true average samples are taken, the number of samples being proportioned to the total weight of the batch and to the gauge of the wire, for works purposes. Two classes of samples are taken:

(a) Samples from interior parts of coils or bundles, the results obtained from which may be taken to indicate the actual efficiency of the tinning.

(b) Samples from exterior parts of coils or bundles, to show to what general extent the efficiency of the tinning has been impaired by mechanical abrasion in transit or handling.

For consulting engineers or inspectors' purposes samples are taken from the strand before the cable is vulcanized.

Reagents—Hydrochloric acid of S. G. 1.088 (= forty-four per cent of acid of 1.2 S. G.)

Sodium sulphide solution of S. G. 1.142 (= about twenty-five grammes per 100 cubic centimetres of water.)

Testing Process—The samples are cleaned with alcohol or ether, and immersed for one minute in the hydrochloric acid. They are then rinsed in clear water, and immersed in the sodium sulphide solution for thirty seconds, again washed, and examined under a hand lens.

This cycle of operations is repeated until blackening of the wire becomes clearly visible. The number of such cycles required to produce this blackening effect is noted, and taken to represent the measure of efficiency of the tinning.

The tests are performed in duplicate.

The wires are bent into loops before immersion to avoid testing ends. The loops should not be bent to a smaller radius than twelve to fifteen times the diameter of the wire.

As a mechanical test for adhesion of the tinning to the wire, samples may be bent around a rod having a diameter equal to four times the diameter of the wire. Any cracking or parting of the coating will be plainly shown by one immersion, according to the test described above.

No wire should show blackening after the mechanical test on immersion for one minute in the sodium sulphide solution only.

The average values obtained from samples taken from any batch of wire should be as shown below:

Diameters of Wires. Inches.	Number of Immersions at 60° F.	
	Single-Tinned Wire.	Double-Tinned Wire.
From 0.0076 to 0.048 inclusive...	6	8
Above 0.048 to 0.080 "	5	7
" 0.080 all sizes.....	4	5½

NOTE—In practice a variation of one immersion from the average values tabulated above may be allowed if the batch of wire under test gives fairly uniform results If a wide variation between individual tests is observed, further samples may be taken, as it would obviously be unfair to allow an isolated defective sample to bring down the average value obtained on the samples. A little experience enables the operator to readily distinguish between defects due to imperfections in the tinning process and those due to subsequent mechanical damage.

APPENDIX II.

GENERAL SPECIFICATION FOR LIGHTING AND POWER CABLES FOR LOW-TENSION PRESSURES UP TO 500 VOLTS.

Lead-Covered Paper Insulated Cables—Conductors of plain copper, as per paragraph 1, insulated with Diatrine paper, as per paragraph 3, lead-covered, as per paragraph 5.

Vulcanized Rubber-Insulated Cables—Conductors as per paragraph 2, pure and vulcanized insulation, as per paragraph 4, taped and braided, as per paragraphs 7 and 8.

Leadless Paper Cables—Conductors as per paragraph 1, insulated with paper, as per paragraph 3, and sheathed with bitumen compound, as per paragraph 6, taped and braided or lapped, as per paragraphs 7 and 8.

Bitumen Cables—Conductors as per paragraphs 1 and 2, the outer layer of the strand being composed of tinned copper wires, insulated with bitumen compound, as per paragraph 6, finished with tapes and braids or lappings, as in the case of the leadless paper cables, as per paragraphs 7 and 8.

Fire-Resisting Cables—Conductors as per paragraph 2, pure and vulcanized rubber, as per paragraph 4, taped and braided as per paragraphs 7 and 9.

MATERIALS.

1. Conductors—Conductors of all wires and cables are to be of solid, well-annealed, high-conductivity copper, English drawn, the strands of cable to be of suitable lay, so as to produce a compact conductor. The conductivity of the copper to be not less than 100 per cent of pure copper, Matthiessen's standard. The resistances and weights of the various sizes to be as specified in the Cable Makers' Association circular, dated December 31, 1902.

2. Where cables are insulated with materials which will react with, or be acted upon by the copper, the wires are

[1] Abstract of paper read before the Institution of Electrical Engineers, of Great Britain, January 31, 1905.

Digitized by Google

to be uniformly and efficiently tinned. The tinning is to be free from lead or other impurities, and must conform to Glover's standard test for tinned high-conductivity copper wires. No joints in single wires are to be within twelve inches of one another.

3. Dielectric Paper—The paper to be composed of pure manila fibre. It is to be free from all metallic particles, carbon spots or foreign matter, and to show no trace of chlorine or other residual chemicals on analysis. It must be free from the slightest admixture of straw, wood or other ligneous fibres. The paper after drying to be impregnated with a high-class insulating compound at a temperature not exceeding 250 degrees Fahrenheit, and to be laid spirally upon the conductor in strips to required thickness in such a manner that the joints are efficiently staggered. The paper strip to be of uniform thickness throughout, not exceeding 0.006 inch before impregnation. The tensile strength of a standard strip fifteen millimetres wide, cut longitudinally from the paper before impregnation must not be less than ten kilogrammes, but it should be so highly impregnated that its strength is increased by fifteen per cent after impregnation. The insulating compound should be of such a character that it is solid at the ordinary working temperature, and should have no tendency to drain away from the cable. It should also be capable of allowing the cable to be sharply bent without any sign of cracking in the paper dielectric. The compound must have no deleterious effect on the copper, paper or lead.

4. Rubber—The conductors are to be covered, first, with a layer of pure unvulcanized fine Para rubber, containing not more than 2.25 per cent of rubber resin, and then with two layers of vulcanizing rubber compound to an approved thickness. The vulcanizing rubber compounds to consist of the finest hard Para rubber mixed with sulphur and mineral matter only. No rubber substitute or organic matter other than rubber is to be used. The proportion of hard fine Para rubber in the vulcanizing compound rubber, in the case of the 500-volt cables, is to be not less than forty per cent by weight. In the case of wire, or cables having a sectional area of less than 0.06 square inch, the rubber compound is to be applied longitudinally. Larger cables are to be spirally lapped to an approved thickness. The pure and compound rubbers to be vulcanized into a homogeneous mass after taping.

5. Lead Sheathing—The cable to be sheathed by a solid tube of the best pure English lead which shall not contain more than 0.5 per cent total impurities on analysis, and shall be free from pinholes, lead oxide and other manufacturing defects, and shall be made direct on the insulated core under strong hydraulic pressure, the lead being allowed to set before pressure is applied. The insulated core to be passed through a bath of compound immediately prior to its entering the lead press. The lead sheathing shall be of uniform thickness, and shall not show any signs of cracking after having been subjected to the bending tests hereafter specified.

6. Compound—To be of the vulcanized bitumen class of compound, containing not more than twenty per cent of mineral matter, to be of such consistency that it will not become decentralized at such temperatures as ordinarily obtained in practice. It must not become brittle at the freezing point of water. It must be so made that it is not really oxidizable, and that it will resist the action of weak acids and alkali. It is to be applied to the cable in the form of a solid tube free from pinholes and similar defects, so that the insulation resistance shall show no deterioration after the insulated cable is submitted to hydraulic pressure of 100 pounds per square inch for at least five minutes.

7. Tapes—Tapes for vulcanized rubber cables should be of fine cotton cloth, counting not less than seventy by seventy per square inch, thoroughly waterproofed on one side with rubber compound containing not less than thirty-five per cent of pure rubber. Tapes for leadless and bitumen type of cables to be of stout cotton cloth thoroughly impregnated with bituminous compound. For outer coverings Hessian tapes treated in a similar way before application to the cable may be used when required.

8. Braidings and Lappings—For rubber cables the braiding may be of jute or cotton, tanned or gray, as required; to be braided on the cable at a suitable lay, and with a sufficient number of ends to efficiently cover the cable. The braidings for main cables, whether rubber, leadless paper, or bitumen cables, should be of tanned jute. In all cases braids are to be efficiently impregnated with preservative compound. In the case of main cables, jute lappings may be used instead, or in conjunction with braidings, as above described; such lappings should be of tarred jute, containing not less than forty-five per cent of the best Stockholm tar. After application to the cable these lappings should be thoroughly impregnated with preservative compound.

9. Fire-Resisting Coverings—The fire-resisting coverings may consist of cotton tapes, jute, or cotton lappings, or braidings. The radial thickness of such coverings to be proportionate to the diameter of the cable and the radial thickness of the insulation. The tapes, braids, or lappings to be chemically treated prior to their application to the cable, with suitable fire-resisting compound, which shall have no deleterious effect on the fibrous material or the insulation of the cable, and shall be of a permanent character. During the taping, lapping, or braiding process the fire-resisting coverings to be further served with suitable fire-resisting compound, and finally served over all with special compound of a similar nature, to ensure a firm but flexible finish.

In special cases leadless or bitumen cables may be finished with fire-resisting coverings, as above described.

10. Armor—Where cables are to be laid direct in the ground or in situations where they may be exposed to mechanical injury, they should be armored with steel tapes of suitable widths and of thicknesses as specified in the Cable Makers' Association circular, dated December 31, 1902, and applied to the cable, so that the spaces between the convolutions of the first layer of steel tape are covered by the second tape. Joints in steel tapes are to be either brazed or welded, no other method being allowable. They are to be laid on a bed of tarred jute, served as described above, and covered with a double layer of jute in a similar manner. Where galvanized iron or steel wires are used as armor, the wires must closely sheath the cable and be applied over a bed of tarred jute lapped on in the opposite direction to the lay of the wires. The wire should be of suitable gauge, and composed of a good quality of steel, which should have a breaking strain of not less than twenty-five tons per square inch, and should be capable of being bent round its own diameter in reverse directions without fracture. The galvanizing must adhere firmly to the surface of the wire, and must not crack or scale off when the wire is bent round a cylinder twelve times its own diameter. The efficiency of the galvanizing must be such that no sign of a deposit of copper should be visible after three one-minute immersions in a saturated solution of copper sulphate at sixty degrees Fahrenheit.

11. Insulation Tests—All cables, as specified above, should be tested after twenty-four hours' immersion in water in the case of vulcanized rubber cables, and after five minutes' hydraulic test in a closed tank at 100 pounds per square inch in the case of the other types with a battery giving an electromotive force of not less than 500 volts. The insulation resistance must be taken after one minute's electrification, and such electrification must proceed steadily and uniformly. After the application of 2,500 volts for half an hour there should be no appreciable difference in the insulation resistance of the cables.

12. Mechanical Tests—A ten-foot length may be taken from any of the cables and bent three times in reverse directions round a drum having a diameter of not more than twelve times the diameter of the cable. The length when subsequently immersed in water, and tested with a gradually increasing voltage, should not break down under a pressure of 5,000 volts.

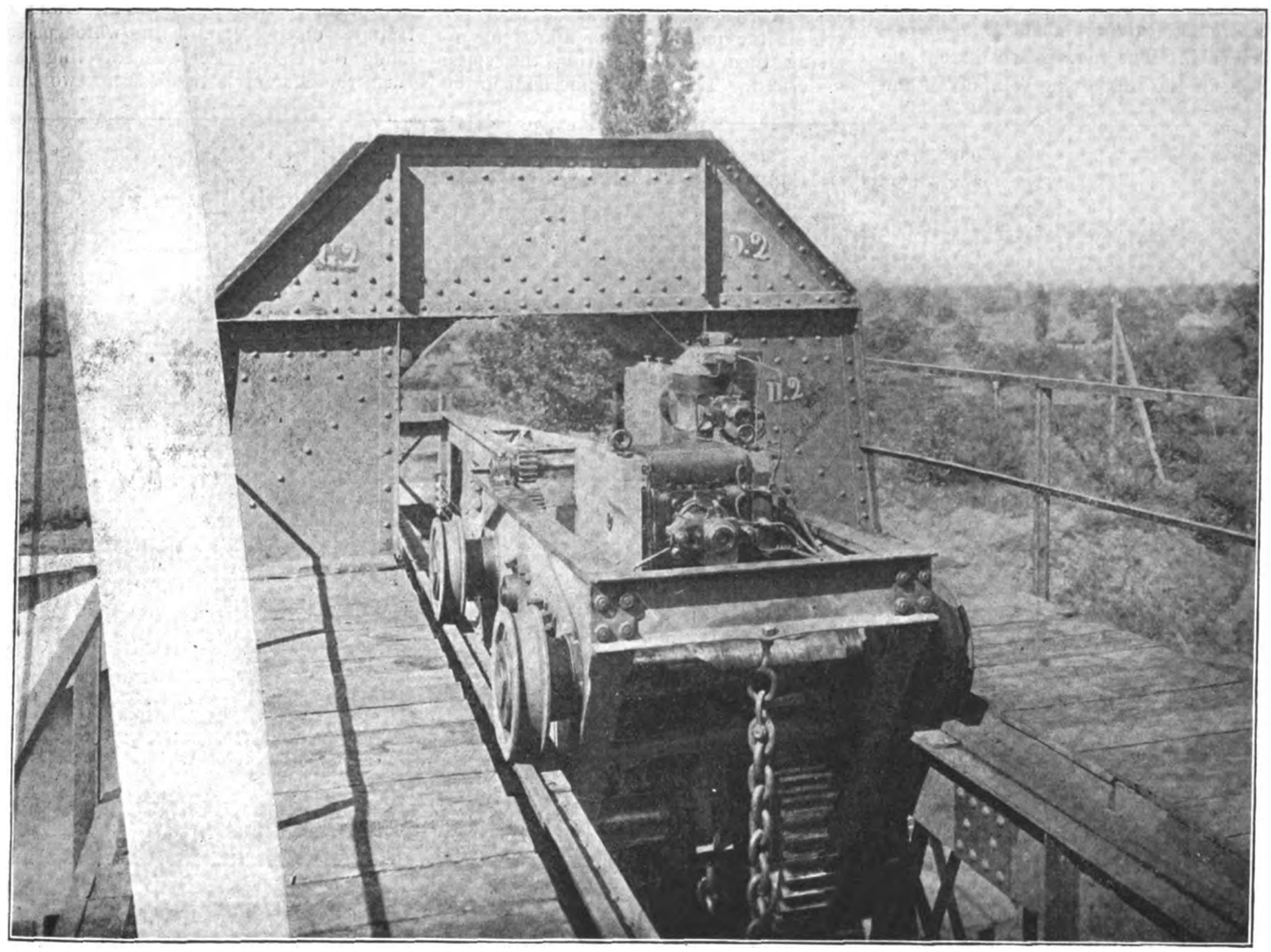
Digitized by Google

Electric Crane at the St. Triphon Quarries, Switzerland.

By C. L. Durand.

THE quarries of St. Triphon are situated in the valley of the Rhone at about one-half mile from the railroad station of St. Triphon, near Lake Leman, Switzerland. It has not been very long ago since the operations of taking the marble from the quarries, forming it into blocks of given dimensions, and transporting it to the nearest railroad station were carried out in a very primitive fashion, giving rise to manœuvres which were long and dangerous and presenting great difficulties. In this way the yield which was obtained from the quarries within a given time was relatively small compared with what is produced at present, owing to the use of improved machines which are employed in all parts of the quarries. The different operations are now carried out with great ease and at a high rate of speed.

The method of cutting the blocks deserves mention, in the first place. The blocks are sawed by means of a cutting cable which is formed of three hard steel wires of 2 or 2.5 millimetres diameter, twisted together to form a strand. This cable is given a movement at the rate of two metres per second at the maximum. The cable is endless, and runs upon a set of jointed pulleys which allow it to take any desired direction and to descend progressively as the cutting advances. A stream of fine silicious sand and water is brought upon the wire to allow it to cut the marble to the best advantage.



THE CAB OF THE ELECTRIC CRANE AT THE MARBLE QUARRIES, ST. TRIPHON, SWITZERLAND.

The most noteworthy feature of the St. Triphon quarries is the new electric lifting and conveying apparatus, which is the only one in Switzerland at the present time. Some analogous apparatus are now in the largest marble quarries of Belgium. The engraving gives an idea of the apparatus. It travels upon a short track which is laid on either side. The distance between the tracks is thirty metres and each track is formed of two rails placed near together and solidly fixed upon cross-ties. The crane is supported upon rollers of cast steel, of which there are two per pillar, and these allow the great crane to move along without an undue amount of friction. Each of the two pillars is built of iron construction which spreads out at the bottom and becomes narrower at the top. It thus gives passage to the traveling carriage and the load. The whole construction is formed of a light ironwork which is very solid and capable of carrying a heavy load. The crane will lift and carry loads reaching as high as forty tons. The total length of the main bridge of the crane is 47.4 metres. The rails carrying the car are 10.8 metres above ground, while the pillars rise 2.5 metres above this level. There is a distance of 8.2 metres between the ground and the main bridge which allows for the largest loads. The maximum load reaches thirty to forty tons. The heaviest pressure upon the track is obtained when the load arrives at the outer end of the

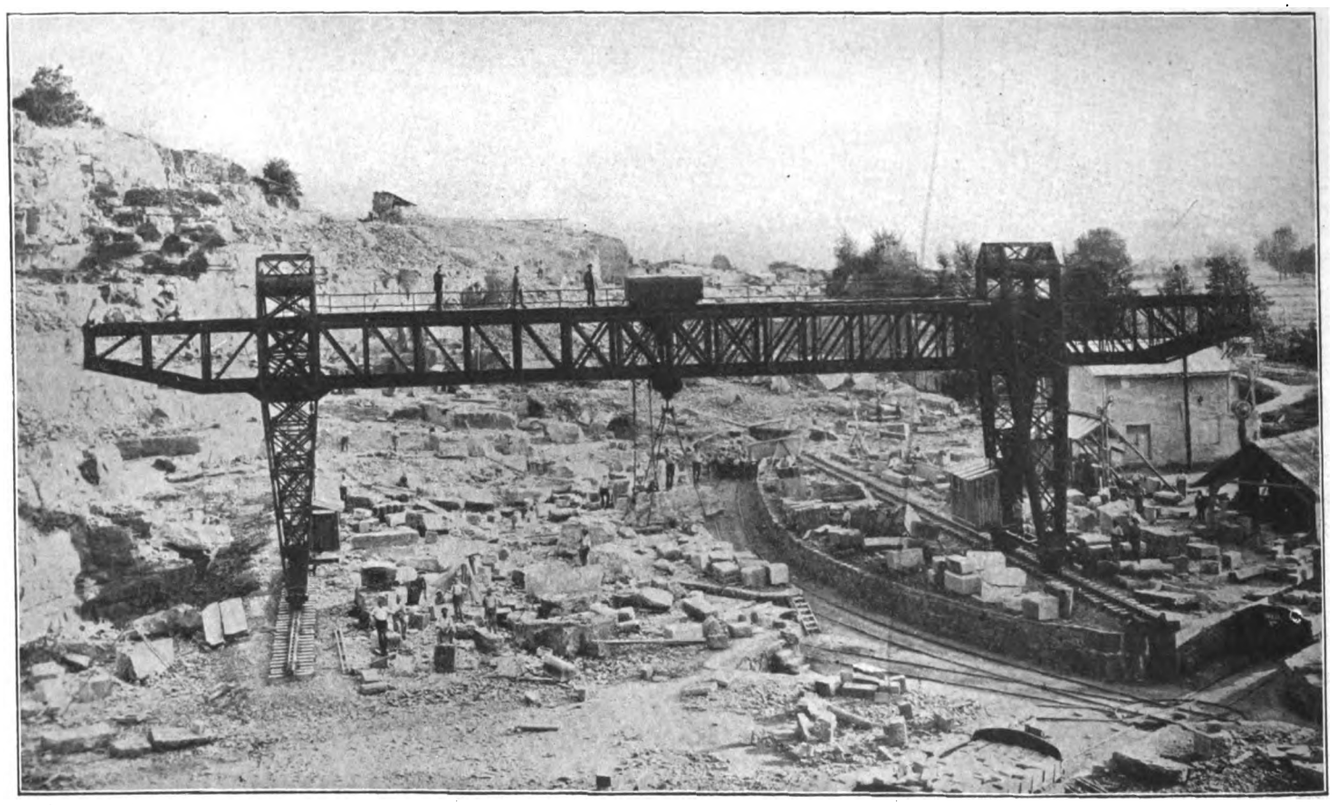
Digitized by Google

overhanging part (9.8 metres from the pillar) and here the two rollers of the pillar have to transmit an effort of eighty-eight tons upon the rail, seeing that the weight of the load is to be added to the weight of the crane, which represents ninety tons.

The traveling carriage is shown in one of the engravings. It is operated by electric motors, for the lifting and the side movement of the carriage. The whole operation of the crane is obtained by four motors which are placed upon a 110-volt direct-current circuit, and are distributed as follows: the movement of the crane upon the track is carried out by two motors of the Thury M5 type, series-wound, giving about 7.5 horse-power each. The motors are placed one in each of the supporting columns of the main bridge by a series-wound motor of the Thury type, giving five horse-power. It gives the movement to the carriage by means of an endless screw working in oil and a gearing transmission. The motor works at a speed of 1,350 revolutions per minute, which is reduced to twenty-two revolutions by the screw and a wheel of sixty teeth. The load is lifted by a compound-wound motor of fourteen horse-power which is mounted on the car as will be observed in the foreground. This motor operates at 900 revolutions per minute, which is reduced to 15.5 revolutions by an endless screw. The control of the three movements of the crane is carried out from a cabin which is placed in one of the supports at the side. A rheostat controller is used for each of the motors which allows of reversing them and regulating the speed as desired. The lifting mechanism on the carriage is provided with a powerful brake which is easy to regulate.

In spite of the great weight of the mass, the crane, when it is once started, can work with a relatively small current, twenty-two to twenty-five amperes at 110 volts, which figures from 3 to 3.5 horse-power. With a total consumption of fifteen to twenty horse-power, the speeds of the different manœuvres gave the following figures during the first period of operation: lifting of the load, 0.75 metre per minute; running of the car upon the bridge, 6.70 metres; speed of the crane on its track, 8.55 metres per minute. It will be seen by these figures that the speed of carrying out the manœuvre was already very high, but more recently these figures have been nearly doubled for the last two movements. As to the lifting of the load, in case where only small blocks are to be raised, this movement can now be carried out with a speed four times as high as before, owing to a different arrangement of the chain.

The current which is required for the motors is furnished by a thirty-horse-power 110-volt generator. The latter is driven from a motor of the same capacity, placed on the circuit which comes from the hydraulic transmission plant of Grande Eau. This plant uses the Thury system of constant-current series, working at fifty amperes, carried out by the Compagnie l'Industrie Électrique. Current is brought to the motors on the crane by trolleys running upon a line which passes along the track. For the traveling carriage the current is taken from two lines placed along the bridge by a set of rubbing contacts.



THE ELECTRIC CRANE AT THE MARBLE QUARRIES, ST. TRIPHON, SWITZERLAND.

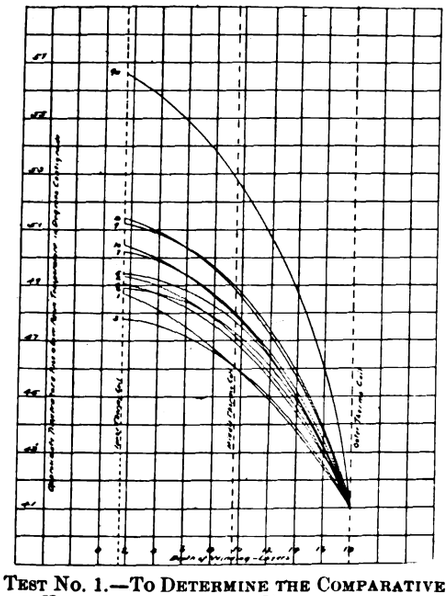
In order to transport the blocks from the quarry to the railroad station of St. Triphon in the most practical manner, a small electric line has been installed. It uses a locomotive which carries two Thury motors of fifteen horse-power each, working at 110 volts. The locomotive can draw two or three loaded cars, and thus gives a very efficient method of hauling. Current is brought to the locomotive by a trolley, with rail return, but in the quarry itself a line is run a few inches from the ground, so as not to interfere with the operations, and the current is taken by contact arms on the locomotive.

Digitized by Google

TESTS TO DETERMINE THE COMPARATIVE HEAT CONDUCTION AND RADIATION OF INSULATING VARNISHES.

BY JOHN C. DOLPH.

The necessity of providing liquid insulation for cotton covering of copper wire in coils has long been recognized. Whether the use of varnishes or compounds is really necessary, other than as a means of protection against moisture, especially in low-voltage work, has been open for discussion. The knowledge that some sort of liquid insulation is required has been gained from actual experience in shop practice where it has been found that coils impregnated with a varnish or compound outlasted coils which had been wound up dry, and only the outside layers of which were protected against moisture. This

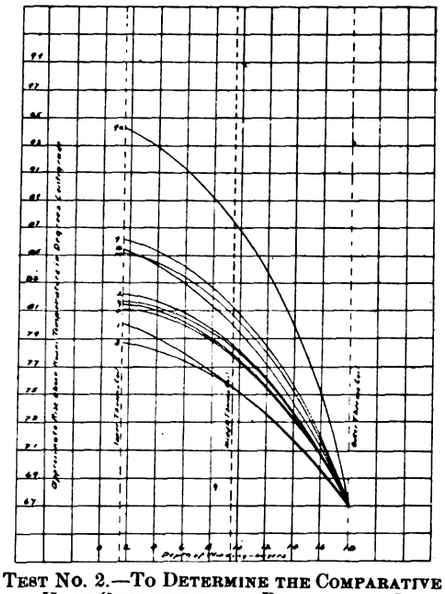


TEST NO. 1.—TO DETERMINE THE COMPARATIVE HEAT CONDUCTION AND RADIATION OF INSULATING VARNISHES.

was found to be especially true of coils containing a great depth of wire.

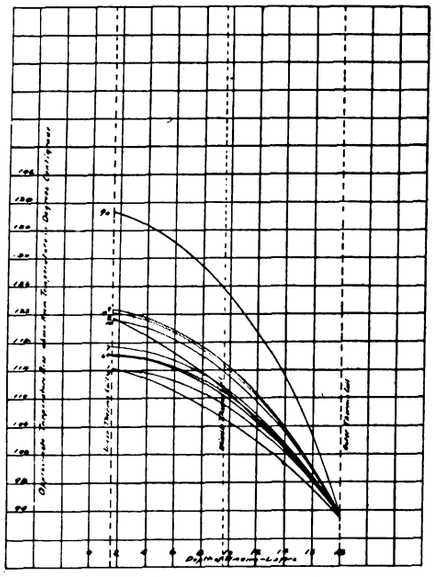
Early in 1903 the writer was impressed with the idea that the life of the coils could be greatly lengthened by increasing the natural tendency of insulating varnishes to dissipate heat either by radiation or conduction, or both. All experience up to this time had clearly demonstrated that ordinary insulating varnish was a very poor conductor of heat, and it was taken for granted that any improvement in this direction would carry with it the introduction into the varnish of material which would have a tendency to lower to the danger point the dielectric strength of the varnish coating.

With these conditions in mind the writer began a series of experiments with varnishes and compounds with the idea of treating them in such a manner as to produce a compound which would constitute an improvement over anything then in use in its ability to conduct and dissipate by radiation the heat generated in the insulation of the windings of high-potential alternating-current apparatus.



TEST NO. 2.—TO DETERMINE THE COMPARATIVE HEAT CONDUCTION AND RADIATION OF INSULATING VARNISHES.

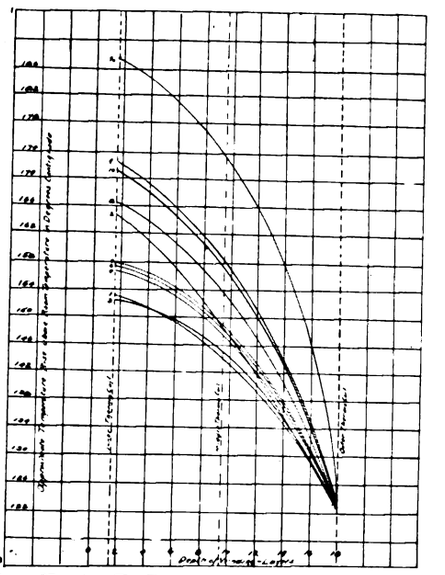
These experiments led to electrical tests to determine whether or not any advantage had been gained by the treatment mentioned. This preliminary test was carried out by taking standard arc lamp spools and running the wire with which they



TEST NO. 3.—TO DETERMINE THE COMPARATIVE HEAT CONDUCTION AND RADIATION OF INSULATING VARNISHES.

were wound through the varnish to be tested. Current was then put through the spools until a temperature of approximately 160 degrees centigrade had been reached, which was determined by thermometers placed inside and outside of the spools, so that readings could always be seen of the temperatures inside and outside the coils, and comparisons made at a glance.

While the above test was not satisfactory, owing to the uncertainty of temperature readings, it demonstrated clearly that there existed a great difference between the temperature of coils insulated with the varnish specially treated for heat radiation and conduction and the ordinary insulating varnish. The next step was to determine accurately this difference, and with that end in view the writer took up the matter with Dr. Sharp of the Electrical Testing Laboratories. After consultation it was decided that the following would be a good method to determine the combined heat radiation and conduction of various varnishes.



TEST NO. 4.—TO DETERMINE THE COMPARATIVE HEAT CONDUCTION AND RADIATION OF INSULATING VARNISHES.

A number of tin cans were provided, on the outside of each of which a layer of cloth was tightly fastened, the cloth then being painted with three coats of the varnish to be tested. Dry steam having ten degrees centigrade of superheat was then passed through each can in turn and by a series of experiments the amount of steam condensed per minute was determined. At the same time a thermopile set up at a given distance from the can was used to determine the relative radiating powers of the surfaces which were afterward expressed in the terms of galvanometer deflections. An uncovered tin can, as well as a can covered with soot, was provided for the purpose of comparison. These tests established beyond any question the marked superiority in point of combined heat radiation and conduction of the specially treated varnishes over the

Digitized by Google

ordinary insulating varnishes. During these tests a peculiar condition developed as regards one of the clear oleoresinous base varnishes under test. While this varnish was naturally a poor radiator of heat, owing to the nature of its surface, it proved to have got rid of a larger proportion of heat than any of the other varnishes tested with the exception of that treated specially for heat radiation and conduction. Inasmuch as this oleoresinous base varnish possessed good insulating properties, it occurred to the writer that varnishes of this description, in view of this important characteristic, were the ones which would eventually give the best results, provided they could be so treated as to develop the necessary heat radiation and conduction without the sacrifice of their high insulating properties.

RESULT OF TEST NO. 1.

Spool Number.	Thermo. Coil.	Resistance in Ohms. Initial.	Final.	Increase.	Increase of Temperature Degrees C.	Difference in Temperature, I. = O. Coil. Degrees.
1	Inner	107.10	129.50	22.40	52.3	
	Middle	116.60	139.80	23.20	49.7	
	Outer	98.30	115.85	17.55	44.6	7.7
2	Inner	109.05	132.35	23.30	53.4	
	Middle	117.25	141.40	24.15	51.3	
	Outer	101.70	120.00	18.30	45.1	8.3
3	Inner	112.75	135.70	22.95	51.0	
	Middle	119.85	143.50	23.65	49.3	
	Outer	75.50	206.60	31.10	44.2	6.8
4	Inner	112.65	136.10	23.45	52.2	
	Middle	120.70	144.90	24.20	50.2	
	Outer	174.95	205.90	30.95	44.2	8.0
5	Inner	109.10	130.60	21.50	49.4	
	Middle	118.50	141.10	22.60	47.7	
	Outer	16.07	18.71	2.64	41.0	8.4
6	Inner	108.30	131.50	23.20	53.5	
	Middle	116.45	140.60	24.15	51.9	
	Outer	101.55	120.10	18.55	45.6	7.9
7	Inner	109.20	132.70	23.50	53.8	
	Middle	118.60	143.10	24.50	51.6	
	Outer	*102.40	120.70	18.30	44.6	9.2
8	Inner	106.95	131.10	24.15	56.4	
	Middle	117.00	142.20	25.20	56.5	
	Outer	105.15	124.60	19.45	46.2	10.3
9	Inner	109.75	134.00	24.25	55.2	
	Middle	115.95	140.50	24.55	52.9	
	Outer	102.00	120.40	18.40	45.0	10.2
9a	Inner	110.50	138.70	28.20	63.8	
	Middle	119.80	148.60	28.80	60.0	
	Outer	99.50	118.70	19.20	48.2	15.6
10	Inner	108.00	131.60	23.60	54.6	
	Middle	119.30	144.20	24.90	52.1	
	Outer	104.10	122.90	18.80	45.2	9.4

*This thermometric coil was found during the test to have one of the wires partially broken, consequently the initial resistance is somewhat uncertain. The outer thermometric coil on the impregnated coil, No. 5, was found to be open-circuited. Some other wire was wound on, but not of sufficient size to give the same resistance as the original. It was put on, however, with the idea that it would be better than nothing. The insulating compound in the impregnated spool, No. 5, began to run pretty badly at these temperatures. (At ordinary temperature the material is rather sticky to the touch, but does not begin to flow until it reaches a temperature of forty degrees to fifty degrees centigrade.)

RESULT OF TEST NO. 2.

Spool Number.	Thermo. Coil.	Resistance in Ohms. Initial.	Final.	Increase.	Increase of Temperature Degrees C.	Difference in Temperature, I. = O. Coil. Degrees.
1	Inner	107.65	142.70	35.05	81.5	
	Middle	117.15	153.30	36.15	77.1	
	Outer	98.75	125.80	27.05	68.5	13.0
2	Inner	108.75	145.10	36.35	83.6	
	Middle	117.80	155.50	37.70	80.0	
	Outer	102.20	130.20	28.00	68.4	15.2
3	Inner	113.35	149.30	35.95	79.3	
	Middle	120.50	157.15	36.65	76.0	
	Outer	176.40	224.05	47.65	67.6	11.7
4	Inner	113.20	150.20	37.00	81.7	
	Middle	121.30	159.30	38.00	78.3	
	Outer	175.80	223.30	47.50	67.6	14.1
6	Inner	108.90	145.40	36.50	83.8	
	Middle	117.10	154.80	37.70	80.5	
	Outer	102.10	130.30	28.20	69.1	14.7
7	Inner	109.85	146.30	36.45	83.1	
	Middle	119.25	157.20	37.95	79.5	
	Outer	102.90	131.10	28.20	68.6	14.5
8	Inner	107.60	146.30	38.70	89.9	
	Middle	117.70	157.90	40.20	85.4	
	Outer	105.70	135.90	30.20	71.5	18.4
9	Inner	110.40	149.60	39.20	88.8	
	Middle	116.70	155.90	39.20	84.0	
	Outer	102.70	131.30	28.60	69.7	19.1
9a	Inner	111.20	156.70	45.50	102.2	
	Middle	120.50	166.50	46.00	95.5	
	Outer	100.10	130.10	30.00	75.0	27.3
10	Inner	108.70	146.80	38.10	87.7	
	Middle	120.00	159.90	39.90	83.2	
	Outer	104.70	133.80	29.10	69.5	18.2

It was then determined to ascertain by electrical means, the relative combined heat conducting and radiating properties of various oleoresinous and hydrocarbon base varnishes. There were provided eleven spools, approximately six inches in length and three inches in diameter. These spools were wound with No. 18 double cotton-covered wire, eighteen layers and 108 turns to the layer, making a total of 1,944 turns. In these coils were wound thermometric coils, the outside of No. 38 silk-covered wire with two turns per space, making a total of 214 turns, a middle thermometric coil of No. 40 silk-covered wire, two turns per space, with a total of 214 turns, and an inner thermometric coil of No. 40 silk-covered wire, three turns per space, making a total of 321 turns. These coils were wound on a split form so that they could be handled without the addition of insulation other than that provided by the covering of the wire and the varnish used on the coil. The wire in all cases was run through the varnish to be tested as the wire was wound on the coil. The inner thermometric coil was wound on the first layer of No. 18 wire, as of course it was not possible to wind it on the outside of the first layer.

The spools were numbered from 1 to 10, inclusive, and were treated with varnishes and compounds as follows:

No. 1 Spool—Clear, quick baking, dipping varnish of an oil and gum-base variety.

No. 2 Spool—Clear, baking, dipping varnish of an oil and gum-base variety.

No. 3 Spool—Heat-radiating varnish, brown, dipping baking, of a combined oleoresinous variety, specially treated for heat radiation and conduction.

No. 4 Spool—Black, dipping varnish of an oil and hydrocarbon base variety.

No. 5 Spool—Black, solid compound of bituminous variety, liquefied under heat and used only in connection with vacuum impregnation apparatus.

No. 6 Spool—Black, brushing varnish of a combined oil and hydrocarbon base, treated for heat radiation and conduction.

No. 7 Spool—Clear, baking, dipping varnish of an oleoresinous variety.

No. 8 Spool—Black, air-drying and

Digitized by Google

RESULT OF TEST NO. 3.

Spool Number.	Thermo. Coil.	Resistance in Ohms. Initial.	Final.	Increase.	Increase of Temperature Degrees C.	Difference in Temperature, I. = O. Coil. Degrees.
1	Inner	108.70	158.80	50.10	115.3	
	Middle	118.40	169.80	51.40	108.4	
	Outer	99.75	137.30	37.55	94.2	21.1
2	Inner	109.85	164.20	54.35	123.6	
	Middle	119.00	173.00	54.00	113.4	
	Outer	103.30	142.70	39.40	95.3	28.3
3	Inner	114.50	166.90	52.40	114.5	
	Middle	121.70	175.00	53.30	109.7	
	Outer	178.20	245.00	66.80	93.6	20.9
4	Inner	114.35	167.80	53.45	116.8	
	Middle	122.50	176.90	54.40	111.0	
	Outer	177.50	244.00	66.50	93.7	23.1
6	Inner	110.00	163.10	53.10	120.7	
	Middle	118.20	172.70	54.50	115.2	
	Outer	103.00	143.20	40.20	97.6	23.1
7	Inner	110.90	164.00	53.10	119.8	
	Middle	120.40	175.20	54.80	113.8	
	Outer	104.10	143.90	39.80	95.5	24.3
8	Inner	108.60	165.70	57.10	131.3	
	Middle	118.80	177.70	58.90	123.8	
	Outer	106.60	150.20	43.60	102.2	29.1
9	Inner	111.30	168.60	57.30	128.7	
	Middle	117.70	174.70	57.00	121.2	
	Outer	103.50	144.50	41.00	99.1	29.6
9a	Inner	112.00	179.30	67.30	150.0	
	Middle	121.60	189.20	67.60	139.0	
	Outer	100.90	143.80	42.90	106.4	43.6
10	Inner	109.60	165.50	55.90	127.6	
	Middle	121.05	179.40	58.35	120.4	
	Outer	105.60	147.70	42.10	99.6	28.0

RESULT OF TEST NO. 4.

Spool Number.	Thermo Coil.	Resistance in Ohms. Initial.	Final.	Increase.	Increase of Temperature Degrees C.	Difference in Temperature, I. = O. Coil. Degrees.
1	Inner	108.50	175.40	66.90	154.0	
	Middle	118.00	186.40	68.40	145.0	
	Outer	99.50	148.50	49.00	123.2	30.8
2	Inner	111.40	186.10	74.70	167.5	
	Middle	118.80	190.40	71.60	150.8	
	Outer	103.00	154.40	51.40	124.9	42.6
3	Inner	114.30	184.30	70.00	152.9	
	Middle	121.50	192.20	70.70	145.4	
	Outer	177.90	265.20	87.30	122.7	30.2
4	Inner	114.10	185.80	71.70	157.1	
	Middle	122.30	194.70	72.40	147.9	
	Outer	177.30	264.30	87.00	122.6	34.5
6	Inner	109.80	180.60	70.80	161.2	
	Middle	118.10	190.00	71.90	152.2	
	Outer	103.00	154.90	51.90	126.1	35.1
7	Inner	110.70	180.80	70.10	158.3	
	Middle	120.20	192.00	71.80	149.2	
	Outer	104.70	156.00	51.30	122.7	35.6
8	Inner	108.55	186.60	78.05	179.7	
	Middle	118.80	198.10	79.30	166.8	
	Outer	106.60	164.30	57.70	135.3	44.4
9	Inner	111.40	194.00	82.60	185.2	
	Middle	118.30	199.20	80.90	170.9	
	Outer	103.55	159.50	55.95	135.0	50.2
9a	Inner	111.90	.....	....	....	
	Middle	121.60	.....	....	....	
	Outer	100.90	.....	....	....	....
10	Inner	109.70	190.10	80.40	183.5	
	Middle	121.10	203.20	82.10	169.5	
	Outer	105.65	162.50	56.85	134.6	48.9

During this test spool 9a began to char badly and the readings became erratic, showing that the thermometric coils were becoming disintegrated. This coil, however, was the only one to show any serious effect. Spool No. 5 was omitted in the last three tests on account of the melting of the insulating compound with which it was impregnated. Spool No. 9a having given out, relative order shown in the following summary was obtained by taking the proportional relations based on spool No. 6, which gave very consistent results throughout.

SUMMARY OF TESTS NOS. 1, 2, 3 AND 4.

Spool Number.	Test No. 1. Ratio.	Relative Order.	Test No. 2. Ratio.	Relative Order.	Test No 3. Ratio.	Relative Order.	Test No. 4. Ratio.	Relative Order.
1	0.494	2	0.466	2	0.844	2	0.465	2
2	0.532	5	0.545	6	0.651	7	0.643	6
3	0.437	1	0.419	1	0.479	1	0.456	1
4	0.510	3	0.506	3	0.530	3	0.522	3
6	0.513	4	0.527	5	0.530	4	0.530	4
7	0.590	6	0.520	4	0.568	5	0.538	5
8	0.661	9	0.581	7	0.670	8	0.663	7
9	0.654	8	0.685	9	0.688	9	0.759	9
9a	1.000	10	1.000	10	1.000	10	1.000	10
10	0.603	7	0.653	8	0.643	6	0.739	8

baking, dipping varnish of one of the hydrocarbon group.

No. 9 Spool—Black, air-drying and baking dipping varnish of a second of the hydro-carbon group.

No. 9a Spool—Untreated coil of No. 18 double cotton-covered copper wire, wound up dry.

No. 10 Spool—Grey, brushing, baking varnish of an oleoresinous variety, treated for heat radiation and conduction.

The varnishes on spools Nos. 1, 2, 3, 4 and 6 were manufactured by the Standard Varnish Works. The varnish used on other spools were those supplied in the market in the United States and Europe for insulating purposes.

It was proposed to obtain the information desired by two similar methods.

1. Heating the spools by passing a constant current through them and getting the temperature at the inner, the outer and middle surfaces by means of the fine wire thermometric coils. (The spool showing the greatest difference between extremes would be the one from which the heat escaped most slowly.)

2. Heating the coils by passing a known constant current through them, and measuring the average rise in temperature of the spool by its increase in resistance. Under the circumstances the spool that became the hottest would be the poorest dissipator of heat.

A number of tests were made, but in the first series the current used was not sufficient to cause a temperature rise in the spools above sixty degrees centigrade. In the last series of tests made, as shown by the curves, sufficient current was used to carry the temperature up to, and in some cases above, that which is met with in the commercial operation of dynamos and motors in service.

The temperature rises were computed from a temperature coefficient of copper assumed to be 0.00383. This is based on the latest value at 0 degrees centigrade, approved by the American Institute of Electrical Engineers (*viz.*, 0.0042), and corresponds to twenty-three degrees centigrade, the general average room temperature throughout the above tests. However, the exact value of the coefficient is unimportant as only comparative results could be expected.

In the last test referred to the spools were all connected in series and set on end on a table in a circle, with about twelve inches of air space between spools. The air spaces in the middle of the coils were corked up at the tops, forcing nearly all of the heat to escape from the outer sur-

Digitized by Google

faces. The two ends of each thermometric coil were then so arranged that they could be readily connected to a Wheatstone bridge. Arrangements were provided for getting the potential across each spool rapidly at stated intervals. The observations were made as follows: first—the resistance of each thermometric coil was measured on a Wheatstone bridge; second—a known current was sent through the main coils and the fall of potential through each was noted every fifteen minutes for about three and one-half hours or until the drop became constant; third—when the temperature became constant, as indicated by the constancy of the drop, the resistance of the thermometric coils was again measured. (Precautions were taken to have the external radiation conditions the same for all spools and to avoid air draughts.)

The accompanying tabulations give the data and derived results, and the curves herewith show the temperature rise throughout the eleven treated coils and the comparative rise in the untreated coil, No. 9a.

On the diagrams it will be observed that the curves have been shifted up or down, as required, to bring the temperatures at the outside to the same point for all spools. This procedure spreads the curves out more and renders the difference between them more noticeable to the eye.

It should be borne in mind that the above results are affected by both the heat radiating and heat conducting properties of the compounds, hence the relative order obtained can not be said to be due to either alone, but to the combined effects of both.

The spool No. 3 while showing among the best, is treated with a clear dipping baking varnish which has high power of penetration, and whose insulating properties have not been affected by its special treatment for heat radiation and conduction, as will be observed by the table below, which gives the puncture test of the varnishes used on the spools in the test for heat radiation and conduction:

Spool Number.	
1	798 volts per mil.
2	783 " "
3	826 " "
4	703 " "
5	No test made.
6	917 volts per mil.
7	811 " "
8	765 " "
9	890 " "
10	83 " "

The results of the tests for heat radiation and conduction show conclusively the superiority in this respect of coils treated with insulating varnishes or compounds over the untreated coil wound up dry.

With the exception of the first test, the tests above set forth were made under the writer's direction by the Electrical Testing Laboratories, and the data presented herein are taken from their reports. He wishes to express his thanks for the aid and advice given by Dr. Sharp, Mr. Howell and Mr. Farmer of this company, in arranging and carrying out these tests.

National Electrical Conference on Standard Electrical Rules.

The national conference on standard electrical rules composed of delegates representing all interests devoted to the subject whether from the standpoint of manufacturers or operators of electric plants and also including those from the technical associations of the underwriters will hold a meeting at Boston, Mass., on Friday, April 21.

The sessions will be held at 55 Kilby street, room 36.

It is stated that the principal object of the meeting is to consider the matter of the relations of the conference to the National Electric Code, which is the result of the meeting of this conference held at New York on March 18 and 19, 1896, and which has been amended and enlarged at meetings of the Underwriters' National Electric Association until it has about doubled in size.

It is understood that these matters will be thoroughly considered at this meeting, and doubtless the questions will be settled upon a definite basis, satisfactory to all interests.

Dallas, Tex.

The telegraph and telephone business at Dallas, Tex., is the largest in the Southwest. More telephones are used in Dallas than in any other city of its size in the world, 7,500 instruments now being in use. The local business is handled through a main exchange and two branches, Dallas being the only city in the Southwest where it is necessary to have branch exchanges. The telegraph and telephone companies have their headquarters for the Southwest in Dallas. The city has seven steam railways, leading in thirteen different directions, and an interurban electric railway extending westward thirty-two miles. In 1904 the steam lines delivered at Dallas 834,479 tons of freight, and took out 393,756 tons. The long-distance telephone line recently completed between Kansas City and Dallas, passing through Indian Territory and Oklahoma Territory, is in fine condition. The report is that conversation over this line is of the highest possible degree of excellence.

The Animas Canal, Reservoir, Water, Power and Investment Company.

The Animas Canal, Reservoir, Water, Power and Investment Company, of Durango, Col., is installing a hydroelectric plant of considerable importance twenty miles from Durango, at a point affording an effective head of 970 feet. This head is available through 2,800 feet of pipe. The initial installation will consist of two 2,250-kilowatt General Electric generators, direct-connected to Pelton waterwheels. Provision has been made in the dam and headworks for an ultimate development of 30,000 horse-power. The present pipe line is of sheet steel, varying in diameter from forty-four inches at the upper end to thirty-four inches at the wheels. The thickness varies from three-sixteenths of an inch to eleven-sixteenths of an inch. The pipe is all double butt-strap riveted, with triple riveting at the lower end, and is provided with flanged connections. In this way an exceedingly heavy and substantial pipe construction is ensured. The waterwheel units—two in number—are of double overhung construction, each unit consisting of two turbine wheels, one overhanging each end of the main shaft, with the engine-type generator in the centre. Needle nozzles are used. These are operated by oil-pressure automatic governors, and ensure accurate regulation and economy of water at all stages of load. The wheels are approximately eight feet in diameter, with centres of cast steel, turned all over, and fitted with Pelton buckets straddling the periphery, and secured to the frame by means of turned steel bolts driven in reamed holes. The buckets are fine ground and machined inside to obtain the highest possible efficiency. Each wheel unit will have a maximum capacity of 4,000 horse-power, to provide for an overload on the generator.

The complete hydraulic plant, including pipe line and water-wheels, was manufactured by the Pelton Water Wheel Company, San Francisco, Cal., and the electrical equipment by the General Electric Company, Schenectady, N. Y. Mr. F. O. Blackwell, 49 Wall street, New York city, was retained as consulting engineer for the company.

Special Railroad Rate for National Electric Light Association Convention.

A number of enquiries are being made regarding hotel accommodations at the twenty-eighth convention of the National Electric Light Association, to be held at Denver and Colorado Springs, Col., June 6 to June 11. These enquiries should be addressed to the Committee on Hotel Accommodations, 405 Seventeenth street, Denver, Col. The personnel of the committee includes W. J. Barker, chairman; J. Hernan, J. J. Cooper, J. F. Vail, S. W. Cantril, H. L. Woolfenden, Philip Cross and J. C. Andrews, secretary.

The Western Passenger Association has named a rate of one fare plus fifty cents for the round trip from all points in its territory to Denver and Colorado Springs. This rate will apply only where a single fare is twelve dollars or more.

Digitized by Google

Annual Report of the American Telephone and Telegraph Company.

The annual report of the directors of the American Telephone and Telegraph Company to the stockholders for the year ending December 31, 1904, has been published. The following extracts from the report of President Frederick P. Fish shows the physical and financial status of the company. A curve is given showing the increase in number of subscribers' stations connected to the system of the Bell telephone companies from January 1, 1876, to January 1, 1905.

The results of the business for the year 1904 were as follows:

Gross Revenue	$18,546,659.21
Expenses, Including Interest and Taxes	7,270,957.46
Net Revenue	11,275,701.75
Dividends Paid	9,799,117.50
Carried to Reserve	586,149.20
Carried to Surplus	890,435.05

The following were the corresponding figures for the year 1903:

Gross Revenue	$16,545,632.39
Expenses, Including Interest and Taxes	5,980,967.30
Net Revenue	10,564,665.09
Dividends Paid	8,619,150.75
Carried to Reserve	728,139.97
Carried to Surplus	1,217,374.37

"The total mileage of wire for exchange and toll service was 4,671,038 miles, of which 712,147 miles were added during the year.

"Including the traffic over the long-distance lines the daily average of toll connections was about 301,000, and of exchange connections about 11,149,000, as against corresponding figures in 1903 of 258,000 and 9,876,000; the total daily average for 1904 of connections both toll and exchange reaching 11,450,000, or at the rate of about 3,687,000,000 per year.

"The total amount added to construction and real estate by all the companies constituting our system in the United States during the year 1904 was:

For Exchanges	$22,673,200
For Toll Lines	8,243,500
For Land and Buildings	2,520,000
	$33,436,700

"The amount added in 1900 was $31,619,100; in 1901, $31,005,400; in 1902, $37,336,500; and in 1903, $35,368,700; making the grand total of expenditure upon these properties during the five years, $168,766,400.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

	1903.	1904.
EARNINGS.		
Dividends	$7,802,833.63	$8,400,301.18
Rental of Instruments	3,047,088.35	3,438,605.54
Telephone Traffic	4,888,158.34	5,575,447.90
Real Estate	73,332.15	76,782.49
Interest	734,219.92	1,055,522.10
	$16,545,632.39	$18,546,659.21
EXPENSES.		
Expenses of Administration	$962,297.84	$1,103,492.95
Legal Expenses	95,564.60	83,530.42
Interest and Taxes	1,993,680.08	2,670,083.61
Telephone Traffic	2,929,424.78	3,413,850.48
	$5,980,967.30	$7,270,957.46
Net Revenue	$10,564,665.09	$11,275,701.75
Dividends Paid	8,619,150.75	9,799,117.50
Balance	$1,945,514.34	$1,476,584.25
Carried to Reserves	$728,139.97	$586,149.20
Carried to Surplus	1,217,374.37	890,435.05
	$1,945,514.34	$1,476,584.25

"The net output of telephones during the year 1904 was 701,047, making the total number in the hands of the operating companies 4,480,564.

"The number of exchange stations at the end of the year operated by the companies which constitute our system was 1,799,633, an increase of 274,466. In addition to this number there were 167,213 exchange and toll stations operated by companies or associations under sublicense contracts and making use of our telephones. Adding also telephones employed for private-line purposes, our companies have a total of 2,003,213 stations.

"The amount expended by this company in 1904 for the construction, equipment and supplies required for its long-distance lines was $4,012,905, making the total investment in long-distance lines and equipment up to the close of the year $30,889,710.

"The development of the business during the past year exceeds that of any preceding year, and this applies not only to the increase of the number of subscribers in established exchanges, but to the toll-line development and the extension of lines and service into the more sparsely peopled sections of the different states. Present indications point to even a larger growth of the business for the year 1905.

"Every extension of the service brings in new subscribers and, what is of greater moment, increases the value of the service to those already connected. The demand for telephonic connection has spread throughout the entire country, so that today not only the smaller householders and business men, but even the isolated farmers in all parts of the country are coming to regard the telephone as a necessity. Its use on railroads, in factories, on steamships, and in other special environments is growing rapidly, and there is an enormous increase in the number of private branch exchanges in hotels, apartment houses and other large establishments where, by the use of the private branch exchange, the same telephones can be employed for intercommunication between the rooms or offices as well as to talk out upon the lines of the general system.

"It is gratifying to note that the service throughout the country is constantly improving, notwithstanding the enormously greater difficulty in carrying on the business on its present large scale. This is due in part to improvements in physical plant and to the adoption of better operating and maintenance methods, but even more to the more definite recognition that a high standard of service must be attained and to the more intelligent and careful supervision of the plant and of the operating which has come with experience and with a higher aspiration for good service.

"Involved in the extension of the business, both from the point of view of the companies and of the public, is the establishment of such schemes of rates as will result in an adequate return to the operating companies and at the same time will make it possible to graduate the cost of the service to the varying requirement of the respective subscribers and therefore be alike fair to the large and small user. In no other business that serves the public are the difficulties of dealing with rates greater than in the telephone business, particularly in view of the facts that in no two localities is the investment or the cost of operating per station the same, and that, as communities increase in size, conditions arise which largely increase these costs.

"The Bell companies are dealing with this question intelligently and on sound lines. By the adoption of measured service in places where it is applicable, and of different grades of service which can be supplied at varying prices to meet the

Digitized by Google

requirements of different classes of telephone users, they are promoting the necessary extension of the service on a basis that is safe, and satisfactory both to the companies and to the public. As a fundamental principle the large user should pay to some extent in proportion to his use, while the smaller user should be offered a service adapted to his needs at a lower price.

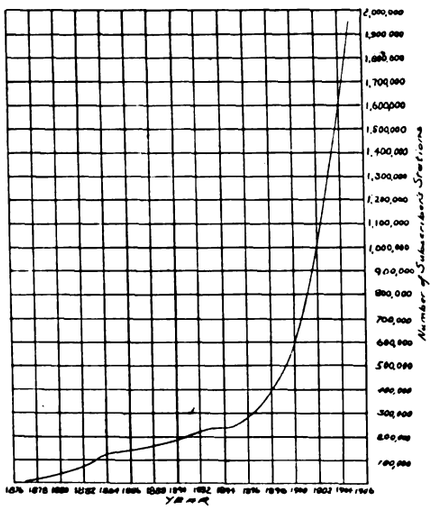
"The number of subscribers to the Bell system is now practically a hundred per cent greater than was the case three years ago. In almost every part of the country each subscriber is able to talk to twice as many stations, and through those stations to a very much larger number of people. Thus the value of the service to the user is constantly increasing, and its cost to the subscribers, in relation to its value, is constantly reduced.

"Moreover, the telephone users on the average pay a substantially less amount for the service they receive, irrespective of its increased value, than was the case three years ago. Not only are the standard rates reduced from time to time, wherever the conditions justify such a reduction, but a constantly increasing proportion of the telephones installed is furnished at the lower scale of rates adapted to the needs of those whose requirements are adequately met by the classes of service offered at such lower rates.

"Concurrently with this reduction of the average rate, and as a consequence of the continued application of sound methods of engineering and of operation, and of the extension of the business into fields where relatively expensive construction and high cost of operation are not required in order to render adequate service, there is a constant decrease in the average investment and cost of operation per station of the Bell system as a whole. This is not true of every locality, and the extent of this reduction, if any, in any given place, depends upon the local conditions; as for example, the size of the community and the density of its population, the proportion of the investment that is required in any special place for real estate, expensive underground construction, intercommunicating trunk lines or elaborate exchange equipment, and the character and extent of service that is demanded.

"As a general principle it seems perfectly certain that it will always be the case that the larger and more densely populated the community, the higher must be the standard of rates for the comprehensive service required for that community. Not only the investment and the cost of operation, but the general difficulty of doing the business which can only be overcome by enlarged expenditure, increase in passing from the smaller towns and cities to the larger.

"All these difficulties and expenses culminate in cities of the first rank. In those cities there is extensive underground construction, laid and maintained under unfavorable conditions and at great cost, the real estate expense is necessarily very high, the central office equipment is complicated and expensive out of all proportion to the number of subscribers served, there has to be a network of trunk lines connecting the different exchanges one with another, and there are many other conditions involving great expense that are not present to a proportionate degree in smaller communities. Moreover, the business is on such a large scale and the element of time so much more important as to require the maintenance of a much higher standard of promptness and efficiency in the service furnished than is necessary in a smaller community,



GROWTH OF TELEPHONE SERVICE OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

and this higher grade of service can only be attained at a disproportionate increase in cost. In fact, the conditions in those cities are such that only engineering skill of the highest order, and the courage to embody the result of that engineering skill in permanent construction and to practice the most sensitive methods of operating regardless of cost, even at times when there was a fair question as to whether the great expense involved was justifiable, have enabled our companies to bring the situation into such shape as to be able to render the amount and character of service that is now required of them. To-day there is no question as to their foresight, and it is certain that the telephone problem in the large cities, complicated and difficult as it is, can be worked out satisfactorily, whatever may be the demands for service.

"Even in the largest cities, however, not only the average rate per station, but the standard rates of the individual subscriber, have been reduced from time to time as the conditions warranted; and this policy will be continued as circumstances permit.

"In some places in the country, particularly where there has been the demoralizing effect of unintelligent competition, the rates are at the present time too low. The service rendered is worth substantially more than the users pay for it, and the net return to the operating companies in those particular localities is inadequate. In many such places the rates have already been raised to the point of reasonable return, with the goodwill and hearty cooperation of the community. There is no doubt that this process of readjustment will continue as the public becomes satisfied that it is the intention of our operating companies to increase rates only where it is necessary, and to reduce them as and when the conditions of the business justify it. That such is the policy of our companies will, it is believed, be recognized more clearly from year to year.

"The number of telephone companies organized to operate independently of the Bell companies in rural districts and relatively small centres of population, and for the most part in places not at the time having the Bell service, which have concluded that it is for their interest to become a part of the Bell system, is constantly increasing, and their course in entering into contracts with the Bell companies, whereby they take our telephones and connect with toll lines of our system, is significant as showing the growing appreciation of the value of the Bell service.

"On the thirty-first day of December, 1902, as appears from the admirable and complete bulletin of the Census Department relating to the telephone and telegraph industry of the United States, there were of the telephones classified as operated by independent companies, so-called, 84,021, which were in fact Bell telephones used under contract with the Bell companies and as part of the Bell system. This number has grown so that on January 1, 1905, there were, as above stated, 167,213 telephone stations of this class. There is every reason to believe that this sublicense business of the Bell companies will increase from year to year to the advantage of all concerned.

Digitized by Google

LINE CONSTRUCTION FOR HIGH-PRESSURE ELECTRIC RAILROADS.[1]

BY GEORGE A. DAMON.

The single-phase high-pressure trolley has arrived and evidently has come to stay. The advantages gained by delivering energy directly to a car without the necessity of an investment in synchronous converters and heavy feeders has long been recognized. That it is entirely practicable to take current from a high-pressure conductor by means of a moving contact has been fully demonstrated. It has required some time to show that there is a field for a single-phase traction motor sufficiently promising to justify its commercial development, but a number of motors of this type are now upon the market and within the last few weeks have been put in actual every-day operation.

To get the full benefit of the new system, it is desirable to carry as high a pressure as practicable on the trolley wire. It is apparent at once that the methods of installation which have become standard with the 500-volt system are inadequate for the new conditions. Several methods of supporting the high-pressure trolley wire have already been developed, and now the time has come to standardize the pressure and the location of the current conductor, as well as the method of current collection in order to provide for an interchange of equipment.

It is the object of this paper to present a brief record of what has already been accomplished in line construction, and to examine the requirements and difficulties of installation in order to obtain permanent insulation at reasonable cost, safety to the public, and reliability in service. It is important that a discussion be developed at this time which will at least indicate the tendency of the developments which are taking place. In order to allow an opportunity for the presentation of the details and advantages of certain systems which are being perfected by others, this paper is purposely left incomplete in certain parts.

THREE CLASSES OF CONSTRUCTION.

The successful use of a single high-pressure trolley wire will have a marked stimulus upon three distinct branches of the electric railroad art:

1. Moderate speed and inexpensively equipped electric lines for country districts.

2. High-speed interurban roads for service between large centres of population.

3. Electrification of steam railroads.

This will leave the city systems with their suburban extensions to be served, for the present at least, by the direct-current motor. In studying the methods of line construction, it will be desirable, therefore, to keep in mind that each of the three classes of roads indicated will have its own individual problems and requirements.

For moderate speed lines in the country districts, the full benefit of the high-pressure system will be obtained only when the first cost of such a road has been reduced to a minimum, consistent with good work. A study of the electric railway situation in the middle western states will emphasize this point. It will be seen that nearly all the territory which promises even a fair return on the investment has been preempted and that some roads are even now being built where there may be some doubt as to their being able to stand the fixed charges resulting from the cost of the illogical synchronous converter substation system. There are still left whole sections of rich productive agricultural districts which will remain unserved by a trolley road until a system has been developed which is so simple in its requirements that it can be built and equipped complete for less than $15,000 per mile, and operated on a basis equally economical. This class of installation means a trolley pressure as high as possible, as well as transformer substations operating without attendance and working in parallel from one transmission line.

For high-speed interurban roads the high-pressure trolley opens up new possibilities. Heavier cars with more powerful motor equipments can now be operated at high speeds between cities without prohibitive first cost. "Limited" electric train service with speed schedules of sixty miles an hour from the heart of one city to another will soon be in vogue, and without the necessity of changing from third rail to trolley in passing from private right of way at corporate limits. Roads of this character, with their better earning capacity, can afford such refinements in line construction as a sectionalized trolley, individual transmission lines to each substation, and separate pole lines for the trolley and the transmission systems.

The electrification of steam roads will present a different set of conditions. Here the steam locomotive will share the tracks with its electric successor for some time, and will do all it can with its acid-charged gases to destroy the handiwork of the electrical engineer. This will make the installation of a contact wire anywhere except at the side of the track a doubtful proposition, and thus calls attention more strongly to the statement that line-construction problems must be divided into classes.

LINES ALREADY BUILT.

It will be instructive to examine the details of construction of several high-pressure trolley lines already in operation. There are details available of three installations in Europe—Valtellina, Spindersfeld, and the Huber system. There are several other lines building in Europe, but either the details of the line work have not been disclosed or the systems adopted are similar to the ones described.

In this country the overhead equipment of the Lansing, St. Johns & St. Louis Electric Railway, the Indianapolis & Cincinnati Traction Company, and the Bloomington, Pontiac & Joliet Electric Railroad will present types, leaving the interesting work which has been done near Schenectady and at Pittsburg to be described and discussed by others.

Valtellina—This is really a three-phase road having two trolleys, but the line construction could easily be adapted for a single trolley. The line is sixty-six miles long, with three branches; is located near Milan, Italy, and has been in operation since September, 1902. The trolley pressure is 3,000 volts at fifteen cycles. The transmission line, at 20,000 volts, is carried on the trolley poles. The contact wires are fixed at a height of twenty feet in open stretches and at sixteen feet in tunnels. The trolley wires are hard-drawn copper wires of eight-millimetre diameter, and the span wires consist of galvanized steel wires of five-millimetre diameter. The span wires which hold the trolley wires, after the usual suspension method, are attached to the poles by means of porcelain insulators of a special type. The contact wire is suspended by ambroin insulators consisting of a cast-iron bell holding a steel bolt imbedded in ambroin and having a mechanical clip at its lower end. The insulators are tested to 10,000 volts.

On tangents and on curves with a radius greater than 3,000 feet, single-bracket poles are used; on curves the contact wires are suspended on double poles with span construction. At stations double-bracket poles are used. A peculiar detail is a circlet of iron with protruding

[1] A paper presented at the 195th meeting of the American Institute of Electrical Engineers, New York, March 24, 1905.

Digitized by Google

spikes to prevent people from climbing the poles.

The current collector consists of a roller of electrolytic copper of 3.125 inches diameter and 2 feet 1.625 inches long. The current is taken from the roller by contacts rubbing on both ends of the roller. One break of the contact wire on this line is reported, the wire falling on the roof of the car, which was thoroughly grounded and thus no harm was done.

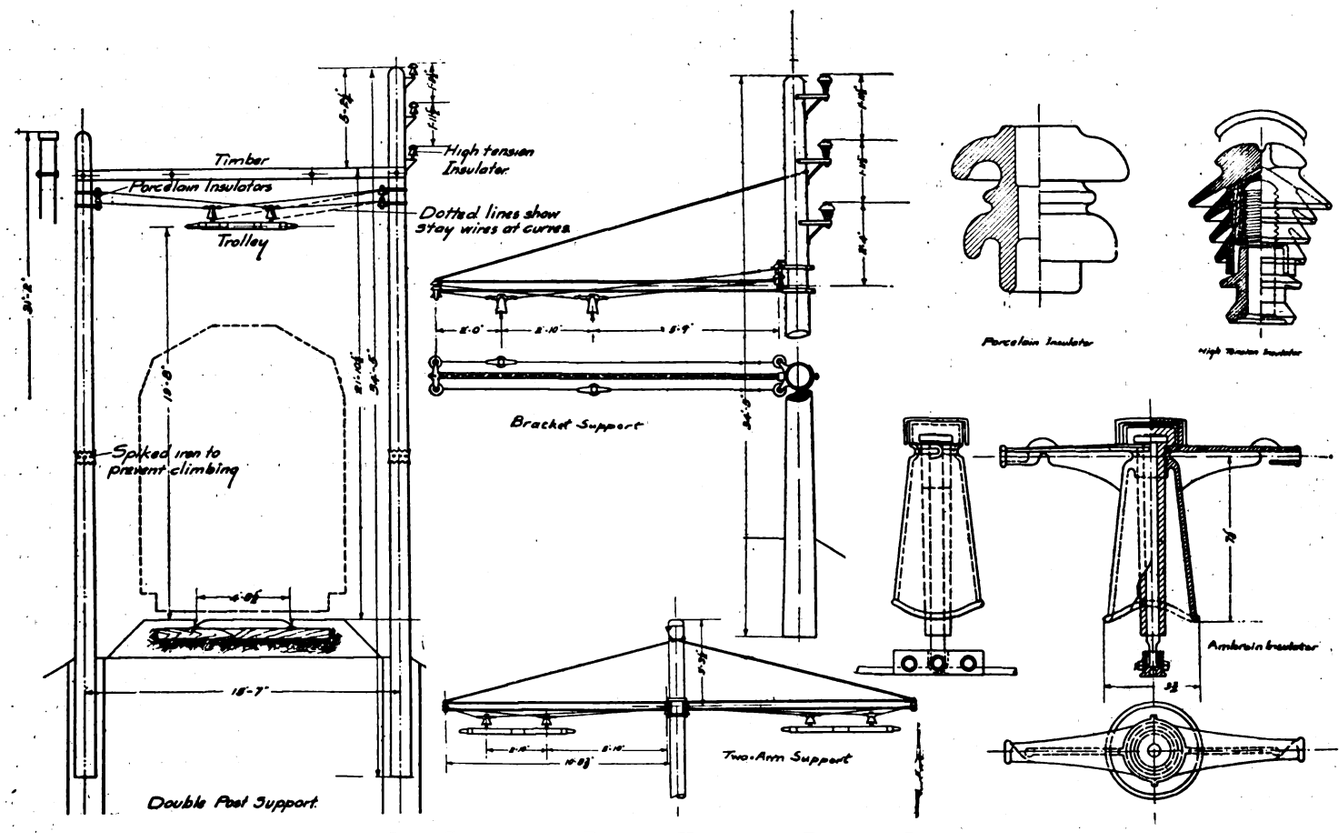
Spindersfeld—This is a single-phase experimental electric line installed on the state railroad near Berlin. The line is insulators and fastened to the bracket arms by means of special clamps.

Underneath the bridle wire there is an earthed bar, so arranged that a break in the line or in the catenaries will cause a contact to be made with the live conductor, grounding the system and throwing a circuit-breaker and thus protecting the line.

All telegraph, telephone, and other wires passing over the trolley are protected by a wire cage which completely surrounds them in order to prevent any possibility of their coming in contact with the high-pressure railroad conductors.

ductor wire. The illustrations indicate diagrammatically the various relative positions of the collecting device and the wire.

In making contact with the wire when over the car the collector arm rubs beneath the wire, but this is only done in tunnels and in other contracted spaces. The current collector is mounted on porcelain insulators and the light arm is held in place in such a way that it can readily be removed and renewed. The entire device is further mounted on a parallel link motion, which is controlled automatically so as to shift the centre of



LINE CONSTRUCTION DETAILS, VALTELLINA RAILWAY, ITALY.

three miles long; it was put in operation in June, 1903. The trolley pressure is 6,000 volts at twenty-five cycles, single-phase system. The trolley wire is hung from two steel catenary wires with suspensions every ten feet. The steel wires also act as current conductors.

The copper wire is of eight-millimetre diameter; this seems to be the standard size on foreign roads. This wire is slightly smaller than No. 0 B. & S. gauge. The contact device is a sliding bow. On parts of the line a single catenary suspension is used, the double catenary being a later development, having been adopted to ensure greater safety and to increase the lateral rigidity of the conductor. The catenary wires are attached by short rubber chains to a bar mounted on two

Huber System—An experimental line has been built by the Oerlikon Machine Works after the plans of E. Huber, technical director of the company. The line uses a single-phase current at 14,000 volts directly on the conductor wire. The current-collecting device is of novel design; it consists of a curved metallic stem with its convex surface bearing lightly on the top of the current-carrying conductor. Normally the wire is located at the side of the car, but in passing through a tunnel or under an overhead crossing, the wire can be brought over the centre of the track. The collecting stem has a rotary motion in a plane perpendicular to the track; the position of the stem at any time is regulated automatically by the location of the overhead con-

rotation of the contact stem when required.

The side wire is carried in mechanical clips held in place on the top of the poles by special porcelain insulators made large enough to stand a test of 30,000 volts. The entire line has withstood a test of 16,000 volts. The average height of the contact wire alongside of the track is fifteen feet and inside tunnels 16.5 feet. The distance between supports is about 100 feet.

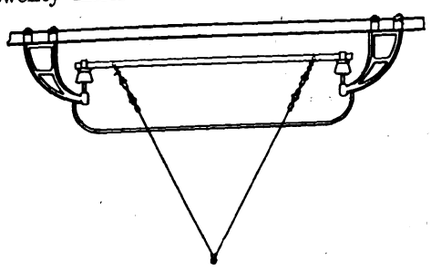
The Huber system is being installed upon the Seebach-Wittingen line, where its operation will be watched with more than ordinary interest.

Swedish State Railroad—It is instructive to note that upon the experimental line authorized by the government of

Digitized by Google

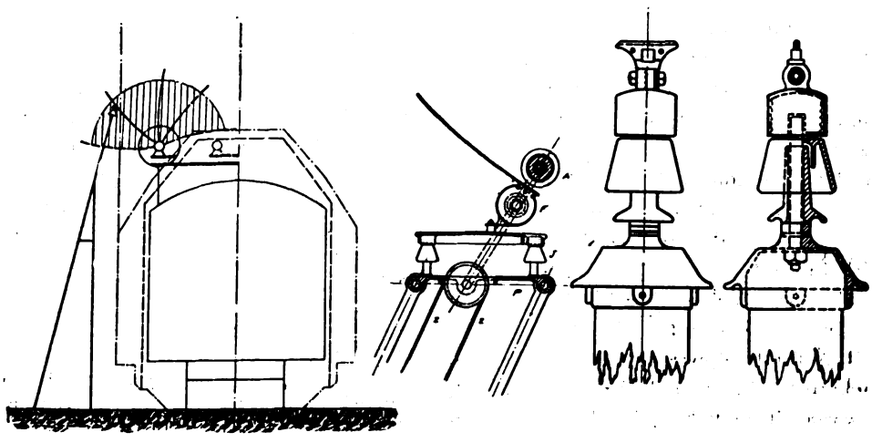
Sweden, and now building, a pressure on the contact wire of 6,000 volts at twenty-five cycles will be used.

Lansing, St. John's & St. Louis Electric Railway—This was the first single-phase electric road to be built. It runs twenty miles north from Lansing, Mich.



DETAIL OF CATENARY CONSTRUCTION, SPINDERSFELD ROAD, GERMANY.

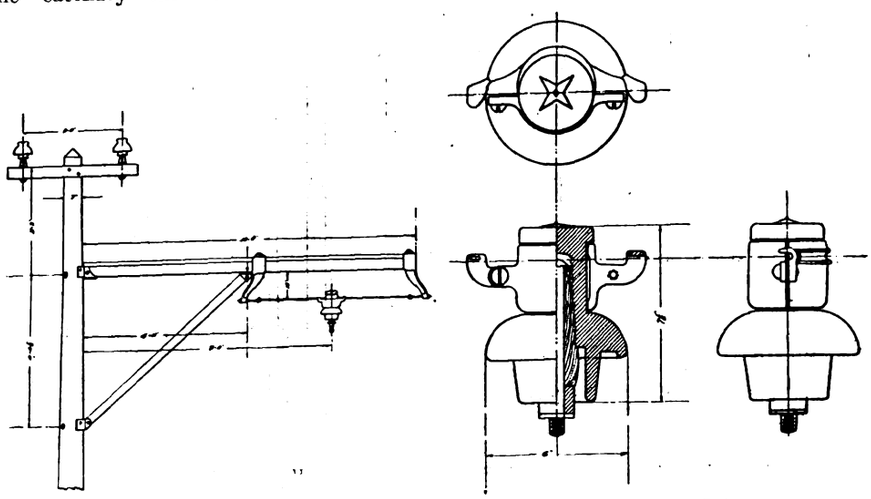
The line was the scene of the pioneer single-phase work done by Bion J. Arnold in 1900-1904. The line has been operated with a pressure of 6,000 volts on the trolley wire. The general method of suspending the trolley wire followed in direct-current work was adopted for this line, but the usual hanger was replaced with a large special insulator of annealed glass, tested to 30,000 volts. This special hanger was held in place on a flexible cross wire suspended between malleable-iron brackets attached to a wooden cross-arm. It was originally intended to stagger the wire supports and use a bow collector, but the experiments were finally conducted with the use of an ordinary trolley wheel. This wheel would at times slip off the wire, and the breaking of the glass hanger insulators from this cause soon demonstrated that this form of suspension was not adapted for places where there was any probability of an ordinary trolley wheel being used.



HUBER SYSTEM OF LINE CONSTRUCTION.

This line proved, however, that the use of trolley pressures as high as 6,000 volts were entirely practicable; and the attention which was attracted to single-phase possibilities by the early work done at Lansing had a marked influence in creating the demand for the general development of high-pressure railroad systems.

Bloomington, Pontiac & Joliet Electric Railway—This line will be ninety miles long, connecting Bloomington and Joliet, Ill. A section of the line was put in operation February, 1905. The trolley pressure is 3,300 volts, and the wires are held in place by catenary construction. Owing to local conditions, such as turnouts, there are two No. 00 grooved trolleys over each track, each hung from a 0.375-inch galvanized steel cable. The poles are so placed that eventually they will be in the centre between a double track. The brackets holding the catenary insulators are made of Washington fir, with a wooden brace underneath. The insulators are cemented on iron pins.



LINE CONSTRUCTION, LANSING, ST. JOHN'S & ST. LOUIS ELECTRIC RAILWAY.

Indianapolis & Cincinnati Traction Company—This is a high-speed interurban line, forty-one miles of which are practically finished. Sixteen miles were put into service January, 1905. The trolley pressure is 3,300 volts. The catenary form of suspension is used with one 0.4375-inch steel messenger wire supported every 100 feet by large flat insulators held on an iron bracket. The copper trolley wire is No. 000 B. & S. gauge and is carried eight inches under the messenger cable. The trolley is supported every ten feet by means of special steel clamps in such a manner that the wire is held very nearly at a perfect level over the centre of the tracks and eighteen feet above the rail.

The transmission line pressure is 33,000 volts; a separate pair of wires connects the power-house with each sub-station. The trolley pole-line and the transmission pole-line are separate, the former being at one side of the right of way. The iron brackets holding the catenary insulators are made of angle iron with a loop at the outside; this will allow for considerable adjustment in the position of the insulator. It is the intention to stagger the position of the catenary supports and thus produce a horizontal wave in the trolley line, which will distribute the wear on the bow collector, eventually to be used on this line.

The trolley wires are suspended from the steel catenaries by means of special mechanical clips attached to the wires every eleven feet. In Pontiac iron poles are used and a special insulator has been designed for the support of the cross-suspension wire. Above the trolley in city streets a lighter catenary construction is placed for protection in case the trolley wire should break; but most of the strain is carried by the regular cross-suspension wires.

REQUIREMENTS OF INSTALLATION.

Bearing in mind the distinct requirements of the three classes of roads already referred to, the problem of line construc-

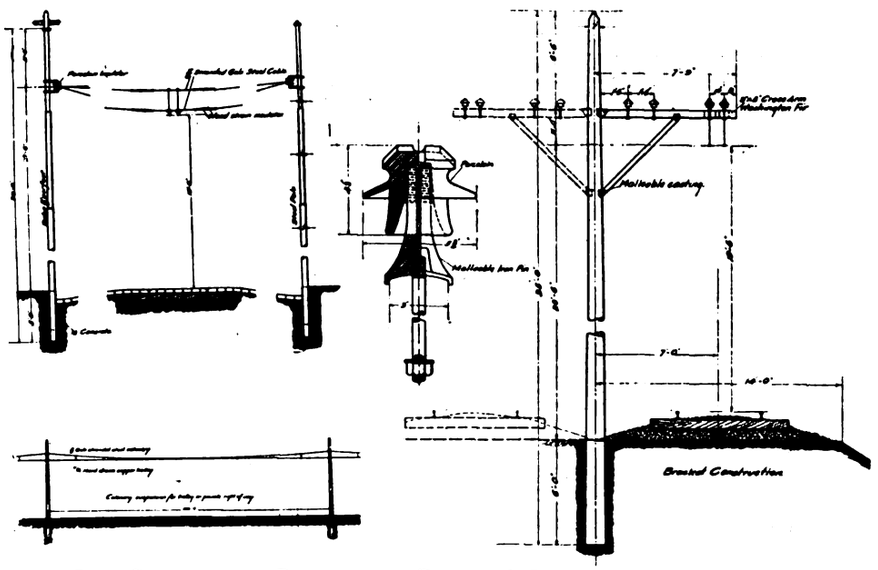
Digitized by Google

tion may be discussed under the following heads:

1. Pressure and insulation.
2. Location of conductor.
3. Requirements for safety and stability.

As an entire paper might be devoted to any one of these subjects, there is offered an opportunity for considerable discussion.

Pressure and Insulation—The single-phase lines now in operation in this country have 3,300-volt trolleys, and several lines under construction have also decided to use this pressure. From present appearances, therefore, 3,300 volts is to be the standard for interurban lines. It would be well, however, to consider just at this time whether it would not be advisable to use a trolley pressure of 6,000 volts. From an operating standpoint there seems to be no reason why this higher pressure is not just as practicable as a lower one; and to get the full benefit of all the advantages inherent with the high-tension system the higher pressure should be adopted.



LINE CONSTRUCTION, BLOOMINGTON, PONTIAC & JOLIET ELECTRIC RAILWAY.

Even if a few of the first roads are built with a 3,300-volt trolley, there is no reason why, with the catenary suspension, the insulation provided should not be capable of standing a working test of 6,000 volts, so that when the time comes to double the pressure the expense of the change will be a minimum.

For steam-railroad conditions, the larger amount of energy required indicates that a pressure of at least 15,000 volts will probably be desirable. Just where to strike a balance between the cost of copper and the cost of insulation for steam-road work is a problem which should be carefully worked out; but there seems to be no reason at this time why pressures of over 10,000 volts should not be considered.

The catenary form of suspension affords so convenient a method of insulation that it should become standard practice for interurban electric lines. When selecting an insulator for this construction, mechanical strength should be the first consideration, and a few cents more spent on the insulator will ensure an abundance of insulating qualities. As far as insulation is concerned, there is no reason why the catenary construction could not be operated at more than 30,000 volts, if desired. For pull-offs and cross suspensions to iron poles special porcelain insulators are being designed and used with success.

It has long been admitted that dry wood is one of the best insulators. The convenience with which a wooden rod fitted with suitable terminals can be worked into an overhead construction will commend this form of insulation. Impregnated with an insulating compound, and of sufficient length to withstand high-pressure tests, the long wooden insulator is applicable to the insulation of guy wires, and cross-suspension wires. Its use in actual practice will be watched with interest.

The use of a wooden bracket to hold the insulator for supporting the catenary will probably appeal to some as a step backward. As far as looks are concerned, however, it may be said that a wooden bracket of a section 3.5 by 5 inches presents an appearance fully as attractive as the ordinary cedar pole to which it is attached; and that a double-track road with a line of centre-poles equipped with wooden brackets will be much less offensive from an æsthetic point of view than a double row of side suspension poles raked outward in the usual fashion.

The wooden bracket has an element of safety not possessed by an iron support, as the insulating properties of the wooden arm would be useful in the case of the failure of an insulator. Unless the wooden bracket were wet it would safely hold up a 6,000-volt catenary until the line could be repaired.

LOCATION OF CONDUCTOR AND COLLECTOR SYSTEMS.

For moderate speed roads the natural tendency will be to have the trolley wire where it has proved to be so thoroughly satisfactory; that is, over the centre of the track, and to continue to use the present trolley-harp and wheel. For speeds not exceeding forty to fifty miles an hour at trolley pressures up to 3,300 volts, this arrangement will work satisfactorily.

For high-speed electric lines there will be little objection to the conductor wire remaining over the track, provided it is properly suspended; but the danger of the ordinary trolley wheel jumping off the wire at high speeds will, no doubt, suggest the use of some form of collector other than the wheel. The bow, the roller, and the shoe will each find advocates until more experience has been obtained and the results are reported and discussed.

Special cases will arise such as the installation of a high-pressure conductor wire over a road already equipped with a direct-current trolley, as was the case with the Ballston, N. Y., road. In such an event the catenary construction can be very nicely adapted to suspending the wire at the side of the track. This location could be advocated for an entirely new installation on the grounds of cheaper first cost and some additional safety in case the wire should break and fall, but both these arguments lack sufficient weight to establish the wire in the side position as standard practice.

For steam-road conditions considerable objection may be found to locating the conductor wire over the centre of the track: the danger to trainmen standing on top of the cars; the fouling of the conductor; the deterioration of the insulation, and the destruction of the wire and supporting cables by the gases of locomotives which may jointly occupy the tracks; the blocking of traffic when it is necessary to repair a broken wire—all these are serious drawbacks to this location of the conductor for heavy railroad practice. To avoid the deleterious effect of the locomotive gases it would seem to be imperative to place the contact wire at one side

Digitized by Google

and as low as possible consistent with general safety. The advisability of installing an independent and duplicate system of conductors is also to be considered for lines of importance; this can be done only by putting the wires on opposite sides of the track.

The Huber system appears to have been carefully worked out, and at the present time is the best suggestion for a solution of the line problems in connection with the electrification of steam roads. There is one serious objection to the arrangement, but this can be overcome. The contact wire carried from pole-top to pole-top is liable to break, and some form of support should be devised to prevent the broken ends falling to the ground. A double-catenary suspension system with one wire carried on an insulator at each end of a cross-arm attached to the pole, say a foot from the top, could be provided, and the contact wire could be supported from the apex of triangular supports attached to the two catenary wires. This method would offer advantages over any system of guard-wires or cradles which might be devised to catch the broken wire, as it would require three wires to be broken before any part of the system could fall to the ground.

REQUIREMENTS FOR SAFETY.

Frequent Supports—Whatever method of construction is followed, every precaution should be adopted to prevent accidents to the public or employés from the loose ends of a broken live wire. Suspensions or supports properly installed every ten to fifteen feet will lessen this danger.

With bracket construction having poles about 100 feet apart, there will be no need of a double-catenary suspension for the wire which is to be used with an underrunning collector. In such a case, the double suspension would mean twice as many insulators as would be required with the single catenary, thus decreasing the insulation resistance and increasing the chances for trouble. With what is known as the "tower" method of construction—using long spans—the double catenary, spreading at the points of insulated supports and converging together at the centre of the span, will be found desirable. The necessity of keeping the wire from swaying will justify the double catenary in this case, and the fact that the number of points of support is reduced by using long spans will more than balance the use of two insulators at each support.

The frequent clips holding the contact wire are not only advantageous from the standpoint of additional safety, but they contribute to the permanency of the construction by keeping the wire almost perfectly horizontal at all temperatures, and thus avoiding the bending of the wire up and down at the support points every time the collector passes. The only disadvantage to clips holding the wire every few feet is the tendency for the trolley wheel to spark at these points. This is not a serious objection if a collector similar to the bow device is used, in which case there will be no interference between the collector surface and the mechanical clips.

Protection from Sleet—In a hard sleet-storm every attachment connected to the wire will naturally be the cause of additional trouble. The arcs due to a coating of ice between the wire and the collector will be much more vicious at 6,000 to 15,000 volts than at 500 volts, but there is no occasion to become alarmed at the possible danger from this source. In this country one of the high-pressure lines using a trolley wheel on a 3,300-volt wire has already passed through a hard siege of sleet; and though the sparking was spectacular, very little damage was done. The frequent trolley supports, however, added considerably to the sparking.

Greased trolley wires are sometimes used to prevent the trouble caused by sleet; it would be interesting to learn the experience of members of the Institute with this device. It is well known that the grease finish of an aluminum wire prevents the collection of sleet upon the wire, and it may be possible that a coating of grease on the high-pressure conductor wire would entirely obviate this trouble. It is evident that with a collector taking the current by means of a contact made on the top of the wire, as in the Huber system, the trouble from sleet would be a minimum. In those kinds of sleet-storms in which icicles are formed and hang from the wire, a top-bearing collector would have every advantage, but when the sleet freezes equally all round the wire, the lighter pressure of the top-bearing contact might put the Huber collector at a disadvantage.

Transmission Lines—The transmission lines from the power plant to the substations will be at a higher pressure than the trolley pressure, and will therefore require careful treatment. For a road which is to be built economically, a single set of transmission wires serving all of the static transformer stations in parallel will be sufficient. These transmission wires will ordinarily be carried on the tops of the same poles which support the trolley bracket.

The next refinement would be to have a separate set of transmission lines from the power-house to each substation, making it possible to put the overload protective devices on the central station switchboard and thus eliminate the substation attendance. With this multiplicity of wires and consequent higher first cost adopted, it is but one step farther to separate entirely the two systems and to install two pole lines on the same right of way; where the electric road is of the high-speed class this should be done.

To be consistent, however, in ensuring safety to the public, it would be well to advocate as standard practice the plan of carrying the high-pressure transmission lines entirely around small towns and cities instead of through them. If the transmission lines are too dangerous to be carried on the railroad company's trolley poles, then there is more danger in carrying them along the streets and over the network of telephone wires inside the corporate limits. The problem of the proper regulation for this situation is one that will shortly have to be faced.

The first investment in the transmission line, the cost of maintenance, and the loss by leakage—all these can be cut in half by thoroughly grounding one side of the single-phase transmission line so as to use the earth as one leg of the circuit. An actual trial of this suggestion to further simplify the distribution system is under contemplation, and no doubt will furnish valuable information as to its effect on telephone and telegraph lines as well as data in connection with the resistance of the earth with alternating currents.

Grounded Guard Wires—Where the transmission lines pass over other wires, there should be a cradle of grounded wires to prevent a broken transmission line from coming in contact with a foreign wire. This cradle will be of little use unless it is of ample dimensions. Some effort has been made on European roads so to install grounded wires that the breaking of a conductor would at once cause the live end of the wire to make a contact with the grounded guard-wire, but in two cases which have come to notice the grounded guard-wire caused more trouble than it eliminated; for this reason it was soon abandoned. In order to encourage the discussion of the unsettled features of line construction for high-pressure electric railroads, the following are offered as

GENERAL CONCLUSIONS.

1. There are no reasons why the standard pressures of the conductor wire for interurban electric lines should not be at least 6,000 volts; this is suggested as a standard in order to provide for interchange of equipment.

2. For the electrification of steam roads a pressure of about 15,000 volts on the conductor wire is desirable.

3. For electric interurban lines, the present tendency is toward the catenary form of suspension, with the trolley over the centre of the track. A connection should be made about every ten feet, between the steel catenary wire and the trolley wire.

4. For steam-railroad stations a contact wire at the side of the track appears to offer the greatest advantages. Some form of construction should be adopted, however, to prevent the falling of the conductor in case it should break.

5. A successful bow collector for interurban work and a contact arm for steam-road installations similar to that in use by the Huber system would allow the location of the contact wire to be standardized.

6. A trolley wire twenty feet above the centre of the track is suggested for interurban roads. For steam-road electrification the height of the contact wire at the side of the track could be made standard at sixteen feet.

Digitized by Google

THE NEW FEDERAL TRADE-MARK LAW.

BY JAMES HAMILTON, M. E., LL. B.

When one considers that a trade-mark is closely akin to the good will of the business in which it is used and that the use of trade-marks bears a very close relationship to commerce, the importance of new legislation affecting trade-marks becomes apparent to every one engaged in commerce. The responsibility resting upon the committees on patents in recommending a trade-mark measure was fully appreciated by them and it was only after the consideration of numerous bills and the holding of many hearings that the present measure was recommended by them for passage. The new law was approved February 20 last, and goes into effect April 1 next.

There is no express authority given by the constitution to Congress to legislate upon the subject of trade-marks and the power to do so has been ascribed to various clauses of that instrument. At the time of the passage of the trade-mark law of 1870 (the first on the subject), it was thought by its framers that the authority was to be found in the clause which gives Congress power to legislate for the protection of patents and copyrights. But Justice Miller pointed out in the opinion handed down in the Trade-Mark Cases (100 United States 82) that this clause had for its object to protect the fruit of intellectual effort—as the result of ingenuity in devising some new and useful thing in aid of industrial development; or the production of some work of literary or artistic merit. But a trade-mark depends for its value not at all upon its novelty or utility in the arts, or upon the degree of ingenuity involved in its production, or upon its literary or artistic features; it need not and generally does not tend to promote the progress of science and the arts. It is sufficient that it indicates origin and ownership of the goods to which it is affixed and the right to it arises from and depends upon mere priority of adoption and use. The law of 1870 was held unconstitutional as being too broad in its scope and beyond the powers of Congress to enact. The present law, enacted in 1881, followed the law of 1870; and the report of the committee having it in charge shows that Congress at that time was of the opinion that the power to legislate upon the subject of trade-marks came within the treaty-making power and was based not at all upon the power given to Congress by the commerce clause of the constitution. For that reason the provisions of the act still in force relate solely to commerce with foreign nations and with Indian tribes. Its constitutionality has never been drawn in question; but in Warner *vs.* Searle & Heroth Company decided in November, 1903, it was held that in order to maintain an action for infringement not only must the owner of the trade-mark registered be using it in commerce with foreign nations or with the Indian tribes, but that the infringing use must be made in such commerce also. This decision made most clear the limited protection given by the present statute. The new law was passed under the belief expressed in the report of the committee of both houses that the power to legislate in regard to trade-marks is found in the commerce clause of the constitution, which gives Congress power to regulate commerce among the several states and with foreign nations and the Indian tribes. In the Trade-Mark Cases (100 United States 82) the Supreme Court expressly refused to pass upon the question whether such power is to be found in the commerce clause; but the argument presented in the committee's report leaves no doubt in one's mind that the relationship borne by trade-marks to commerce in general is such that the power to regulate commerce between the several states and with foreign nations and the Indian tribes carries with it the power to regulate trade-marks used in such commerce.

One of the most important changes made by the new law is the extension of protection to trade-marks used in commerce among the several states. After April 1, 1905, trade-marks used in interstate commerce may be registered equally with those used in foreign commerce, and an action may be maintained under the new law whenever the infringing use takes place in interstate commerce.

The government fee has been reduced from twenty-five dollars ($25) to ten dollars ($10), thereby reducing materially the cost of registration. This reduction will tend to make the registration of trade-marks more general and thereby give the public notice of what trade-marks have been appropriated to exclusive use.

An important change has been made by the new law in the matter of procedure for the registration of a trade-mark. Under the present law and practice, an appeal may be taken to the commissioner of patents in person from the adverse decision of the examiner of trade-marks as to registrability and the commissioner's decision is final. By the new law an appeal is allowed from an adverse decision of the commissioner to the Court of Appeals of the District of Columbia consisting of three justices, thereby ensuring the building up of a uniform system and the establishment of uniform rules governing and controlling the registration of trade-marks and doing away with conflict of decisions under different commissioners, about which so much complaint has been made in the past. A like change has been made in the procedure on appeal in trade-mark interferences.

Under the present law and practice only technical trade-marks may be registered; that is, trade-marks which are in nature arbitrary, fanciful and non-descriptive. But the courts have granted relief under the equitable doctrine of unfair competition, in many cases involving the wrongful use of trade-marks which could not be registered under the strict rule of present Patent Office practice; for instance, in the case of trade-marks which are descriptive or geographical in character but which from long use have come to be recognized by the trade as indicating the origin and ownership of the goods to which they are affixed. The new law conforms to the policy adopted by the courts in such cases and provides for the registration of all marks that have been in actual use as trade-marks for a period of ten or more years.

Registration under the new law is not compulsory. The right to exclusive use of a technical trade-mark is founded upon priority of adoption coupled with continuous use and depends not at all upon statute. The ownership of a trade-mark is the ownership of property at common law and trespass upon the owner's rights by wrongful use is a good cause of action either at law for damages or in equity for an injunction and an accounting of profits and damages. To protect owners who have not registered their marks, the new law provides that when an application is filed and the trade-mark therein described is upon examination found registrable, the commissioner shall cause the mark to be published at least once in the *Official Gazette* of the Patent Office. Owners of unregistered marks are thus kept informed of the filing of applications for registration of marks identical with or closely resembling their own and upon the filing of such a mark may within the period of thirty days file an opposition to the registration of the applicant's mark and, upon a proper showing to the commissioner, prevent the registration. Registration is made *prima facie* evidence of

Digitized by Google

ownership; but even if no opposition is filed and the applicant's mark is registered, the true owner of the mark may rebut the presumption arising from the registration and prove his ownership at common law arising from priority of adoption and use. He may do more. He may under the new law apply to the commissioner to have the registration of the conflicting mark cancelled. The commissioner thereupon refers the matter to the examiner of interferences for determination, and if the petitioner prevails, the registration is cancelled. The proceeding for cancellation is really supplementary to the proceeding on opposition and serves to safeguard the rights of true owners of unregistered marks who have missed seeing the publication in the *Official Gazette* and have, therefore, allowed the conflicting trade-mark to be registered.

Since registration is not compulsory, and since the true owners of unregistered marks have still all rights under and given by the common law, of what value is registration? In the first place, registration gives public notice of the appropriation to exclusive use of the trade-mark. Second, it furnishes *prima facie* evidence of ownership. Third, it gives the registrant the right to bring his action against the infringer in the United States courts. Fourth, in case the action is brought at law under the new law, the court may in its discretion treble the damages awarded by the jury. Under the common law the owner of an unregistered mark must be content with the damages awarded by the jury. Fifth, in case the action is brought in equity asking for an injunction and accounting of profits and damages, under the new law, the complainant in the accounting has to prove only the sales made by the defendant, and it is for the defendant to prove all elements of cost. In a suit in equity upon an unregistered mark, the complainant has the burden of proving exactly what profits accrued to the defendant and what were the actual damages sustained by the complainant, without aid from the defendant. Sixth, where the suit is under the new law upon a registered mark, the court may order the defendant to deliver up all prints, labels, receptacles, etc., bearing the infringing mark to be destroyed. This follows an analogous provision in the copyright statute. No such remedy is given under the common law to the owner of an unregistered mark. Seventh, where an injunction has been issued after hearing and notice to the defendant, the writ may be served upon him anywhere in the United States in case the suit is under the new law upon a registered trade-mark; and in case the injunction is violated, an action for contempt may be brought in any United States court. In the case of an unregistered mark the proceeding for contempt must be brought before the court issuing the injunction. In the case of a registered mark, the defendant can not remain in the United States and escape service under these provisions; in the case of an unregistered mark he may do so, for the above provision is limited to proceedings under the new statute.

A consideration of these advantages will show that the new law gives to registrants so many benefits not to be obtained under the common law and at so low a cost that no owner of a trade-mark can afford to allow his trade-mark to remain unregistered. If he does not register, he is bound, if he desires to prevent another from registering his mark or one closely resembling it, to scan the *Official Gazette* closely every week, and in case a conflicting mark is offered for registration, to go to much expense in maintaining the opposition. Were the trade-mark registered, the Patent Office would reject the conflicting application upon the prior registration, and the applicant could obtain registration only by engaging in an interference proceeding in which he would be the junior party with the burden of proving his case beyond a reasonable doubt. And in case the owner of the unregistered mark desires to have a conflicting certificate of registration delivered up for cancellation, he must engage in the expensive proceeding of proving his case; whereas, had the mark been registered by him, the conflicting certificate would have never been issued to his competitor.

Will the owners of trade-marks registered under the law of 1881 (now in force) be entitled to the benefits conferred by registration under the new law without again registering? They will not. That was made clear at the hearings before the committees having in charge this new law. To have given the added protection to registrants under the present law would be to have given the certificates a force and effect which they did not have at the time of their issue, and it was decided this could not be done. Such certificates when renewed, however, "shall have the same force and effect as certificates issued" under the new law. Until such renewal or until the mark is re-registered, the certificate has only the force and effect that it has under the present law, and suit can not be brought under it unless the wrongful use is made in foreign commerce, or commerce with the Indian tribes; actions for contempt in violation of an injunction can not be heard before any court other than the one issuing the writ of injunction; treble damages can not be imposed in the discretion of the court; and the complainant must prove exactly the profits made by the defendant. The wisdom of re-registering the mark need not be further enlarged upon.

The new law makes our statutes conform to treaty stipulations entered into between this country and certain other governments, and particularly provides for giving full force and effect to the provisions of the convention for the protection of industrial property to which the United States became a party in 1887. The foreign owner must first register in his own country before being entitled to registration here; but he need not have made use of the mark in commerce with this country. The new law provides that no goods bearing a false or counterfeit mark shall be allowed entry at any custom-house of the United States, and the foreign registrant has equally with the citizen registrant the right to stop importations into this country of goods bearing an infringing mark.

Congress has no power to legislate as to trade which takes place wholly within a state; hence, a trade-mark which is used wholly within the boundaries of a single state can not be registered under the new law, and an infringement which does not go beyond the confines of a single state can not be reached under the new law. To each state is left by the constitution the control of commerce which takes place wholly within its own borders, and, hence, the control of trade-marks used in such commerce. Nearly all the important states except New York, Ohio and Kentucky have passed general laws for the protection of owners of trade-marks and labels, and the three states excepted have passed laws giving such protection to trade-marks used in certain trades, as bottlers', distillers' and lumbermen's marks. The state laws are more liberal, in general, than the new federal law, and almost without exception provide for punishment by fine and imprisonment of persons using counterfeits of registered marks. A penal provision is conspicuously absent from the new federal law, it having been decided in view of the opposition expressed to omit such a provision from the new law at present and to leave it to be inserted by future legislation should the necessities then demand such an amendment.

Complete protection of a trade-mark can be obtained by registration under the new federal law in the United States Patent Office, and under the trade-mark laws of those states which are important to the owner by virtue of the bulk of his sales being made therein. The federal registration protects in commerce among the several states, with foreign nations and the Indian tribes; the state registration in commerce restricted in its field to the territory of the state of registration. As to what is included under the new law as within the territory of the United States for the purposes of the act it may be said that any territory under the control of the federal government is within its scope, and includes, therefore, Porto Rico and the Philippines.

Digitized by Google

American Institute of Electrical Engineers.

At the 195th meeting of the American Institute of Electrical Engineers, held at Carnegie Hall, New York city, Friday evening, March 24, two papers were presented and discussed, both dealing with the new types of line construction which have been developed to meet the requirements of the single-phase alternating-current system.

The first paper was by Mr. Theodore Varney, and was entitled "High-Pressure Line Construction for Alternating-Current Railways." Mr. Varney described the different types of construction. The new methods of suspending trolley wires differ most radically from the older methods found suitable for direct-current supply in the use of a messenger wire and a catenary suspension of the working conductor. This suspension gives flexibility, but it has been found advisable to prevent excessive lateral deflection by means of "steady strains"—rods which take up the lateral thrust. This method of suspension and the higher voltages employed in alternating-current railway work necessitate new types of insulators. In some systems a double catenary suspension is used, which tends to prevent lateral deflection of the working conductor. A brief reference was made to collecting devices. It is said that there are forty miles of road using single catenary suspension in operation in Indiana. This line has been running successfully since the first of the year. Sixty additional miles of road will be completed in the near future. The pressure used is 3,300 volts. The more complicated catenary suspension had been developed, with a view to obtaining a system of overhead construction for moderate and heavy traction service which will approach, in a far greater degree than heretofore, the reliability and permanency of present railroad equipment.

The second paper of the evening was by Mr. George A. Damon, of Chicago, and was entitled "Line Construction for High-Pressure Electric Railroads." In the absence of the author, it was read by Professor George F. Sever. The paper appears on another page of this issue. It gives a concise review of different types of overhead construction which have been developed in this country and in Europe.

Mr. F. N. Waterman, New York city, opened the discussion by giving a fairly complete description of the Ganz system, which is in use on the Valtellina road in Italy. This system has been under trial for four years, and in actual operation for two years. Mr. Damon, in his paper, speaks of the value of dry wood for overhead construction. Mr. Waterman said that this material is used to a large extent in the Ganz system, where it is employed for taking up strains and for cross-arms. The links in the catenary suspension are also of hardwood. The speaker referred to the difficulty of obtaining good mechanical and electrical construction in tunnels, where the moisture collects on the insulators, and where fouling occurs, due to the passage of steam locomotives. This has happened on the Valtellina road, during a period of heavy work when it was found necessary to supplement the electric locomotives by steam locomotives. This made it necessary to clean the insulators ever so often. The use of double insulation between the wire and the ground was important. As the Ganz system employs three-phase currents, there must be two working conductors, but these are suspended by two messenger cables. There are but two suspensions between the cross-arms, and one directly under the cross-arms. This gives uniform flexibility along the entire wire. When passing switches and cross-overs it is customary to lower the collector, unless the train is making up time. The collector is described in some detail. This consists of a horizontal hardwood rod, upon which are placed two bronze cylinders carried on ball bearings. This collector has been found to work satisfactorily at speeds as high as sixty-two miles per hour, when collecting 100 amperes. The rotation of the collecting cylinders prevents wear on the wire. The life of these bronze collectors has not yet been determined. Examination of the ball bearings after long use shows no apparent wear. It is said that the cost of maintaining this construction is $102 per mile per year. When the system was first put into service, all the signaling and telephone systems of the railroad were put entirely out of service, due to the ground return. It was found, however, that if the telephone and signaling grounds were carried down through earthenware or hard-fibre pipes to a depth of thirty feet, this trouble was eliminated.

Mr. Calvert Townley, New Haven, Ct., thought that it was not wise to jump at once to higher voltages, as had been suggested by Mr. Damon. At the present time 3,000 volts on the trolley is sufficient, and going higher is merely inviting trouble, without sufficient compensating gains. He does not think that the time has yet come for standardization. There are many requirements to be met which are not at once obvious. For example, it is probable that higher voltages will not be allowed within cities or villages. This would complicate matters with a high-voltage system. The danger to employés and others must also be considered, and any increase in voltage be made only after careful consideration.

Mr. A. H. Armstrong, Schenectady, N. Y., agreed with Mr. Townley as to the inadvisability of using higher voltages. Three thousand volts will do the work; to raise it increases the cost of the line construction and the danger to the system and to individuals. In his opinion, 3,000 volts is high enough at the present time. Using this potential on the trolley enables power to be supplied to the road for twenty miles on each side of a substation. This will divide the road into twenty-mile sections, which are surely long enough. With heavy traffic, or on stiff grades, it may be necessary to use 5,000 or 6,000 volts, but there should be no occasion for going above this. Both the centre and the side trolleys have advantages. At the present time we can not make either system standard. For high-speed service but few suspension links should be used, so as to give the greatest flexibility possible. As the troubles of transmission lines increase in proportion to the number of miles of wire, one line is better than two. It may be necessary to place an attendant at each substation. This may not require his entire time, but he should always be within call to throw switches or to cut in spare apparatus.

Mr. A. H. Babcock, of Oakland, Cal., described some of the difficulties encountered in that section in high-voltage transmission work. In the mountainous country very little trouble is met, and a comparatively low line resistance is satisfactory; but as the coast is approached, fogs occur, which condense on insulators and cause grounds. This trouble is partially overcome by the use of fog boxes. Mr. Babcock is of the opinion that porcelain is not the proper material for line work. While its insulating qualities are excellent, mechanically it is poor. He spoke of the clearance which is maintained rigidly on steam railroads. Electrical engineers should bear this in mind, as no trespass will be allowed. He said that, at the present time, the companies in California are carrying 60,000-volt lines through cities. No accident has happened as yet, though in one case a line

Digitized by Google

did break and fall on an asphalt pavement. He referred to the trouble which telephone systems may experience on account of the low frequencies now coming into use.

A communication from Mr. C. O. Mailloux, New York city, was read by Dr. Samuel Sheldon. This describes the former's recent inspection of European systems, dealing particularly with the Huber system now being developed by the Oerlikon Machine Works. A large number of excellent slides illustrating this system were shown.

Mr. Varney, in closing the discussion, described some tests which had been made to determine the amount of leakage taking place on a 3,000-volt system. In all cases it was found to be an exceedingly small quantity.

Professor Sever, referring to the point Mr. Babcock had made as regards railway clearance, said that the New York, New Haven & Hartford Railroad would not allow any wire to pass over its tracks at a less height than twenty-one feet. Professor Sever thought that high voltages are too dangerous to carry through towns, and should be carried around them.

The meeting then adjourned.

An interesting comparison of present methods of travel with that of a little over half a century ago is found in an article entitled "The National Road," by Philip S. Rush, in the *Four-Track News* for April. When the National road was nearly completed the panic of 1837 swept over the country, and the consequent political disturbances caused the abandonment of the highway, then barely half through Illinois. No work was done after 1841. Two years before, however, a line of stages and post routes had been started from Cumberland, Md., to Terra Haute, Ind., from where a tri-weekly service carried passengers and mail to Springfield, Ill. This marked the first regular overland travel from East to West. Passengers and mail fared alike as they jolted along in the cumbersome coaches, drawn by four strong western horses, and driven by men hardened to exposure in the bitterest winter and the hottest summer. Travel was confined principally to merchants and professional men, on account of the high rates. A passenger, and fifty pounds of baggage, was charged ten cents a mile. Clay and Lincoln, and many other great men of the country, traversed this pathway.

The Constitution of Matter.

Professor J. J. Thomson lectured on Friday, March 10, before the British Royal Institution on the modern electric theory of matter. The following report of the lecture is taken from *The Electrician,* London.

The theory of the atom now almost universally accepted supposes that a number of negative corpuscles are held balanced in orbital motion by the attraction of a positive nucleus to which, therefore, the corpuscles are satellites. The number of satellites determines the nature of the element, about 1,000 corpuscles, for instance, going to the making of an atom of hydrogen. Now the potential energy possessed by each corpuscle in an atom has been found by Professor Thomson to depend on the number of corpuscles present, and is thus different for different atoms; in fact, if a curve be drawn expressing as heights the potential energy per corpuscle and as horizontal distances the number of corpuscles present in an atom, this curve has crests and hollows. If number of corpuscles and atomic weight be taken as identical, a crest thus represents an atom which can exist for but a moment, while a hollow represents a stable element.

Thus we get a glimpse of the reason why in the evolution of the universe only a certain number of elements of very definite atomic weights remain in permanent existence. The reason is, in fact, analogous to that of the gathering of boulders in the hollows and not on the summits of a hill and dale country. The lecturer explained, however, that the calculation of the potential energy per corpuscle gives different numerical results on different assumptions as to the behavior of positive electricity when two atoms coalesce to form a new element. If positive electricity be supposed, for example, to behave as an incompressible fluid, then with increasing atomic complexity the potential energy per corpuscle on the whole increases, and thus the general tendency in atomic evolution will be toward smaller and smaller atoms. Further, if the generalization be permissible, the universe probably began (if the above assumption regarding positive electricity is correct) as a single vast atom which has in the course of the ages broken down to the state in which we now know it. Another new development announced by the lecturer lies in the introduction of the idea that in such a system as he imagines the atom, there is a number of directions along which the combined actions of the positive and negative charges give an electric field which possesses the peculiarity that close in an electric charge will be repelled, further out will be attracted. This theorem was effectively illustrated by a variation of that magnetic model of the atom used a year or more ago by Professor Thomson. In that model movable magnets are gathered into definite geometrical patterns, in spite of the mutual repulsions, by a central attracting pole. The central pole represents the positive nucleus, the attracted poles the negative satellites. The new variation of this experiment consisted in representing a certain atom by three like magnet poles placed at the corners of an equilateral triangle at whose centre were gathered the opposite poles. With this arrangement distant floating poles were repelled when nearer in, attracted when further out, and thus came to rest in perfectly definite positions. But all this happened only along certain lines of symmetry radiating from the atom. These directions round the atom are the valency bonds of the chemist, now for the first time materialized. Thus the electric atom brings into consideration two types of field force existing round it. There is the ordinary electric field which it creates when it becomes electrically charged through possessing a corpuscle or two too many or too few; and there are the valency attractions which promise stable combinations between atoms to form molecules. Pushing this idea further Professor Thomson showed that it gave to the atom precisely those properties Van't Hoff and Le Bel have demanded in their theory of the asymmetric carbon atom, which, developed out of a consideration of the rotation given by certain compounds to plane polarized light, plays now so large a part in stereochemistry.

Telephonic Detection of Wine Adulteration.

It is reported by Mr. Richard Guenther, United States consul at Frankfort, Germany, that M. Maneuvrier has devised a method for detecting the adulteration of wine with water or other liquids. Two glasses are filled, one with the wine to be tested, and the other with a like quantity of wine known to be pure. These are placed in an apparatus, apparently a modification of the Wheatstone bridge. Current is then passed through the two liquids, and a noise will be heard in the telephone if one sample of wine is impure. When this is the case, by moving an index until the noise disappears, the resistances in the two cups are equalized, and an indication of the quantity of extraneous matter in the wine is given.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

An Ampere-Meter for High-Potential Circuits.

A description is here given by Mr. H. C. Snook, of an instrument for measuring the current flow in the secondary of an induction coil. The particular application of the instrument is that in connection with the excitation of X-ray tubes. The current flowing in the secondary circuits of these coils is alternating, but unsymmetrical, and as it is desired that it shall flow in one direction only, it is customary to prevent a discharge passing through the tube while the primary current is flowing, and to allow only the discharge due to the break of the primary current to flow; hence, the instrument mentioned must be designed so as to average the value of a number of rapid, intermittent discharges having one direction. This is accomplished by using a suitable damping arrangement. The instrument itself is of the D'Arsonval type, and the discharge is passed through the movable coil. The arrangement is as follows: one terminal of the movable coil is connected to the core of the permanent magnet and to the case. This is done to avoid any great difference of potential between the parts of the instrument. In parallel with the movable coil is a non-inductive resistance and a small condenser. The function of the non-inductive resistance is to maintain a difference of potential between the terminals of the meter, proportional to the current flowing. The condenser is used to obtain a more uniform flow of current through the coil. The apparatus is useful in several ways. It enables different coils to be compared, and the condition of one coil to be determined, for the current flowing varies with the vacuum of the tube. A "soft" tube usually takes more current than a "hard" one. For a given tube, it has been found that the ammeter reading is closely proportional to the quantity of X-rays radiated; hence, the ampere-meter is useful as a means of regulating the dosage. —*Abstracted from the Journal of the Franklin Institute (Philadelphia), March.*

Parallel Running of Alternators Driven by Large Gas Engines.

During a recent trip through Germany and Belgium, Mr. E. K. Scott had an opportunity of inspecting a number of generating stations where alternators are driven by large gas engines. At these stations the engines varied from 500 to 1,500 horse-power. Nearly all of them were three-phase generators, and the engines were supplied with blast-furnace gases. All but one were single-crank engines, working with two impulses per revolution. There was no difficulty in running the three-phase generators in parallel at any of the plants. At the Oberhausen works there are two 1,200-horse-power Körting engines, driving Siemens alternators, and two 600-horse-power Körting engines, driving Allgemeine Elektricitäts Gesellschaft alternators. These machines run perfectly in parallel, and are easily synchronized with the switchboard, although the attendant can not see all of them when synchronizing. It is believed that, with one single-crank large gas engine of good construction, in which there are two impulses on the crank per revolution, and where sufficient flywheel weight is allowed, either in the generator wheel, or, better, in the generator wheel plus a flywheel, parallel running is easy. The higher the speed, the better is the paralleling. In the operation of these plants the only thing that causes trouble is the water used for cleaning the gas. This is sometimes carried over into the cylinder, and interferes with the operation of the sparking plugs. The piston rods and pistons are cooled by water, as also are the exhaust valves. A spray of water plays into the exhaust pipe, and thus prevents noise and firing back. The engines are started by means of compressed air without any difficulty. They do not require many attendants, and the work is practically identical with that of running a slow-speed steam engine.—*Abstracted from the Electrical Review (London), March* 10.

The Engine Equipment of Motor Omnibuses.

A description is here given of the types of motor omnibuses which have been developed for city use. They vary considerably in design, some being double-deckers, some having but a single deck. Some of them are intended to be operated by one man, others require two. The mechanical equipments vary considerably. They are all either steam or gasoline machines. The engines vary in output from twenty to thirty horse-power. For instance, the machine manufactured by the Brush Electrical Engineering Company contains a twenty-horse-power gasoline engine, and will make speeds varying from four and one-half to fourteen miles per hour. The Clarkson steam omnibus is equipped with a thirty-two-horse-power steam engine. This is a double-decked omnibus, and carries thirty-two passengers. The same company makes a thirty-two-horse-power country omnibus with seats for eighteen passengers, and space for 1,500 pounds of baggage. This machine is steam-heated. The maker estimates that the cost of operating the latter bus is less than seven cents per bus-mile. The Maudslay Motor Company is building a small bus for the Great Western Railway Company. This carries from twelve to fourteen passengers, at speeds up to twelve miles an hour. It is driven by a fourteen-brake-horse-power, two-cylinder gasoline engine. Another bus, built for the Great Western company by the Milnes-Daimler Company, is driven by a four-cylinder, twenty-four-horse-power engine, and makes speeds varying from two and one-half to twelve miles an hour. This bus seats thirty-four passengers. The Motor Car Emporium builds a single-deck bus seating sixteen passengers, which is driven by a four-cylinder, twenty-horse-power engine, and a double-deck bus for thirty passengers, which is driven by a four-cylinder, twenty-four-horse-power engine. The average consumption of these buses is one gallon of gasoline for eleven miles. They carry enough fuel to run them 100 miles. The bus manufactured by John I. Thornycroft & Company is a double-decker, and seats thirty-four passengers. It is driven by a twenty-four-horse-power gasoline engine, at speeds varying from three to twelve miles an hour. A number of other buses are described, but they all have about the same seating capacity, and are equipped with engines having about the same rating.—*Abstracted from the Tramway and Railway World (London), March* 9.

The Secondary Roentgen Radiation.

It has been found by Dr. C. G. Barkla, while the intensity of secondary radiation from light substances varies considerably in different directions, owing to the partial polarization of the primary radiation, the amount of this variation diminishes with an increase in the atomic weight of the radiator, and ultimately is inappreci-

Digitized by Google

able. The radiations from air, carbon, paper, aluminum and sulphur vary in intensity in different directions by a considerable amount. From calcium the radiation is much less, while from iron, copper, zinc and lead it is inappreciable. This must be connected with the fact that the radiation from light substances differs in character only from the primary, while the heavier substances emit radiations differing more from the primary producing them. The radiation from the heavier metals was found not to consist of an easily absorbed radiation superposed on a radiation such as proceeds from light substances, and of intensity given by the law found for them from light substances, but is a completely transformed radiation. This is strong evidence that the freedom of motion of the electrons, which permits what may be called a simple scattering in substances of lower atomic weight, is not interfered with in the heavier atoms, for we find from them a more absorbable radiation in place of—not simply superposed on—a more purely scattered radiation. The radiation from compounds appears to be merely a mixture of the radiations which proceed from the separate elements of the compound. Atomic weight, not molecular weight or density, seems to govern the character of the radiation produced by a given primary. These results may be accounted for by considering the electrons constituting the atoms as the radiators. In light atoms the electrons are far enough apart and have sufficient freedom to move almost independently of one another under the influence of the primary pulses; consequently, to emit a secondary radiation similar to the primary, but the intensity of which depends on the direction of propagation with regard to that of electric displacement in the primary beam. In heavier atoms considerable inter-electronic forces are probably brought into play by small displacements, and the resultant acceleration of motion of an electron is then not in the direction of electric displacement of the primary beam, and evidence of polarization of that beam vanishes. Also, there ceases to be a simple connection between the time for which the electron is accelerated and that of passing of the primary pulse.—*Abstracted from Nature (London), March 9.*

Steam Turbine Tests at the Neepsend, England, Electric Station.

Last year the new turbo-generators were put into service at the Neepsend electric station. These are two-phase machines, there being two of them. They are of the revolving-armature type, and were specified to give an output of 1,500 kilowatts at from 2,000 to 2,200 volts, and fifty cycles per second, on an inductive load, having a power-factor of 0.85. An overload capacity of ten per cent for one hour with a steam pressure of 190 pounds at the stop valve, and a superheat of 100 degrees Fahrenheit at the same point, was called for. The temperature of the circulating water was to be from sixty to eighty degrees Fahrenheit. The speed was 1,500 revolutions per minute. The steam consumption in pounds per kilowatt-hour was to conform to the following figures: with circulating water at sixty degrees Fahrenheit, 18.4 at full load; 21.2 at half load. At eighty degrees Fahrenheit it was to be 20.2 at full load, and 23.4 at half load. These figures were not to include the power required for the air and circulating pumps, as these are motor-driven from the station bus-bars. The exciters are direct-coupled to the turbine shafts. The turbines were tested at the shops of the Sheffield corporation before erection, and showed a steam consumption of 24.02 pounds per kilowatt-hour with a load of 534 kilowatts, the superheat being 119 degrees Fahrenheit, and the steam pressure being 137 pounds. The vacuum was twenty-six inches. With a load of 1,029 kilowatts, the superheat being 142 degrees, the pressure above atmosphere 115.6 pounds, and the vacuum 28.18 inches, the steam consumption was 20.70. With a load of 1,584 kilowatts and 128.5 pounds steam pressure, 125.3 degrees of superheat, and 26.76 inches of vacuum, the steam consumption was 17.61 pounds per kilowatt-hour. At this load the average full-load excitation was one-half of one per cent. After the machines had been erected—that is, in July, 1904—they were tested, with the following results: with a load of 1,596.9 kilowatts, the steam pressure being 179.8 pounds, the superheat 92.7 degrees Fahrenheit, and the vacuum twenty-seven inches, the steam consumption was 18.9 pounds per kilowatt-hour. When the load was raised to 1,611.4 kilowatts, with a steam pressure of 193.7 pounds and a superheat of 100 degrees, the vacuum being 27.4 inches, the consumption of steam was 18.3 pounds per kilowatt-hour. After the machines had been in operation for five months, an average was taken of ten weeks, from November 20 to January 22, with the following results: steam pressure, 190 pounds; superheat, 100 degrees Fahrenheit; vacuum, twenty-seven inches; load, 979 kilowatts; steam consumption per hour, 22.41 pounds per kilowatt. The total operating cost of the Neepsend station averaged, during ten weeks, 0.42 cent per kilowatt-hour—*Abstracted from the Electrician (London), March 10.*

Facilitating Export and Import Business with Austria.

Mr. Urbain J. Sidons, American consul at Prague, Bohemia, Austria, announces a system whereby American exporters and importers may facilitate an exchange of commodities between America and the kingdom of Bohemia. A series of filing cards will be forwarded, upon request, to manufacturers. These are to be returned to the consul, bearing the following commercial data: name of firm, street, city and cable address, codes used, export discounts and prices, languages of correspondence, reference or commercial rating, nature of exports and imports, list of foreign branches and agents. This information is to be accompanied with catalogues, prices current, discount sheets, photographs and small samples—in fact, with all the commercial literature necessary to secure proper recognition of the company's material. The idea of this system is to place before the foreign buyer full data concerning any American manufacturer, making it feasible to send orders by cable in the most direct and economical manner.

Railway and Telegraph Rates in Panama.

United States Consul-General H. A. Gudger, at Panama City, Panama, announces that, for many years, the passenger, telegraph and freight rates for service across the Isthmus of Panama have been very high. It is generally understood, however, that during the present month, the rates will be greatly reduced. In anticipation of this the company has issued a tariff covering the subjects under consideration, in which a considerable reduction is made in charges. The passenger rates across the isthmus have been four dollars gold for first class, and six dollars currency for second class. By the new tariff, a first-class passage will cost $2.40 gold, while the second-class rate will be $2.85 silver. These rates do not cover the charge for baggage, that remaining as heretofore at three cents gold per pound. The old rate for telegrams was one dollar gold for ten words, and ten cents for each extra word. The new rate is twenty-five cents gold for ten words, and two cents for each extra word.

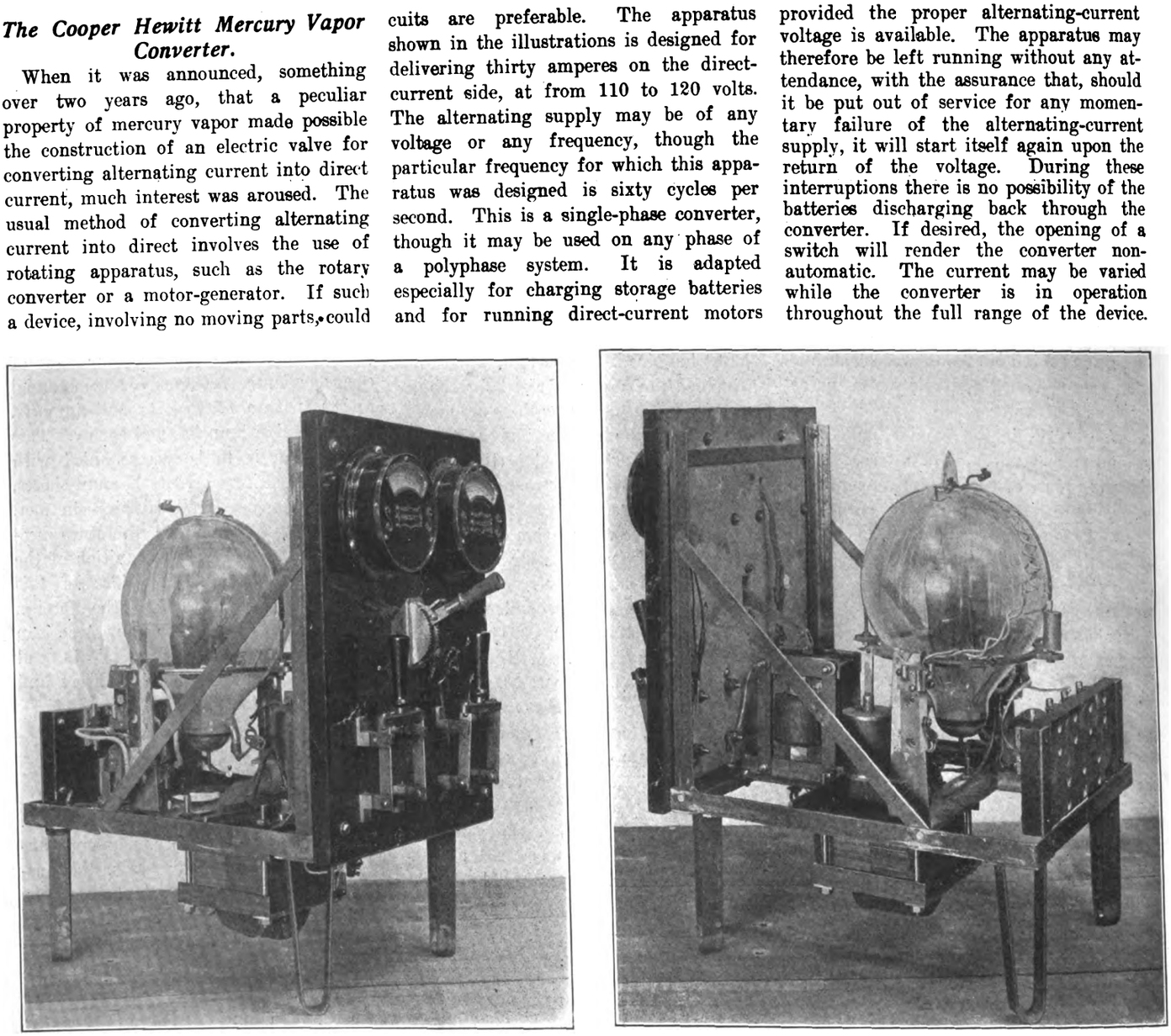
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Cooper Hewitt Mercury Vapor Converter.

When it was announced, something over two years ago, that a peculiar property of mercury vapor made possible the construction of an electric valve for converting alternating current into direct current, much interest was aroused. The usual method of converting alternating current into direct involves the use of rotating apparatus, such as the rotary converter or a motor-generator. If such a device, involving no moving parts, could be produced, it would form a very desirable addition to electrical appliances. This has now been done, and the principle discovered by Mr. Peter Cooper Hewitt is being applied in a commercial device developed by the Cooper Hewitt Electric Company, 220 West Twenty-ninth street, New York city. This device is illustrated in the accompanying photographs.



FRONT AND REAR VIEWS MERCURY VAPOR CONVERTER.

The Cooper Hewitt mercury vapor converter may be used for converting alternating current into direct current for any purpose, but for different uses some changes in the arrangements of the circuits are preferable. The apparatus shown in the illustrations is designed for delivering thirty amperes on the direct-current side, at from 110 to 120 volts. The alternating supply may be of any voltage or any frequency, though the particular frequency for which this apparatus was designed is sixty cycles per second. This is a single-phase converter, though it may be used on any phase of a polyphase system. It is adapted especially for charging storage batteries and for running direct-current motors and mercury vapor lamps. It is also suitable for electrolytic work, and will operate well on a pure resistance load such as incandescent lamps. The outfit, as supplied, is complete, ready for installation in any garage where only an alternating current is available. It operates without any attention after once being started. There are no movable parts except the automatic starter, but this only comes into play when it is necessary to start the converter. The outfit is automatic. To start it it is only necessary to close the alternating-current and the direct-current switches. Should the converter go out for any reason, it will start itself again, provided the proper alternating-current voltage is available. The apparatus may therefore be left running without any attendance, with the assurance that, should it be put out of service for any momentary failure of the alternating-current supply, it will start itself again upon the return of the voltage. During these interruptions there is no possibility of the batteries discharging back through the converter. If desired, the opening of a switch will render the converter non-automatic. The current may be varied while the converter is in operation throughout the full range of the device. This is accomplished by means of a variable inductance in the alternating-current side. The variation of this particular converter is between six and thirty amperes, though a wider range could be secured with some sacrifice in efficiency. The apparatus is stable. It will operate throughout any reasonable range of voltage.

The device, as shown in the illustration, consists of a glass bulb about nine inches in diameter, having at the bottom a mercury electrode, and projecting through the upper part two large electrodes, the terminals of which are solid. This is mounted on a rocking cradle, which is supported upon a stand. The entire apparatus occupies a space about

Digitized by Google

fifteen inches wide, twenty inches long, and twenty inches deep. If desired, it may be mounted on brackets, for attaching to the wall. To the front of the stand is attached the controlling switchboard, and the device is protected at the top and back by a sheet of iron, and on the sides by wire gauze, which allows for ventilation. On the stand are mounted also the regulating inductance, the sustaining coil and the automatic starter. Upon the switchboard are a voltmeter and ammeter, connected in the direct-current circuit. Below are the alternating and direct-current switches, and the handle for regulating the current. This handle shifts the core of an inductance coil which is placed in the alternating-current circuit, and in this way varies the voltage of the supply. The voltage of the direct-current side will vary with the alternating voltage, and thus the current is regulated to the desired intensity.

Without some auxiliary device, a single-phase, alternating-current, when rectified, would form a pulsating current varying through a considerable range. If the current be allowed to die out when the alternating-current voltage is less than a certain low value, the converter would go out, and would require restarting. To avoid this, a sustaining coil is placed in the direct-current side. This is merely a large inductance coil, designed to carry the full load of thirty amperes. Its action is such as to maintain the direct current very nearly constant, and this prevents the converter from going out of operation. However, should the alternating-current voltage fail, and the apparatus go out of operation, the automatic starter will at once restart it.

The device is started by tilting, in a manner analogous to one of the types of Cooper Hewitt mercury vapor lamp. When the alternating-current switch is thrown, a small electromagnet attached to the rocking cradle tilts the converter bulb through an angle, and thus starts an arc between an auxiliary electrode and the mercury electrode. As soon as this is started, the current will begin to flow through the direct-current circuit, if the switch be closed, and the bulb will return to its normal position.

In the apparatus designed for lower alternating-current voltages—say, not above 450—an autotransformer is used for obtaining the proper alternating-current potential. Where higher voltages are used a transformer is better, since this separates the primary and secondary windings.

The efficiency of this apparatus is high for its output. The apparatus is protected by fuses, and may be left in operation over night, if desired, provided there is no risk of overcharging the batteries. It is noiseless in its operation, and as skilled attendance is not required to operate it, it is particularly suitable for garages. All that is necessary to start or stop the apparatus is to close or open the switches. A number of these outfits have been ordered, and are in service.

Single-Phase Motors for Electric Hoist and Traveling Crane Service.

The Wagner Electric Manufacturing Company, St. Louis, Mo., is now prepared to furnish sixty-cycle, single-phase, alternating-current motors for elevator, hoist and traveling crane service. These motors are of the induction type, and possess all the desirable characteristics of the best types of direct-current motors for work of the same character. This single-phase motor possesses in one winding the starting characteristics of the series type of direct-current motor, and the running characteristics of the shunt type of direct-current motor.

Elevator service imposes a heavy static and inertia load at the instant of starting, this load, with the best types of elevators, being about fifty per cent in excess of full running load. The driving motor must therefore develop at the first instant of starting a torque not less than fifty per cent in excess of its full running torque. With the single-phase motor now offered by the company, starting current under full load conditions not exceeding fifty per cent in excess of the full load running current is used. This excess of starting current disappears quickly, since the nature of the service is such as to require an excess of torque momentarily, the first couple of turns of the rope drive eliminating the static and inertia elements. The excess energy demand from the circuit to provide the necessary starting torque is limited to one or two seconds. With the proper controlling mechanism, the starting current will fall to full load current within two seconds after the current is applied to the motor, and will thereafter be practically full load current up to full speed.

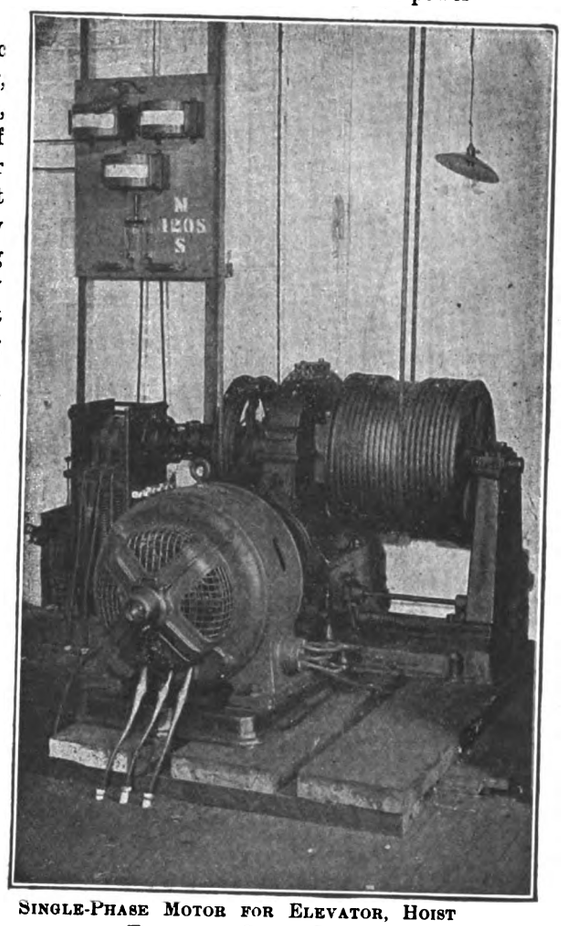
The inherent characteristics of this single-phase motor are such that this load is not abruptly applied to the circuit, but may, with the proper controlling devices, be applied with sufficient gradation to make it possible to serve an elevator motor from a lighting transformer without affecting the lights to a noticeable extent.

The power-factor, as with all types of induction motor, is less than unity. By proper design, the company has been able to secure a power-factor of from eighty per cent to eighty-five per cent, both in starting and at running speed.

Elevator service requires an acceleration from rest to full speed of from four to ten seconds, depending upon the frequency of stops and upon the kind of duty to be performed. The inherent characteristics of this single-phase motor are such that the acceleration can be made anything desired.

Conditions frequently arise in elevator service under which it is desirable to employ the braking power of the motor running as a generator on the down trips. This single-phase motor acts as an induction generator when the armature is rotating at a speed in excess of synchronism.

The company is prepared to furnish this type of construction in all of the usual standard sizes up to and including twenty-five horse-power. Immediate delivery can be made on the ten-horse-power



SINGLE-PHASE MOTOR FOR ELEVATOR, HOIST AND TRAVELING CRANE SERVICE.

size. This size at present is required for probably sixty per cent of elevator service.

At the present time the company has developed controllers for rope control only. It is the expectation, however, to develop other types of control in the near future.

This type of motor is capable of a speed control through fifty per cent of the speed range. Installations requiring service of this sort will be undertaken upon receipt of specifications. This characteristic of the motor will be especially useful with ventilating fans and certain kinds of machine tools.

Digitized by Google

The Case Controller.

The Case Manufacturing Company, Columbus, Ohio, is meeting with considerable success in the application of its "F" and "FS" type controllers. The

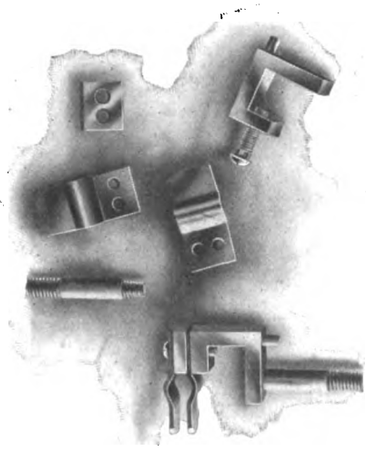


FIG. 1.—PARTS OF KNIFE CONTACTS.

Case Manufacturing Company, in its work of engineering and building cranes and power-transmission appliances, realized the requirements of control for electric motors, as applied to cranes and steel mill work. The design of this controller is radical in many ways. The contacts

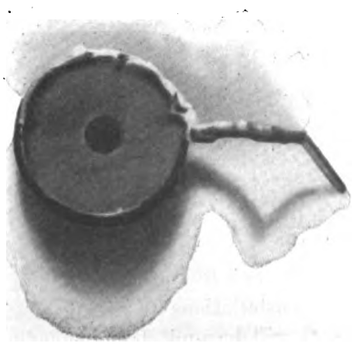


FIG. 3.—BLOW-OUT COIL.

are of large area, and made of hammered copper and phosphor-bronze. The principles involved are similar to the old knife switch, with a hard copper disc passing between the blades in a constant shearing motion. The disc is always in contact with at least two of the contact blades, minimizing sparking between steps. The first step is provided with a quick-break device, making it impossible to prolong the arc by shutting the controller off slowly. The reversing circuit is opened

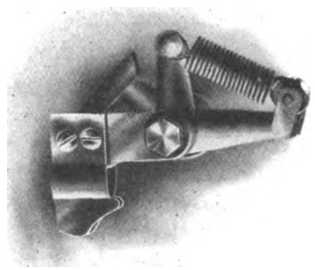


FIG. 4.—QUICK-BREAK CONTACT.

only after the lines have become dead through the action of the quick-break device.

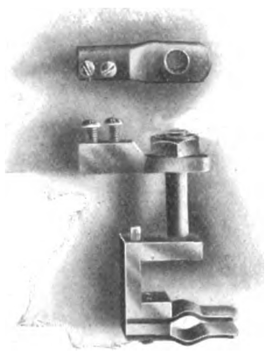


FIG. 2.—KNIFE CONTACT ASSEMBLED.

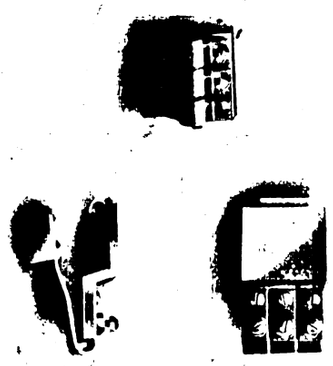


FIG. 5.—REVERSING SWITCH FINGERS.

Fig. 1 shows the various parts of the knife contacts, Fig. 2 showing the knife contacts assembled. These phosphor-bronze knife-blade contacts are easy to replace, requiring the removal of two machine screws to replace each set. The contacts are mounted on a slate slab, and connection to the resistance is accomplished by means of an ordinary brass terminal. The roller knife blade is made of a hammered copper disc, rotating in a strong magnetic field, the arc on the break being at direct angles to the magnetic lines of force across an air-gap of a half inch. Fig. 3 shows the blow-out coil. These coils are wound on a form and dipped in an insulating varnish, thoroughly baked, then taped with friction tape and painted with an insulating compound.

The contacts for reversing the motor

FIG. 7.—INSULATING BUSHING, JUMPER AND COILS' TERMINAL.

are of cast brass of large surface, and machined true. The fingers for the reversing contacts are made of hammered copper, and are of large dimensions. They are carried on phosphor-bronze springs of large sectional area, and in the large sizes, the "pigtail" connector is used to relieve them of the load. They are provided with an adjustment of tension which is easy to operate. They do not perform the function of a switch at any time, as the circuit is always open before they pass off the contacts. Fig. 4 shows the quick-break contact, and Fig. 5 the reversing switch fingers.

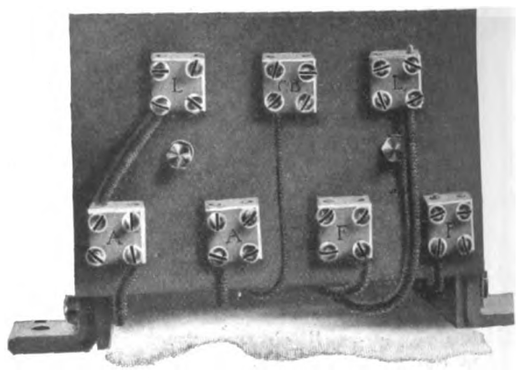


FIG. 8.—TERMINAL BOARD.

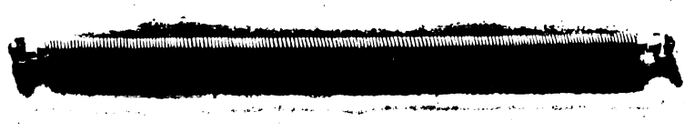


FIG. 6.—RESISTANCE COILS.

Fig. 6 shows the resistance coil. The

Digitized by Google

resistance consists of German steel and iron wire coils on asbestos knobs mounted on formed tin stiffeners. These are supported at either end on a porcelain bushing through a cast-iron channel, the ends of the coil being screwed on to a malleable iron terminal. The cross-connections are

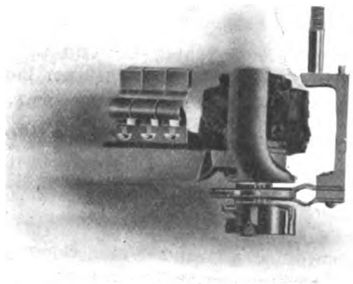


FIG. 9.—CONTROLLER LEVER ASSEMBLED.

accomplished by means of copper ribbon jumpers placed at the top and bottom of the controller, and in order to replace a coil, all that is necessary is to remove two nuts on either end, and the coil comes out without disturbing any other coils or any connections.

The wiring from the resistance coils to the controller is made with underwriters' wire, and asbestos and mica are used liberally for insulation. The terminals are all brought out to a slate terminal board at the base of the controller. All that is necessary to install the controller is to run one wire from each line, two from the fields, and two from the armature circuit to the terminal board. Fig. 7 shows the insulating bushing, jumper and coil terminal. Fig. 8 shows the terminal board.

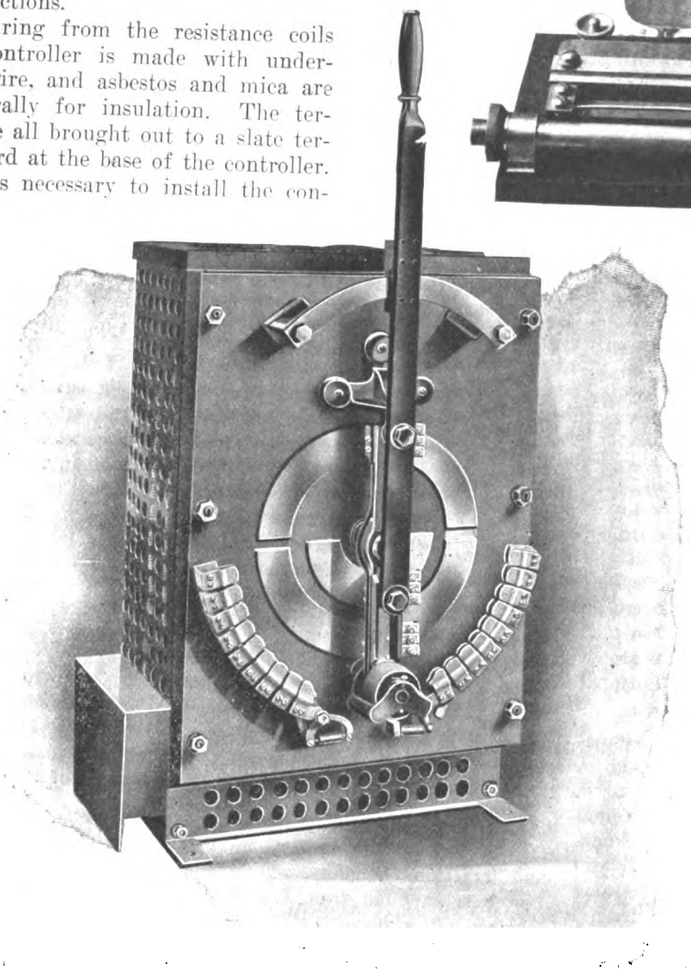
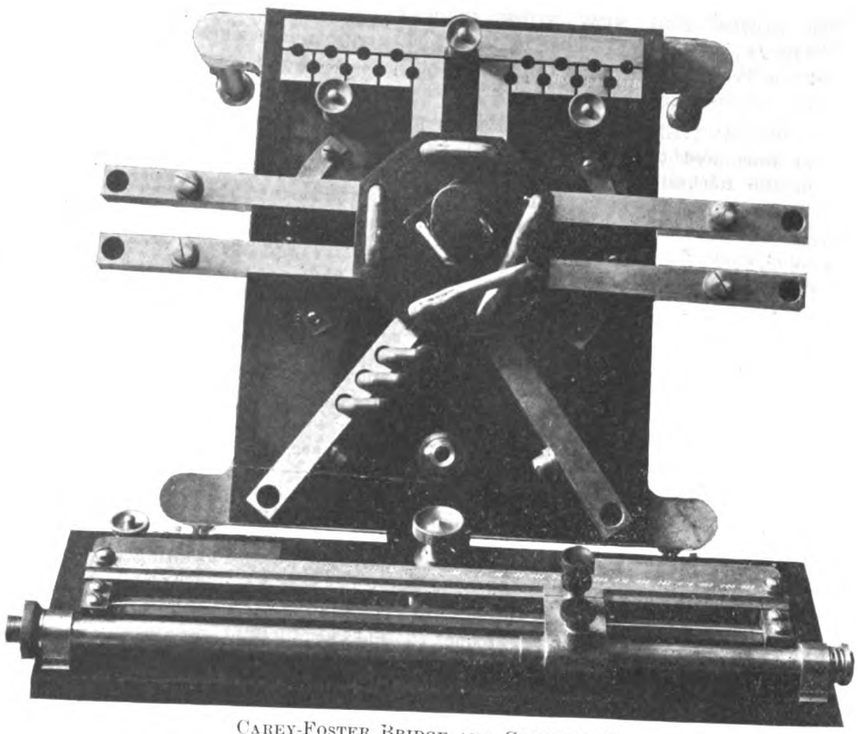


FIG. 10.—THE CASE TYPE F CONTROLLER.

Where especially close regulation is required, such as handling cores and cope on a crane in foundry work, an auxiliary lever is placed on the controller, by means of which is secured double the number of variations of speed. The company states that it can guarantee the control of any series motor from ten per cent of its rated speed to the maximum speed, under any load up to its rated capacity. Fig. 9 shows the controller lever assembled. Fig. 10 shows the type "F" controller.

The Carey-Foster Bridge and Commutator.

The accompanying illustration shows the form of Carey-Foster bridge and commutator made by Queen & Company, Philadelphia, Pa. This apparatus possesses several features of advantage. The bridge and commutator is made in two sections. The section containing the commutator is complete in itself, and can be used with any slide and wire attachments.



CAREY-FOSTER BRIDGE AND COMMUTATOR.

The conductors of heavy copper rod are mounted on a hard-rubber base, around the outside edge of which is a light ribbed brass casting. In each corner of this an adjustable leg is mounted, providing for various styles of resistance standards used in comparisons.

To join up any pair of ratio coils, it is only necessary to insert two plugs in the properly numbered holes to have them connected in circuit. The layout is such that the ratio coils can be joined in series, if desired, thus obtaining an appropriate value for all of the ranges of resistance which may be compared with it.

By reason of the adjustability in height, the Reichsanstalt pattern can be used, with or without the cooling bath.

Three separate shunts are provided for the bridge wire, and any single shunt or combination of shunts can be used. The bridge wire is about 300 millimetres long, with a vernier reading to one-twentieth of a millimetre. The contact device is of Queen & Company construction, which does not allow the bridge wire to be dented through undue pressure upon the key.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

BONDS FOR NEW YORK CITY LIGHTING PLANT APPROVED—Mayor McClellan, of New York city, approved, on March 21, a $600,000 bond issue for money for the purchase of a site for the proposed municipal lighting plant.

ROCHESTER & EASTERN ELECTRIC RAILWAY SOLD—It is announced that a deal has been closed whereby the property of the Rochester & Eastern Railway, in New York, has passed to George L. Lewis, of Buffalo, N. Y. It is said that the price paid for the property was something over $2,000,000. The road runs from Rochester east, through a rich and populous country, to Geneva, N. Y.

NEW TELEPHONE RATES IN NEW YORK CITY—The New York Telephone Company has announced a revision of rates for telephone service, to go into effect on May 1. For 600 messages the rate has been reduced from $75 to $60; for 1,200 messages, it has been reduced from $111 to $87; for 1,800 messages, from $141 to $111; for 2,400 messages, from $165 to $135; for 3,000 messages, from $183 to $159; for 3,600 messages, from $201 to $177; for 4,500 messages, from $228 to $204.

WIRELESS REGULATIONS—The international conference called by the German government to consider questions relating to the regulation of wireless telegraphy and to the granting of international concessions, which was to have been held on April 4, has been postponed to an indefinite date in the near future. The German government has requested that, pending the meeting of the conference, no action be taken by other governments that might be in conflict with the possible action of the conference.

NEW YORK CENTRAL BUYS POWER—It has been announced that the Hudson River Water Power Company has contracted to furnish the New York Central & Hudson River Railroad with 25,000 electrical horse-power yearly for twenty-five years. The minimum charge will be $125,000 per year. Power will be delivered from Speir's Falls and Scoharie Falls, together with current from a temporary steam plant to be erected in Utica, N. Y. The energy will be used in the development of various trolley interests which the railroad company is taking up.

MANHATTAN ELEVATED TO BUILD ADDITIONAL ELEVATED TRACKS—The directors of the Manhattan Elevated Railway Company have voted to build two additional elevated railroad tracks in conjunction with the Second Avenue elevated railroad. The two new tracks will be used for express trains, and at the downtown end will run into the subway, so as to afford a new express route from the Battery to Harlem. The present tracks on Second avenue are along the sides of the thoroughfare, so that there is a wide intervening space between the up and downtown tracks. This space will be utilized for the proposed additional tracks.

MEXICAN ELECTRIC RAILROAD—The Dwight-Furness Company, of Guanajuato, Mexico, which purposes constructing a standard-gauge railroad from Guanajuato to Irapuato, Mexico, with an extension to Salamanca, to connect with the National Railroad, is endeavoring to secure entrance for the road to Guanajuato. It is stated that an offer of $200,000 has been made to the Guanajuato Street Railroad Company for its lines and concessions in the city of Guanajuato, and for its right of way from Guanajuato to Marfil. Surveyors are now in the field laying out the route of the electric line, and it is expected that active construction work will be commenced within a few months.

ELECTRIC LIGHTING.

TEMPLE, TEX.—Thomas Fairweather, of Belton, has purchased the holdings of J .T. Smither in the Temple Water Works Company and the Temple Electric Light Company.

ELGIN, ILL.—The mayor of Elgin has signed the electric light ordinance providing for the turning over of the city plant to the Elgin, Aurora & Southern Traction Company, for a period of ten years.

BALTIMORE, MD.—The new Consolidated Electric Light and Gas Company, of Baltimore, has made a bid of $57.49 per lamp for lighting Baltimore. The city is now paying $99.92 per lamp.

COVINGTON, GA.—Arrangements are being made by the Covington city council for the reestablishment of the city electric lighting plant, which was destroyed on December 26 by the explosion of a boiler.

SANFORD, ME.—The Sanford Light and Water Company has let the contract for its proposed reservoir, on Hansons ridge, to L. N. Farnham. The reservoir will have a capacity of 1,000,000 gallons.

WAYNESBURG, OHIO—The Sandy Valley Heat, Light and Power Company has been granted a fifty-year franchise by the town of Waynesburg, on condition that plant is built and in operation in two years.

SHELBYVILLE, ILL.—A contract for the sale of the plant of the Charleston Gas and Electric Company has been closed by Ning Eley, of Chicago, representing a company of capitalists headed by Senator Shumway, of Taylorville.

ONEIDA, N. Y.—At a meeting of the board of public works the mayor and city clerk of Oneida were authorized to enter into a contract with the Madison County Gas and Electric Company for lighting the city for a term of two years. The contract calls for about $7,000 per year.

PUEBLO, COL.—The trustees of the north side waterworks of Pueblo have decided to install an electric light plant in the pumping station. It will have a capacity of 100 incandescent lamps. The cost of operating will be light because steam can be drawn from the present boiler equipment. The superintendent, Wilson, has been authorized to begin the installation at once.

TRENTON, N. J.—An agreement of merger between the Carteret Electric Light and Power Company and the Middlesex Lighting Company has been filed. The name of the consolidation is to be the Middlesex Electric Light and Power Company. The directors are Thomas M. McCarter, Newark; Albert B. Carlton, Elizabeth; Charles A. Sternberg, East Orange; Thomas C. Burr, Newark; Frederick Evans, New York city. Mr. McCarter is president of the new concern. The capital stock is $200,000.

CANAAN, CT.—The Berkshire Power Company has concluded a deal for the purchase of the Sharon Electric Light and Power Company, of Sharon. The Berkshire company is erecting a large power plant on the Housatonic river, and power from this station will ultimately be used to operate the Sharon business. Work on the dam is being pushed as rapidly as possible. The three waste gates at the west end have been completed, and one section of the dam is now being constructed on the east side of the river.

NIAGARA FALLS, N. Y.—Two 500-kilowatt generators in the De Ceu Falls power station of the Hamilton Cataract Power, Light and Traction Company, of Canada, have recently been started. Power is supplied from the Welland canal feeders, tapped about fourteen miles above the station. The power is transmitted thirty-five miles to Hamilton, at a pressure of 20,000 volts at present, which pressure is ultimately to be increased to 40,000 volts. A reserve steam-driven station at Hamilton contains two 1,000-kilowatt units. The power is used for lighting, traction and manufacturing purposes. At the annual meeting the following officers and directors were elected: president, the Hon. J. M. Gibson; vice-president, James Dixon; treasurer, J. R. Moodie; secretary and general manager, W. C. Hawkins. Directors—John Dickenson, J. W. Sutherland, J. A. Kammerer.

Digitized by Google

TELEPHONE AND TELEGRAPH.

MILFORD, IOWA—Milford has granted a franchise to the Midland Telephone Company.

LITTLE ROCK, ARK.—Poles are being erected and wires strung for a new exchange at Atkins.

CORVALLIS, ORE.—The Independent Telephone Company has purchased the Alsea telephone line.

MISHAWAKA, IND.—The Central Union Telephone Company has been granted a franchise in River Park.

WILLARD, UTAH—The Willard city council has granted a franchise to the Independent Telephone Company.

GLASSBORO, N. J.—The Rural Telephone Company has obtained right of way through Glassboro and Clayton.

MONTREAL, QUEBEC—The Bell Telephone Company has decided on the erection of a large branch exchange building.

CAMDEN, TENN.—A new telephone line will be built from Cooley's Landing, to a point on the Tennessee river, to Camden.

ANGOLA, N. Y.—The Hanover Telephone Company is building a new line from Brant to North Collins, to tap the Frontier system.

GARDNER, MASS.—The New England Telephone and Telegraph Company is to establish a telephone exchange in Hubbardston.

RENSSELAER, N. Y.—The Hudson River Telephone Company has purchased a site on which it will shortly erect a new exchange.

NEWARK, N. J.—The Chester Telephone Company will extend its line to German Valley, Middle Valley, Vernoy and Califon this spring.

COSHOCTON, OHIO—The sum of $35,000 is to be expended on the Coshocton exchange of the Bell Telephone Company this summer.

LYNCH STATION, VA.—The Carion Telephone Company, organized by Walter Fauntleroy and W. S. Frazier, is extending its line to Leesville.

WHEELING, W. VA.—An ordinance permitting the Pittsburg & Allegheny Telephone Company to build its lines in Canonsburg, Pa., has been signed.

CLINTON, N. J.—The Merchants and Farmers' Telephone Company is arranging to extend its line from Clinton to Glen Gardner, Junction and Asbury.

VAN ETTEN, N. Y.—The Nanticoke Valley, the Newark Valley and the Foster Valley telephone companies have united with the York State Telephone Company.

FINDLAY, OHIO—A telephone extension will be made from the Benton Ridge Mutual central office, following the Benton Ridge road into Findlay corporation limits.

SALT LAKE CITY, UTAH—The Rocky Mountain Bell Telephone Company is planning some important improvements in Bingham, owing to the rapid increase in business.

BIRMINGHAM, ALA.—The People's Home Telephone Company has secured a franchise to extend its lines to Woodlawn, a suburb of Birmingham, with 5,000 population.

BLOOMFIELD, IOWA—The Mid-Western Electric Company, of Cedar Rapids, has bought the Davis County telephone system, and will make make extensive improvements.

REDDING, CAL.—The Sunset Telephone Company has purchased the line of the Trinity Copper Company between Redding and Kennett, and will use it for public service.

WHEELING, W. VA.—The farmers living between St. Clairsville and Warnock have organized and will install a telephone system. There will be about thirty-five telephones on the line.

BIRDSBORO, PA.—The Conestoga Telephone Company will extend its lines into Union, following the Schuylkill road, and branching out to connect with patrons adjacent thereto.

HOUGHTON, MICH.—The Bell Telephone Company has arranged to extend its line from Nestoria west along the south shore, making short connections between Duluth, Marquette and the copper country.

TOLEDO, OHIO—The farmers about Muntanna are erecting a mutual telephone line. Those residing near Wisterman have organized a mutual telephone company also, with H. D. Taylor as president.

YOUNG HICKORY, N. Y.—The extension of the farmers' mutual telephone line to connect with the line of E. H. Austin, Jr., has been completed. This will give connection with Troupsburg and points east.

ROCKFORD, ILL.—Stockholders of the Winnebago County Telephone Company at a recent meeting voted to borrow $15,000 to complete the work of construction. W. F. Atley, of Durand, was elected a director.

BAY CITY, MICH.—District Manager Saunders, of the Michigan State and the Northeastern Telegraph and Telephone companies, announces the completion of the improvements in the telephone service in the Tawases.

STAMFORD, CT.—Contracts are soon to be let by the Southern New England Telephone Company for the work of laying conduits between Stamford and Bridgeport, preliminary to putting the toll-line wires underground.

SEDALIA, MO.—The merchants and farmers at Houstonia have formed a local telephone company and will put in an exchange. The officers are: M. P. Tuck, president; C. T. McConnell, secretary; Glen Robertson, treasurer.

MILTON, KY.—At a meeting of the citizens of Trimble County it was decided to form an independent telephone company, to connect Bedford and Milton and other points in Kentucky. The capital of the concern will be $15,000.

WEST POINT, VA.—The West Point town council has granted a franchise to the Southern Bell Telephone Company, of Richmond, for the use of the streets in erecting and operating a local and long-distance telephone system.

LYNCHBURG, VA.—All of the formalities concerning the granting of the telephone franchise to the Southern Bell Telephone Company for the right to construct and operate a modern telephone system in Lynchburg have been completed.

CORNING, N. Y.—The Campbell & East Campbell Telephone Company will build a line connecting Campbell and East Campbell. This line will exchange service with the Campbell & Risingville Telephone Company, and also with the Inter-Ocean company.

GUTHRIE, OKLA.—The Waynoka Telephone Company, to be located in Woods and Woodward counties, has been organized. J. A. Green, J. F. Scraman, G. P. Chestnut, R. A. Hendrie, E. P. Clapper and D. P. McNally, all of Waynoka, Okla., are the incorporators.

ST. LOUIS, MO.—At the annual meeting of the Laddonia, Rush Hill & Mexico Telephone Company, D. L. Rodgers was elected president to succeed J. N. Rosser. The other officers elected are: E. A. Fentz, secretary, and John Fry, J. W. Rosser and Earl Cunningham, directors.

PORT BYRON, N. Y.—The Port Byron Telephone Company has let the contract for constructing upward of fifty miles of new lines to Claude P. Taylor & Company, of Penn Yan. All the material for the work has been purchased, and work will begin as soon as the material arrives.

WATERVILLE, N. Y.—At a meeting of the directors of the Waterville Telephone Company the following officers were chosen: president, I. D. Brainard; vice-president, S. W. Goodman; secretary, H. M. King; treasurer and general manager, Parks A. Terry. The company is capitalized at $25,000.

MUSCATINE, IOWA—Six new telephone lines will be constructed north of Muscatine during the next two months. The lines will radiate from Flat Iron Point, and will extend for several miles in all directions from that place. The telephone instruments will all be of the latest type.

UNIONTOWN, PA.—The Tristate Telephone Company will begin shortly the construction of the line from Uniontown to Brownsville. The line is twelve miles long and will be finished in six weeks. No toll will be charged on the line between the two cities

Digitized by Google

nor to other parts of Fayette County. The direct line of the Tri-state company from Connellsville to Baltimore has also been completed.

MILWAUKEE, WIS.—The Wisconsin Telephone Company has re-elected as directors E. G. Bigelow, F. H. Whitcomb, Charles Ray, Ira B. Smith and Alonzo Burt, all of Milwaukee, and the following from Boston: F. Fish, John Balch, Phillip Dexter, W. S. Hutchinson, H. J. Pettingill and Thomas Sherwin.

DOWNEY, CAL.—The Home Telephone Company has completed the building of its system in Downey, and is working on the connections with Rivera, Clearwater and Norwalk. The Downey office will be central for the neighboring country. Seven carloads of material have been ordered to complete the work.

ST. PAUL, MINN.—The Torah Telephone and Improvement Company, of Torah, Minn., has filed articles of incorporation. J. J. Ahnman, F. Wurst and R. T. Zemple, all of Torah, are the incorporators. The company will furnish telephone service to Richmond, and will also install an electric light plant in the town.

HANNIBAL, MO.—The Missouri & Kansas Telephone Company has accepted the ordinance passed by the Hannibal city council, granting the company a franchise for an exchange in that city. The franchise is for twenty years. The city is to receive two and one-half per cent of the company's gross receipts annually.

CONCORD, MICH.—At a meeting of the Concord telephone system the following officers were elected for the following year: trustees, Edward Ford, Albert Hubbard, Charles W. Dart, John C. Root and John H. Magel. The trustees elected Edward Ford, president; Albert Hubbard, secretary, and John C. Root, treasurer.

SALT LAKE CITY, UTAH—The Pacific States Telephone Company announces its intention of building east from Reno to the Utah state line within the next few months, connecting with the lines of the Rocky Mountain Bell Company, of Utah. The line between Reno and Ogden will be 400 miles, and the work of construction will not occupy over two months.

OBITUARY NOTICES.

MR. JOHN CAMPBELL, manager of the power-house of the Interborough Rapid Transit Company at Fifty-ninth street, New York city, died suddenly on the evening of March 18.

MR. THOMAS J. McTIGHE, a veteran inventor and promoter of electrical and mechanical apparatus, died suddenly at Salisbury, N. C., on Friday, March 24. He had been failing in health for some time. He was remarkably versatile in invention, and in the earlier days of electrical engineering contributed much to the advancement of the art. His late residence was at 2012 Cropsey avenue, Bensonhurst, Brooklyn, and he was buried at Greenport, Pa., on Tuesday, March 28.

MR. CHARLES H. SEWALL, of 1964 Seventh avenue, New York city, son of Dr. Samuel G. Sewall, died on Sunday, March 26, aged fifty-eight years. His death was followed on Monday by that of his wife, Jennie Hoover Sewall, aged fifty-nine years. Mr. Sewall was born in Skowhegan, Me., and was well known in telegraph and electrical circles. He acquired the printers' trade in his early years, and was a compositor on the Lewiston, Me., *Journal;* afterward he became a telegrapher serving in the Civil War, and was manager of the International Telegraph Company at Portland, Me., and Boston, Mass. In 1878 he became manager of the Atlantic & Pacific Telegraph Company at Albany, N. Y., and established there one of the first telephone exchanges, operating it upon the messagerate plan, the first exchange, it is believed, to be so operated. Mr. Sewall was also, as a member of the firm of Pope, Sewall & Company, instrumental in the organization of the Citizens' Illuminating Company, of Brooklyn, and through it the introduction of central station lighting into Brooklyn. He was for a number of years superintendent of the American District Telegraph Company in New York city. Mr. Sewall was the author of several books on telephony and wireless telegraphy. A father, son and daughter survive Mr. and Mrs. Sewall.

DR. ELMER HEWITT CAPEN, president of Tufts College, died on the morning of March 22. President Capen would have completed thirty years as head of Tufts College next June, having been elected on March 13, 1875, and inaugurated on June 3 following. President Capen was responsible for what is probably one of the most remarkable growths of a college institution in the history of education. From what would now be considered a small academy with a theological seminary attached Tufts College grew during President Capen's administration into a flourishing university—one of the great educational institutions of the land. With all his work as an administrator President Capen found a great deal of time for actual classroom work. He taught ethics and political economy for many years, and also the ancient and international law. Tufts College was the first New England college to substitute modern languages for Greek as an admission requirement, and to omit Greek as an essential to the degree of A. B. Likewise, this college took the lead in granting degrees upon completion of a definite number of term hours, rather than on the length of time spent in college. During Dr. Capen's administration Tufts was the first American college (in 1882) to offer a course in electrical engineering.

MR. CHARLES C. WARREN, president of the Warren Electric Manufacturing Company, Sandusky, Ohio, died on Wednesday morning, March 21. Mr. Warren was one of the pioneers in electric railway development, and for many years was a leading figure in the electrical world. Mr. Warren began his personal business career in Michigan as a merchant, serving for a time as cashier of a national bank, and subsequently becoming the founder and proprietor of what afterward developed into the Woolson Spice Company, of Toledo. He was the Chicago manager of extensive eastern electrical interests for some years before he went to Sandusky, Ohio. His first business enterprise in Sandusky was the purchase of the old Rockwell Manufacturing Company, formerly known as the Barney & Kilby plant. In its place was established the Warren Electric Manufacturing Company. Of this company Mr. Warren was president until his death. Mr. Warren in his business relations always took a peculiar interest in his employés and associates. In his administration of the affairs of the company he was untiring in his efforts to improve the situation of all whom he gathered about him. Socially he was a man of excellent qualities, and had a wide range of acquaintances and friends throughout the country. He was one of the leading promoters and active members of the interlake yacht clubs, and at the time of his death held the office of commodore. He was a member of the Men's Literary Club, of Sandusky, and took a faithful part in the upbuilding of this association. He was a freemason and a member of the Order of Elks. His death is a serious loss to the city of Sandusky and to those who have worked with him and known him for so long a time.

MR. CHARLES C. WARREN.

LEGAL NOTE.

INCANDESCENT LAMP SUITS—The General Electric Company has brought suits in the United States Circuit Court for the Southern District of New York against the Jaeger Miniature Lamp Manufacturing Company, alleging infringement of patent to H. J. Jaeger, on dental incandescent electric lamps, No. 692,294; and against the Kimball Electric Construction Company in the same court, for selling lamps manufactured by the Germania Electric Lamp Company, alleging infringement of Branin patent No. 532,760. Bills were filed on March 9. The Edison Electric Light Company had commenced suits, under date of March 13, against the Elmwood Mills, Providence, R. I., in the United States Circuit Court for the District of Rhode Island, and against the Electric Contract Company in the United States Circuit Court for the Southern District of New York, for alleged infringement of patent to Edison, numbered 544,530.

Digitized by Google

PERSONAL MENTION.

MR. C. W. TAGGARD, of Middletown, Ct., has been appointed superintendent of the new municipal electric lighting plant at Burlington, Vt.

MR. M. J. FRENCH, roadmaster of the Rapid Transit Railway, of Syracuse, N. Y., has resigned to become engineer for the Utica & Mohawk Valley Railway Company. His headquarters will be at Utica, N. Y.

MR. EDGAR W. DENNISON, who was for thirteen years in the employ of the New York & New Jersey Telephone Company, in New Jersey, has been made secretary of the Edison Manufacturing Company, Edison Phonograph Works, National Phonograph Company and Bates Manufacturing Company.

MR. LOUIS J. AUERBACHER, engineer for the Sarco Company, New York city, sailed on March 25 on the steamship Minnetonka for London. Mr. Auerbacher will make a long trip in the United Kingdom and the Continent, visiting all the prominent cities and making a careful study of all electrical installations.

COMMANDER R. E. PEARY, the Arctic explorer, gave an illustrated lecture at the Catholic Club, New York city, on March 19. He outlined the plans of his coming trip in search of the North Pole, and told of his expectations. One of the principal features of these plans will be the establishment of wireless telegraph stations along his course to the north. The new ship which Commander Peary will use is to be equipped with wireless apparatus, so that he may order supplies from some northern port. Wireless stations will be established at Cape York and Cape Sabine.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—The New York section of the American Electrochemical Society held the first of its social meetings on Saturday evening, March 25, at the Chemists' Club, New York city. Dr. P. L. T. Héroult, of France, was the guest of the evening.

ENGINEERS' CLUB, OF ST. LOUIS—The next meeting of the Engineers' Club, of St. Louis, will be held on Wednesday evening, April 5, at the club-rooms, 3817 Olive street, St. Louis, Mo., at 8.15 P. M. Mr. E. G. Helm will deliver a lecture on "The Levee and Drainage Problem of the American Bottoms."

LECTURES BEFORE THE ELECTRICAL ENGINEERING SOCIETY OF COLUMBIA UNIVERSITY, NEW YORK CITY—The following programme of lectures before the Electrical Engineering Society of Columbia University, New York city, has been announced: April 5, "Elevators," by W. W. Lighthipe; April 18, "Alternating-Current Railways," by J. H. Hallberg; May 3, "The Storage Battery," by F. J. White; May 17, "Electrochemical Industries," by Professor C. F. Chandler. There will also be a lecture on central stations, by H. G. Stott, at a date to be announced later.

INSTITUTION OF ELECTRICAL ENGINEERS, OF GREAT BRITAIN—The Journal of the Institution of Electrical Engineers, of Great Britain, for February, 1905, contains an interesting paper upon "Hydrodynamical and Electromagnetic Investigations Regarding the Magnetic Flux Distribution in Toothed-Core Armatures," by H. S. Hele-Shaw, Alfred Hay and P. H. Howell; a paper entitled "Studies in Magnetic Testing," by G. F. C. Searle, and a paper entitled "The Use of Iron in Alternating-Current Instruments," by W. E. Sumpner. This issue also contains the report to the council on the International Electrical Congress, at St. Louis, and the presidential address of B. J. Arnold, which was delivered at the joint meeting of the American Institute of Electrical Engineers and the Institution of Electrical Engineers, of Great Britain. There are given, as well, the discussions on the various papers noted above.

ELECTRICAL SECURITIES.

While the general average of prices is well below the high level for the year, there has been so much of a recovery from the reactionary proceedings of the past two weeks that in no quarter is there heard a sentiment which could be interpreted as apprehensive of future development. The reactionary development, as has been noted before, was brought about by conditions which were logical in the extreme. Unattended by news influence of any importance, certain manipulators forced prices down to a point from which a healthy start can again be made. Reports of large current and prospective earnings will aid materially in upholding the value of all the prominent industrials. It is freely predicted that a bull movement will be under way even before a full realization of the effects of the temporary reaction. As to the general trade or industrial outlook, further activity and expansion are looked for. Railroad earnings reflect increased traffic, and this would seem to indicate a much larger production on the part of every branch of trade.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MARCH 25.

New York:	*Closing.*
Brooklyn Rapid Transit	67⅜
Consolidated Gas	208
General Electric	187
Interborough Rapid Transit	209¾
Kings County Electric	200
Manhattan Elevated	168½
Metropolitan Street Railway	122½
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	190

Directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 2½ per cent on the preferred and the assenting and non-assenting stocks, payable April 10.

Boston:	*Closing.*
American Telephone and Telegraph	144¼
Edison Electric Illuminating	254
Massachusetts Electric	66
New England Telephone	136
Western Telephone and Telegraph preferred	100

The American Telephone and Telegraph Company announces that, under an agreement with the trustee, the principal and interest of the 4 per cent collateral trust bond of the company, due in 1929, will, at the option of the holder, be payable as they become due in gold coin of the United States of the present standard of weight and fineness. If desired these bonds will be stamped accordingly on presentation to the Old Colony Trust Company, Boston, Mass., on or after May 1, 1905.

The Western Telephone and Telegraph Company has issued its annual report for the year ending January 31 as follows: total receipts, $1,408,215; expenses, interest, taxes, $533,124, making the net revenue $875,091; dividends, $800,000, leaving a surplus of $75,091, as compared with $59,630 in 1904, and $33,849 in 1903. The business of the companies in which the Western Telephone and Telegraph Company is interested, and from which its revenues are derived, has shown continued improvement over that of previous years. The number of exchanges operated by these companies at the end of 1904 was 325, and the stations connected with these exchanges numbered 149,431, an increase during the year of 17,094. The expenditures within the year for the extension of various properties have been $1,739,271. At the annual meeting of the company directors were reelected.

Philadelphia:	*Closing.*
Electric Company of America	11⅞
Electric Storage Battery common	83
Electric Storage Battery preferred	83
Philadelphia Electric	10¾
Philadelphia Rapid Transit	30¾
United Gas Improvement	116⅜

Electric Storage Battery directors have declared the regular quarterly dividends of 1¼ per cent, both on the common and preferred stocks, payable April 1.

Mr. Henry W. Phipps, of Pittsburg, has been elected a director of the Philadelphia Rapid Transit Company to take the place of Michael Murphy, resigned.

Chicago:	*Closing.*
Chicago Telephone	141
Chicago Edison Light	169
Metropolitan Elevated preferred	64
National Carbon common	45
National Carbon preferred	114
Union Traction common	10½
Union Traction preferred	39

Northwestern Elevated has paid to the city of Chicago a check for $15,248.83, as 10 per cent of the gross receipts of the Union Loop during the six months ended December 31, 1904. The check for the same period of 1903 was $16,511.

Digitized by Google

NEW INCORPORATIONS.

WINDHAM, OHIO—Windham Telephone Company. $10,000.

ALBEMARLE, N. C.—Lucas Telephone Company. $10,000.

LINCOLN, NEB.—Staplehurst Telephone Company. $5,000.

LAKE CITY, MINN.—Dwelle Telephone Company. $100,000.

DES MOINES, IOWA—Calumet Telephone Company. $1,000.

WILMINGTON, DEL.—Delaware Interurban Railway Company. $500,000.

LINCOLN, ILL.—Lincoln & Mt. Pulaski Interurban Railway Company. $25,000.

CHICAGO, ILL.—Globe Light and Heat Company. Decreased from $500,000 to $50,000.

CLEVELAND, OHIO—Brilliant Electric Company. Increased from $75,000 to $125,000.

INDIANAPOLIS, IND.—Indianapolis & Cincinnati Traction Company. Increased to $2,000,000.

EAST PALESTINE, OHIO—Unity Telephone Company. $8,000. Incorporators: J. F. Johnson and others.

ALBANY, N. Y.—Long Island Central Telephone and Telegraph Company. Increased from $5,000 to $100,000.

BRUCE, ILL.—Bruce Mutual Telephone Company. $2,500. Incorporators: C. C. Luttrell, J. W. West, F. E. Bundy.

WAUSAU, WIS.—Wisconsin River Traction Company. $30,000. Incorporators: Neal Brown, G. D. Jones and Carl Mathie.

ANACONDA, MONT.—Silver Bow Electric Company. $5,000. Directors: Eugene Carroll, Frank H. Miles and A. G. Elerick.

FORT RITNER, IND.—Fort Ritner Telephone Company. $486. Incorporators: E. C. Wicker, W. A. Holland, Thos. A. Holland.

APPLETON, ME.—West Appleton Telephone Company. $10,000. Incorporators: A. Millett, Searsmont; C. R. Bartlett, Appleton.

DECATUR, ILL.—Consumers' Electric Company. $50,000. Incorporators: W. M. Bering, Charles S. Needham and James M. Gray.

BUTLER, IND.—Toledo, Fort Wayne & Chicago Railroad Company. $10,000. Incorporators: G. E. Cummings, John White, J. S. Clark.

CHARLESTON, ILL.—Charleston Illuminating Company. $1,000. Incorporators: George M. Sefton, Flavien Mason, E. C. Jenks, J. C. Brooks, Eli Huron.

SIOUX CITY, IOWA—Bronson Telephone Company. $5,000. Incorporators: M. G. Smith, H. H. Onstot, D. B. Semple, D. D. Law and George W. Elliott.

WEST TERRE HAUTE, IND.—Farmers and Merchants' Mutual Telephone Company. $5,000. Incorporators: W. F. Tiffin, Jas. H. Davis, M. T. Goodman.

GREENVILLE, S. C.—Saluda River Power Company. $300,000. Incorporators: Lewis W. Parker, A. G. Furman, J. I. Westervelt and H. J. Haynsworth.

JERSEY CITY, N. J.—The Interurban Electric Construction Company. $125,000. Incorporators: J. J. Reed, De Witt V. D. Reilly and K. K. McLaren.

ALBANY, N. Y.—New York Independent Telephone Company. $50,000. Incorporators: Otho S. Lee, Jr., James M. Woods, H. S. Gould, all of New York city.

COLUMBUS, OHIO—Montgomery County Electric Company. $100,000. Incorporators: Robert P. Nevin, Fred A. Funkhouser, F. G. Withoff, R. R. Knowles and W. R. Craven.

SOUTH McALESTER, I. T.—Choctaw Electric Company. $150,000. Officers: A. E. Pierce, president; C. G. Wehrley, vice-president; M. M. Lindley, secretary; A. W. Thomas, treasurer.

MEMPHIS, TENN.—The Pine Bluff & Southern Railway. To build a line from Pine Bluff, Ark., through Lincoln and Jefferson counties to Star City, a distance of thirty miles. $400,000.

OCEAN PARK, CAL.—Citizens' Gas and Electric Company. $7,500. Officers: Frank E. Bundy, president; A. E. Barke, vice-president; A. E. Robinson, treasurer, and F. C. Lamb, secretary.

LONDON, KY.—Cumberland River Telephone Company. To construct lines from Barbourville, Ky., to Keely, Tenn., *via* Williamsburg, Ky. $5,000. President, John Woodward; secretary and treasurer, L. R. Benjamin.

CRENSHAW, ALA.—Luverne Electric Light and Water Company. $10,000. Incorporators: J. R. Horn, R. G. Reddoch, J. O. Sentell, E. O. Bishop, J. M. Cody, T. W. Shows, F. M. T. Tankersley, T. I. Morgan and B. R. Bricken.

ALBANY, N. Y.—Robinson Telephone Company. To operate in St. Lawrence and Franklin counties. $10,000. Directors: T. J. Robinson, of Potsdam; W. F. Robinson, of Addison, Vt., and Lindley Robinson, of Crary's Mills.

SANTA FE, N. M.—The Rio Grande Valley Electric Railway. To build an electric line sixty-five miles long from El Paso, Tex., to the mining camp of Organ, in Dona Ana County, *via* Las Cruces, Dona Ana and Anthony. $1,000,000.

WHEELING, W. VA.—The Mannington Light and Power Company. To construct and operate an electric railway between Fairmont and Mannington. $100,000. Incorporators: W. H. Furbee, J. M. Barrack, F. W. Batlett, George W. Bowers and L. S. Schwenk, all of Mannington.

FARIBAULT, MINN.—The Rice County Rural Telephone Company. $100,000. Officers: A. G. Chase, president; Isabella G. Chase, vice-president; W. T. Mollison, secretary and treasurer; W. T. Mollison, Cora B. Mollison, Isabella G. Chase, Catherine G. Chase and A. G. Chase, directors.

ALBANY, N. Y.—Corry, Findlay Lake & Northeast Railway. To operate an electric road, sixteen miles long, in Chautauqua County, on the border line between New York and Pennsylvania. $130,000. Directors: Charles P. Northrup, of Warren; M. H. Raymond and A. L. Bush, of Corry, Pa.; Ross Knight, of Westfield, N. Y.

ALBANY, N. Y.—The Chemung Valley Traction Company. To operate a street railway line eighteen and one-half miles long, from Elmira to Waverly. $700,000. Directors: E. E. Buchanan, Boyd McDowell, George McCann, George H. Davidson, J. E. Rawlins, J. Henry Clark and Fred D. Herrick, of Elmira, and J. E. Ford and P. L. Lang, of Waverly.

PERTH AMBOY, N. J.—Citizens' Light, Heat and Power Company. $125,000. Incorporators: Jacob Goldsmith, Fred J. Cox, John K. Sheehy, Louis Briegs, Max Goldberger, Edward M. Kelly, Ambrose P. Kenedy, George F. Reynolds, Clarence Sexton, Henry McCullough, C. D. Boynton, Nathan Roth, Jacob Goldberger, Barnet Goldman, Peter Floersch, John P. Holm and Jesse Sickles.

ALBANY, N. Y.—The Bronx, Yonkers & White Plains Railway Company. To operate an electric railroad line eleven miles long from Yonkers to White Plains, there to connect with the Harlem division of the New York Central & Hudson River Railroad Company. $110,000. Directors: W. H. Whittaker, J. H. Matthews, G. A. Matthews and W. C. Shires, of New York city; F. S. Fisher, E. M. Booth, Patrick McCann, Nathan Fernbacher and I. M. Hunt, of White Plains.

LITTLE ROCK, ARK.—The Little Rock & Hot Springs Electric Railway Company. $2,000,000. Officers: president, C. J. Kramer, Little Rock; first vice-president, L. Garrett, Springfield, Mo.; second vice-president, A. S. Blodgett, Springfield, Mo.; secretary, J. C. Marshall, Little Rock; treasurer, George W. Rogers, Little Rock. Directors: Max Mayer, W. W. Dickinson, W. S. Mitchell, C. L. Ketcham, P. M. Pierce, H. Murdock, M. D. Welch and B. Bowman and the officers.

ALBANY, N. Y.—Electric Bond and Share Company, of Schenectady. To conduct a railway, electric, gas and hydraulic equipment business. $4,000,000. Directors: Marsden J. Perry, of Providence, R. I.; Philip L. Saltonstall and Robert Treat Paine, 2d, of Boston; Jacob K. Newman, of New Orleans; Charles A. Coffin, Charles W. Wetmore, Alden M. Young, Sidney Z. Mitchell, S. Redding Bertron, William M. Barnum and Louis B. Stanton, of New York city; Homer B. Johnson, of Cleveland; William B. McKinley, of Chicago; Hinsdill Parsons, of Schenectady; William H. Alms, of Cincinnati, and Dwight W. Morrow and Graham Sumner, of Englewood, N. J.

Digitized by Google

ELECTRIC RAILWAYS.

GULFPORT, MISS.—It has been decided to build an electric road to connect Gulfport with Biloxi.

DOVER, N. J.—The trolley line from Camden to Haddonfield will be extended to Clementon shortly, and eventually to Berlin.

KINGSTON, ONT.—The Kingston Street Railway Company has passed into the hands of the bondholders, who held a mortgage for over $150,000.

LOCKHART, TEX.—The business men of Lockhart have taken the initial steps toward the construction of an interurban route to intersect the San Marcos route.

SPRINGFIELD, OHIO—Surveyors have begun work on a traction line it is proposed to build from Springfield to Lima by way of Catawba, Mechanicsburg and Marysville.

OAKLAND, CAL.—A contract has been granted by the supervisors of Bakersfield for the completion of the Kern River road between Bakersfield and Hot Springs Valley for $21,000.

BOLIVAR, N. Y.—Wellsville capitalists are talking of building a trolley line from Wellsville to Bolivar, a distance of fourteen miles. It is proposed to begin the work of construction early this spring. The cost of building the line is estimated at $10,000 per mile.

PARIS, ILL.—The Edgar County board of supervisors has granted the Paris Traction Company a right-of-way on the Chicago road, north from the city limits to Reservoir Park. A franchise having already been secured from the city, the work will proceed as soon as the material can be secured.

ST. LOUIS, MO.—The Sedalia Transit Company, successor to the Sedalia Electric and Light Company, is letting contracts for new rails and several extensions. The property was recently merged with the Sedalia Water, Light and Gas Company, and is now controlled by Horace Rumsey, Joseph Clark and other St. Louisans.

FINDLAY, OHIO—Jerry Reeves, of Canal Dover, chief owner of the Toledo, Findlay & Fostoria electric line, has purchased ties and steel for the construction of a branch line from Fostoria to Pemberville, a distance of seventeen miles, and a branch from Pemberville to Bradner to Prairie Depot, a distance of two and one-half miles.

ST. LOUIS, MO.—The Hillsboro, Ill., city council has granted to the St. Louis & Northeastern Railway Company a fifty-year franchise for the construction and operation of an electric railway over several streets in Hillsboro. The company is preparing to build an interurban line to Litchfield, and the line will ultimately extend to East St. Louis.

SOUTHINGTON, CT.—The contract for building four miles of trolley road, connecting the Meriden, Southington & Compounce Tramway's lines at Milldale and the lines of the Cheshire Street Railway Company at Cheshire, has been let to George J. Roberts, of Philadelphia. The terms of the contract call for the completion of the work by July 15 next.

ZANESVILLE, OHIO—The Muskingum, Coshocton & Tuscarawa Electric Railway Company has been incorporated and organized with John J. Adams, president, James R. Alexander, secretary and treasurer, and Henry I. Buell, chief engineer. The company proposes to construct an electric railway from Zanesville through Coshocton to New Philadelphia.

GENEVA, N. Y.—The Rochester & Eastern Company has decided to build a supplementary electric road between Rochester and Geneva. It is said work will be begun as soon as weather permits. The plans are to build a new line from Canandaigua to Geneva, passing through Shortsville, Clifton Springs and Phelps. At Hathaways Corners the new line will connect with the present one.

POTTSVILLE, PA.—The Tamaqua & Pottsville Electric Railroad Company has been granted franchises for building two branches through the town of St. Clair. This company will, during April, start work on a line from Pottsville, through St. Clair, Frackville and Shenandoah. It is controlled by the Pottsville Union Traction Company, which has a $3,000,000 investment in Schuylkill County.

WALLA WALLA, WASH.—The Walla Walla city council has granted to Edwin S. Isaacs and his successors a franchise for an electric street car system within the corporate limits of the city. The time of the franchise is twenty-five years and provides that the road must be constructed and cars operated in the business district on or before May 31, 1906, otherwise the franchise will be null and void.

MONTGOMERY, ALA.—A controlling interest in the Montgomery Traction Company, which was recently placed in the hands of a receiver, and which operates about ten miles of street railway track and a summer park at Montgomery, has been sold to Philadelphia capitalists. The purchasers also assume all the bonded indebtedness, amounting to $318,000. It is announced that they will improve the present system in the immediate future.

JACKSON, MISS.—The charter of the Durant-Lexington Electric Railway has been approved. The capital stock is placed at $300,000, and the company is to build an electric line from Durant to Lexington, both points being in Holmes County. Construction on the line is to be begun within thirty days. The company, after establishing the connection between the two points named, will extend the road so as to take in other towns in the surrounding territory.

WORCESTER, MASS.—John M. and C. J. Buckley have been awarded a contract to erect the power plant at Lyons, N. Y., for the Rochester, Syracuse & Eastern Railway Company, at a cost of $60,000, the structure to be roofed by July 1. Work will begin April 3. This is part of contracts totaling $300,000 for the Rochester-Lyons division of the electric trolley road to be completed November 15. The system is seventy miles long and parallels the New York Central.

SPEARFISH, S. D.—A mass meeting of business men has been held for the purpose of considering the question of building an electric line to connect Spearfish with Belle Fourche, Deadwood and Lead. It is proposed to raise the money by popular subscription, and it is generally believed that the enterprise will be a success. It is intended to go to the northern hills by way of Belle Fourche. The enterprise is receiving support from the business men of Lead and Deadwood.

AUSTIN, TEX.—The charter of the Houston-Galveston Electric Railway Company, having a capital stock of $1,350,000, has been filed in the secretary of state's office. The company is formed for the purpose of building and operating an electric railway to run between Houston and Galveston, a distance of fifty-four miles. The principal office of the company is at Houston. The board of directors are Frank Pread, William Johnston, R. M. Johnston, George L. Horton and A. D. Trotter, all of Houston.

SOUTH BEND, IND.—At a meeting of the board of directors of the Indianapolis, Logansport & South Bend Traction Railroad Company it was decided to increase the capital stock of the corporation to $100,000. Active operations will begin in the spring as soon as the weather will permit and the work will be pushed to early completion. The company will build from Logansport to South Bend, to connect with a line running to Indianapolis. Surveys have been made and all arrangements perfected for installing the line.

LEXINGTON, OKLA.—Ground has been broken on the Oklahoma City, Lexington & Sulphur Springs Electric Railway, which was projected last summer from Oklahoma City, Okla., to Sulphur Springs, in Indian Territory, a distance of eighty-five miles. It is understood that the grading will be pushed north to Oklahoma City, and it is reported that the road will be in operation between Lexington and Oklahoma City within the next six months. This line of railroad, when completed, will afford an outlet to the fruit growers of Southern Oklahoma.

LEXINGTON, KY.—The Central Kentucky Traction Company has been incorporated, capitalized at $200,000 and backed entirely by Lexington capital. The new company will take over all the holdings of the Fayette Interurban and Bluegrass Consolidated Traction companies. Work on the Lexington-Versailles line will be commenced as soon as the weather will permit, and pushed to completion before the other roads are built. The incorporators of the new company are: Louis Des Cognetts, president of the Lexington Railway Company; D. F. Frazee, J. W. Rodes, Peter G. Powell, W. W. Bain and T. P. Young.

Digitized by Google

INDUSTRIAL ITEMS.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., recently announced in a circular letter that a reduction in the price of "Little Gem" rosettes would be inaugurated, and that shipments from branch offices would be at the same price as in the past.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., is equipping a number of the war department divisions with switchboard and telephone apparatus. A recent shipment to Washington included two fifty-line local battery switchboards.

THE ECCLESTON LUMBER COMPANY, New York city, on April 1 opens its new agency at 44 and 46 Broadway. This company supplies ties and poles in southern cedar and juniper. Orders of any magnitude can be undertaken, and prompt shipments guaranteed.

THE ELECTRICAL APPLIANCE COMPANY, Cincinnati, Ohio, announces that its plant and business pertaining to interior telephones, and all business other than rectifiers, were transferred to the Churcher Electric and Manufacturing Company on March 11, 1905.

THE AMERICAN ELECTRICAL SUPPLY COMPANY, 83-87 Fifth avenue, Chicago, Ill., has secured the sole selling agency for the "Newgard" receptacle. This company has completed a new bulletin descriptive of this material, and will be pleased to mail full information upon application.

ALLIS-CHALMERS COMPANY, of Milwaukee, Wis., U. S. A., will be represented hereafter in West Australia by Mr. F. R. Perrot, and in New Zealand by the firm of John Chambers & Son, Limited. Mr. Perrot's headquarters are at Perth, West Australia, and those of John Chambers & Son, Limited, are at Auckland.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is mailing to the trade a novel folder, calling attention to its fluid flux made with Allen soldering salts. This soldering salt is claimed by the manufacturer to save time and solder, and to ensure a clean, strong and perfect joint. Full information will be sent upon request.

THE SWITCHBOARD MANUFACTURING COMPANY, New York city, has moved to greatly increased quarters at Fifty-eighth street and Eleventh avenue. This company will now have all the manufacturing facilities necessary to meet the increased demand for its lines of distributing apparatus, in the way of switchboards and switchboard equipments.

THE WILLIAMS ELECTRIC MACHINE COMPANY, Akron, Ohio, reports a large number of sales during the past month of its magnetic clutches. Among the purchasers of this apparatus were a state university, a brass rolling mill, an engraving company, and a large clay manufacturing company, showing the diversified application of these clutches.

THE TRAY PLATE BATTERY COMPANY, Binghamton, N. Y., advises that its business has increased to such an extent that it has become necessary to open an office at No. 39 Cortlandt street, New York city, for the care of its sales. In the future the sales department will be in charge of Mr. Harry B. Oakman, who is well known throughout the electrical engineering fields, and especially the storage battery field.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is distributing bulletin No. 2 of its electrical catechism. This number takes up the determination of the units, and an explanation of Ohm's law. This series of bulletins should be preserved, as the catechism is intended to become a handbook of valuable information to engineers. Those on the regular mailing list of the National Electric Company will receive a cover for these issues.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., will be pleased to send the April number of "Graphite" to any one interested in this material. This paper is issued in the interest of Dixon's graphite productions, for the purpose of establishing a better understanding in regard to the different forms of graphite and their respective uses. The April number is especially interesting, containing, as it does, so many illustrations of structures of various natures which have been protected with different graphite materials. The issue is replete with carefully worked illustrations, and the text is illuminating and convincing at the same time.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, has just renewed arrangements with the Stuart-Howland Company, of Boston, whereby the latter company retains the exclusive agency in New England for the "Sterling" and "Sterling Special" types of incandescent lamps. The sales of incandescent lamps by the Stuart-Howland Company for the previous year aggregated over 200,000 incandescent lamps, and it is believed that these figures will be exceeded during the coming twelve months.

FRANK B. COOK, Chicago, Ill., has received a number of orders recently for complete protector equipment for telephone exchanges, both inside and out. Among these are the Red Wing Telephone Company, Red Wing, Minn., 900 pairs of No. 8 protectors for switchboard protection and thirty-five type S. M. cable terminals for outside protection; the Seward Telephone Company, Seward, Neb., 200 pairs of No. 8 protectors and eighteen pole cable terminals, type S. W.; Williamsport Telephone Company, Williamsport, Ind., 520 pairs No. 8 protectors and twenty type S. W. pole cable terminals; Fairbury Telephone Company, Fairbury, Neb., twenty type S. W. terminals for outside protection.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has published the Exide battery instruction book for 1905. This instruction book gives a description of the battery parts, directions for unpacking, charging connections, charging batteries and vehicles, a table giving rates of charging current, and voltages when charging. There is, in addition to all this, a large amount of information covering all conditions under which storage batteries will need attention in ordinary service. The condensed rules for the proper care of batteries are well thought out, and are a ready reference to full information upon this matter. In addition to the text there are illustrations of the parts of the battery, with views showing the proper method of connecting up battery sets.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., announces that on account of the general growth of its business on the Pacific coast it has decided to discontinue all agency arrangements for the sale of its products, and on April 1 will open its new offices in the Rialto Building, San Francisco, Cal., with Mr. A. B. Saurman as manager for the Pacific coast territory. This territory includes Washington, Oregon, Idaho, California, Nevada, Arizona, British Columbia, Alaska and the Hawaiian Islands. Mr. Saurman has, in turn, been connected with the Standard Underground Cable Company in both construction and sales departments at Philadelphia and New York, and for several years was manager of the Boston office. For the past two years his position has been that of manager of the Pacific coast sales department. The Standard Underground Cable Company expects, at an early date, to make announcement of the location and personnel of subsales offices at Los Angeles and Portland. The company reports that its factory at Oakland, Cal., has been unusually busy during the past six months, and that the future on the coast points to its continued activity.

DODGE & DAY, Nicetown, Philadelphia, Pa., have issued bulletin No. 175, entitled "A Modern Industrial Plant." Dodge & Day have made a study of economics as applied to manufacturing establishments, and the engineering work of their mechanical, electrical and architectural departments ensures harmony of building and equipment. The bulletin contains a graphical chart of their organization, and gives illustrations of their methods. It indicates that they are prepared to lay out, construct, equip and systematize new plants, as well as modernize old ones. Dodge & Day were commissioned some time since by the Lehigh Coal and Navigation Company to take charge of its extensive shop improvements at Lansford, Pa., including new buildings, machine tools and electrical equipment. They have been further commissioned to take charge of the erection of a new centrally located power plant. This plant will provide current for the shops of the Tamaqua & Lansford Street Railway, and electrical equipment will be installed in the mines for pumping and transportation purposes. Mr. Herbert Clarke, engineer for the Tamaqua & Lansford Street Railway, will cooperate with Dodge & Day on the specifications for this plant.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 14. NEW YORK, SATURDAY, APRIL 8, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Diamond Dies . . . 559
Responsibility for Accidents . . . 559
The Efficiency of the Incandescent Lamp . . . 560
Popular Electricity . . . 560
Water Rheostats . . . 561
Radium Infection . . . 561
And Still the Wonder Grows . . . 561
Searchlights in Lighthouses . . . 561
The Convention of the Ohio Independent Telephone Association . . . 562
Comparison of New York and London Transit Systems . . . 562
The American Railway Appliance Exhibition . . . 562
An Alternator for 120,000 Cycles per Second . . . 562
Electricity in the Anthracite Coal Mines—I, by Robert Thurston Kent . . . 563
Control of Electric Locomotives, by William Cooper . . . 568
The Infection of Laboratories by Radium . . . 569
Power Capacity of a Running Stream without Storage, by William G. Raymond . . . 570
Letters to the Editor . . . 572
In the Early Days, by Frank B. Rae . . . 573
The Best Economy of the Piston Steam Engine at the Advent of the Steam Turbine, by Professor James E. Denton . . . 574
The Milan Exposition . . . 575
Method of Protecting Against Voltage Rises for Transmission Systems . . . 576
High-Tension Underground Hauling Gear . . . 577
The Siemens & Halske Oscillograph . . . 577
BOOK REVIEW . . . 578
The Faraday Society . . . 579
The New Rolling Road at Cleveland, Ohio, by D. A. Willey . . . 580
High Pressures in Electric Railroading . . . 582
Foreign Scientist to Lecture at Columbia University . . . 583
Magnetic Change Speed Gear . . . 583
New Testing Car of the Berlin Traction Company, by C. L. Durand . . . 584
Electrical Combinations in Germany . . . 585
Electric Motor Cars for British Railways . . . 585
Economy in Recharging . . . 586
Wireless Telegraph Licenses in Great Britain . . . 587
A Correction . . . 587
Suits for Infringement . . . 587
ELECTRICAL PATENTS . . . 588
A Modern Isolated Electric Light Plant, by G. W. Frost . . . 591
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 592
INDUSTRIAL SECTION:
Dan River Power and Manufacturing Company . . . 595
Equipment Being Installed by the Allis-Chalmers Company . . . 595
Automatic Reversible Starters for Alternating-Current Motors . . . 596
New Design of Field Rheostats . . . 597
Valve Gear Used on Engines Made at the Nurnberg Works . . . 597
Removal of General Offices of the Allis-Chalmers Company . . . 597
A Portable Electrical Internal Grinder . . . 597
Fan Outfits . . . 598
Some Recent Installations of Water-Wheels . . . 598
Special Commutators . . . 598
CURRENT ELECTRICAL NEWS . . . 601

DIAMOND DIES.

It is not perhaps generally known that diamonds are used quite extensively as dies for drawing wire of the smallest sizes; for instance, the sizes less than say 0.025 inch diameter. The hardest steel dies are not suitable for this work, for the reason that the wear upon them so enlarges the die that the diameter of the wire is not uniform within the required percentage of variation at the beginning and end of a drawing. Sapphires are also used sometimes for this work. Copper, silver and platinum are the metals usually drawn to the very small sizes. With diamond dies it is practicable to draw platinum to a diameter of five ten-thousandths of an inch. An idea of the fineness of a copper wire drawn to only three one-thousandths of an inch in diameter may be gathered from the fact that in one pound of the metal there are over six miles of such wire.

The weight of the diamonds used for this work is from four to five carats and they are uncut except as to the die. The value of these dies, which, of course, are not of the first water, varies from fifteen dollars to twenty dollars per carat, and several hundred thousand dollars worth of diamonds are utilized as dies in the various wire factories of this country alone.

Skilful, however, as must be the artisans who sink these small dies and attenuated as the wires drawn through them may be, yet neither will stand comparison with the output of the spinnaret of the common spider, which ejects a single thread of silk so fine that 18,000 threads are required to equal in thickness an ordinary single strand of sewing silk.

RESPONSIBILITY FOR ACCIDENTS.

In our hurry to crowd two days' work into one, we frequently take risks which would be avoided by a man who is taking life more leisurely. We run for the passing car, although we know that another one will be along presently. We men, at least, do not hesitate to board moving vehicles, provided, of course, that the guard or conductor will let us on. Indeed, some of us force ourselves into the car against the energetic protest of the man in charge. The same condition prevails in other things. If a risk is possible, some one is sure to discover it and take it.

Since we take so many risks, we, of course, expect accidents to occur occasionally, but each one of us feels that he, at least, is able to take care of himself, and is cautious enough to avoid a mishap. Then, when it does happen, he is apt to feel that he is not to blame because he was careful; hence the company was at fault somehow or other. When one really believes this it does not take much to persuade him that the railway company should pay for its supposed negligence, and to start one of the suits for damages for which the company really should not be held responsible.

But they do things differently in England, as a recent incident shows. It seems that a Russian, who had only recently arrived in England, in his hurry to go somewhere or to get away from some other place, jumped on a moving train of the Central London Railway. As the gate had been shut, he was caught between it and the wall of the tunnel, and was only saved from death by the quick action of the guard, who applied the emergency brake. The worst he suffered was a cut head and the loss of some skin from his legs. As suit for damages was threatened, the company brought the matter up before the court, and the poor foreigner, in spite of his ignorance of English, was fined forty shillings. We have no doubt that this one experience will be sufficient for him. It would be well if some such lesson could be impressed upon us occasionally—that is to say, of course, upon those who take needless risks.

Digitized by Google

THE EFFICIENCY OF THE INCANDESCENT LAMP.

The luminous efficiency of the incandescent lamp is generally accepted as being somewhere between four and six per cent—that is to say, of the total amount of electrical energy delivered to the lamp, only four to six per cent is believed to be converted into luminous rays. This low efficiency, combined with the poor efficiency of our methods of converting the energy of fuel into electrical energy, gives us a final efficiency from coal pile to incandescent lamp that would be disgraceful, where it not better than the efficiency of other methods of lighting. Assuming a fair figure for the efficiency of the generating station, we find that of the energy contained in the coal and converted into heat, less than one-half of one per cent eventually becomes light. It is this fact which makes so important the endeavors being made in various directions to increase the efficiency of the electric lamp, whether arc or incandescent; for while the arc lamp is more efficient than the incandescent lamp, it is still far from what we wish it were.

Poor as the efficiency of the incandescent lamp has been held to be, we are now told that it is not as good as we thought it was. In an article appearing in the *Physical Review* for March, Mr. C. E. Mendenhall gives the results of a recent determination of the luminous efficiency of a carbon filament. A modification of Angstrom's method is used. In this the ratio between the total rays and the visible rays of an illuminant is determined by means of a thermopile. The efficiencies found varied, of course, with the energy delivered to the lamp. At what was supposed to be normal brilliancy, it was only 2.6 per cent, or at least thirty per cent less than the lowest figure accepted previously. This is somewhat disappointing; but, on the other hand, it shows that there is greater room for improvement than had previously been thought. The saving of a quarter of one per cent of the energy contained in coal would seem to be a matter of little concern, but if this could be accomplished at the lamp it would almost double the amount of light which is now obtained from the same amount of coal.

While upon this subject of increasing the efficiency of the incandescent lamp, one or two characteristics of the new tantalum lamp may be mentioned. The filament of this lamp has a positive temperature coefficient. Carbon, as is well known, has a negative coefficient. The resistance of the tantalum lamp, when incandescent, is five times as great as its resistance when cool. The effect of this is to cause a rush of current something like five times the normal at the moment of starting the lamp which causes a momentary flash, the lamp almost instantly coming to its normal brilliancy. It is hardly probable that any condition will arise in which this characteristic of the tantalum lamp would cause trouble. The inductance of the circuit will diminish the effect under ordinary conditions. Still, the effect is there and should be borne in mind. The carbon lamp behaves just the other way, the resistance decreasing as the lamp heats up; therefore, throwing a large number of carbon lamps on to a system at once should produce less strain on the system than throwing an equivalent number of tantalum lamps. In fact, any lamp in which a filament having a positive temperature coefficient is employed must behave in somewhat the same way as does the tantalum lamp.

POPULAR ELECTRICITY.

There is a tendency now-a-days to be commended—that is, the interest taken by the public in electrical matters, and the desire of most people to know something about the many and various kinds of electrical devices which they meet at every turn. For this reason one is inclined to be lenient with the writers of popular articles on electrical matters, since it is through such writings that the public receives its information. Such articles we have read from time to time—many of them with pleasure, but occasionally one does irritate. It seems to us that such articles should recognize the necessary limitations of the man who has not, and who does not pretend to have, much knowledge of higher physics. Explanations of electrical phenomena should be simple and such as he can grasp readily. The action of voltaic batteries is easily explained to any one by pointing out the chemical reactions going on and showing how these differ when a current is drawn from the cell and when it is not. But it seems to us that to belabor a poor little dry cell with the electronic theory in order to show how it does its work is rather hard on the reader and on the cell. It is true that this very pretty theory is absorbingly interesting to those who have at all studied it, but even they find it not easy to follow the reasoning of its advocates at all times.

On the other hand, there are those who go to the other extreme, and because they have not followed attentively all of the recent work in electrical theory, will have nothing to do with the new ideas, and have no patience with those who care to discuss them. These persons should remember that the electronic theory and the new theory of matter, which is so interwoven with it, are not haphazard guesses at what might be true. In fact, the very things which Thomson and his school are now trying to demonstrate, or disprove, by mathematical analyses and experimental research were guessed at by so-called philosophers years ago. The theories as put forward to-day are based upon a vast amount of scientific work and reasoning. Taken merely as hypotheses, they are pretty and interesting enough to repay for studying them. But they do more than this, for there seems to be no doubt that, for the present, they offer the most satisfactory explanation of many scientific facts. Only recently Dr. Thomson, in an address before the Royal Institution, London, said that the new theory of matter suggests a plausible explanation of chemical valency, a phenomenon which has puzzled the chemists since the beginning of their science. At first thought this seems to be an unexpected outcome of the study of conduction of electricity through gases. On the other hand, we must remember that in dealing with a gas, we are dealing with an aggregation of more or less independent units, and should expect the characteristic of these units, as individuals, to assert themselves more than if we were dealing with a mass, the particles of which were not so independent.

Digitized by Google

WATER RHEOSTATS.

Why is it that the water rheostat has such a bad name as a commercial device? It has so much in its favor: it is cheap, simple, easily changed to give varying values and gradual in its effect. These are valuable properties, yet the water rheostat is seldom or never used outside of the laboratory, and even there it is used apologetically, because "it's so convenient."

What are the objections to the water rheostat? First, the electrodes may be acted upon. When employed to control direct currents, a material such as carbon, which is not affected, must be used, but there is no such need when alternating currents are employed. Another disadvantage lies in the necessity for adding to the solution, from time to time; and further, anything containing a liquid is usually assumed to be non-portable.

In answer to these criticisms it may be said that portability may be secured by proper design of the containing-vessel. Are there not other devices which require the addition of some solution from time to time, in which this disadvantage has not been considered serious? The proper dissipation of the heat developed can be secured by proper design. There seems to be no good reason why the water rheostat should not play a larger part in the electrical world. In Europe there seems to be less prejudice against this device, for we frequently find reference to it. One noticed recently was a description of the water rheostat which is used for controlling the new locomotives of the Valtellina road in Italy. As these locomotives are each equipped with two double motors which are required to draw a train weighing 460 tons at a speed of twenty miles per hour, it is evident that the rheostats are not playthings, but are intended for serious work.

RADIUM INFECTION.

In a recent communication to *Nature,* an abstract of which is given on another page of this issue, Mr. A. S. Eve calls attention to the danger of the unrestricted use of radium and other radioactive substances in physical laboratories. As has been shown, these materials give off an emanation which condenses or collects on neighboring objects and confers upon them a secondary activity. This secondary activity persists for some time, and, as Mr. Eve found, may cause trouble and annoyance to the experimenter. It is probable that by this time a great many of our physical laboratories are already infected, and for that reason it will be difficult, if not impossible, to conduct experimental work of a certain class within them for some time at least. While this secondary activity can be removed from articles by treating them with acids, it is out of the question to treat everything in this way, and it would seem advisable for those in charge of physical laboratories to restrict the use of radium, whether for experimental or other purposes, or otherwise the efficiency of their buildings will be greatly impaired. Work with these materials should be conducted in special buildings. When the material itself is kept in the physical laboratory it should be kept sealed up closely. As the emanation which causes the trouble seems to be a gas, sealing it in a glass tube will retain it.

AND STILL THE WONDER GROWS.

Undoubtedly one of the most startling discoveries in physical science of recent times was that of radioactivity. That a substance which appeared to be an element could break up into something else, with the liberation of energy, or that this material had the power of catching some kind of unknown radiation, and converting it into a known form, were ideas that would have been scoffed at but a short time before they were being earnestly considered and energetically discussed. Then, as the one theory seemed to gain the upperhand, it was found that there was not one kind of radiation only, but that there were three, which were promptly given alphabetic names. The first in order seems to be a particle of atomic dimensions, carrying a positive charge. The second has subatomic dimensions, and is negatively charged. The third class of rays is, it appears, a kind of invisible light which is due to the impact of the particles themselves upon some more or less impenetrable substance. And still the wonder grows, for there has now been found a fourth kind of ray, which, to be in harmony with the accepted terminology, is designated as the δ ray. These new rays were described by Professor J. J. Thomson, in a recent lecture, who said that the δ rays seem to be negatively charged particles of the subatomic dimensions. They seem to be a sort of tired-out β ray, for they resemble these rays in everything except their speed. Whether they arise directly from the breakup of the atom, or in a secondary way, due to some interference with the discharge of the β rays, has not been explained. They have not been detected previously, it appears, because of their feeble penetrative power. They are entirely stopped by a few millimetres of air at ordinary pressures. The wonder is that one small atom can give birth to so many small bodies. A few years ago, when we had got down to the atom and thought that we were about at the end, it seems that we were only at the door of a new science.

SEARCHLIGHTS IN LIGHTHOUSES.

It has been announced that one of the features of the Lewis & Clark exposition will be a large searchlight surmounting Mount Hood. This will be used to good effect for illuminating the snow-capped mountain peaks within one hundred miles of the light. It is also said that the beam thrown from this searchlight will be visible to vessels one hundred miles off the coast. This statement suggests that the searchlight might be used as a valuable aid in lighthouse service, for warning vessels when they are approaching land. The ordinary range of visibility of a lighthouse is about twenty or twenty-five miles. For a lightship it is somewhat less, as the light is lower. Now, a powerful searchlight can throw a beam upward which will be seen thirty or forty miles, under favorable conditions. It is probable that a powerful ray thrown vertically upward from a lighthouse would be visible long before the direct rays of the lighthouse could be seen. A somewhat similar scheme has been tried on railroads, where a beam from the electric headlight of a locomotive was thrown upward as a warning to the engineers of other locomotives.

Digitized by Google

The Convention of the Ohio Independent Telephone Association.

The convention of the Ohio Independent Telephone Association was held in Columbus, Ohio, at the Hotel Hartman, March 30, 1905. The address of welcome was made by Mayor Robert H. Jeffrey, and the response by Mr. Frederick S. Dickson, Cleveland. The report of the president, Mr. Frank L. Beam, of Columbus, was replete with interesting information concerning the advance of independent telephone interests in the state. To-day the association has over 300 incorporated companies, operating over 600 exchanges, with 1,300 toll stations and 200,000 telephones.

Following the report of the president there was heard the report of the secretary, Mr. E. E. Knox, of Portsmouth, and the report of the treasurer, Mr. Ralph Reamer, of Columbus.

It was determined at the convention to employ a state organizer to promote the interests of the independent holdings in Ohio. For the purpose of providing funds, the association made itself liable to an assessment for emergency purposes, this assessment not to exceed four cents per telephone in active service. This is in addition to the regular membership fee of constituent companies.

The convention voted that the association should become a member of the National-Interstate Telephone Association, and appointed Frank L. Beam a member of the advisory committee of that organization. Delegates and alternates were named to the annual convention, to be held in Chicago, June 20 and 21.

The officers chosen for the ensuing year were: president, Frank L. Beam, Columbus; vice-presidents, E. G. Miller, Warren; W. F. Laubach, Akron; J. B. Rhodes, Zanesville; G. P. Thorpe, Wilmington; W. G. Thompson, Hamilton; I. H. Thedieck, Sidney; G. H. Metheany, Lima; R. E. Hamlin, Toledo; D. E. Sapp, Mount Vernon; secretary-treasurer, Ralph Reamer, Columbus.

The programme included the discussion of "Standardization of Equipment," by M. H. Clapp, St. Louis, Mo.; O. F. French, Cleveland, Ohio, and B. H. Brooks, Columbus, Ohio. "Development of New Territory and Importance of Placing Properties on a Dividend-Paying Basis," Dwight E. Sapp, Mount Vernon. "Operating Rules and a Standard Method of Accounting," C. Y. McVey, Cleveland; S. E. Ward, Mansfield; George H. Metheany, Lima; J. P. Boylan, Cleveland; C. E. Stinson, Toledo; M. B. Overly, Cleveland. "Practical Operating and Maintenance of Exchanges," C. E. Stinson, Toledo. "How to Increase Long-Distance Business," M. B. Overly, Cleveland. "Protection of Independent Interests by Manufacturers," W. F. Laubach, Akron. "The Importance of the Association's Appointing a Man to Give His Entire Time to Its Interests," H. P. Folsom, Circleville. "National-Interstate Telephone Association," J. B. Hoge, Cleveland.

The banquet at the Hartman Hotel was in every way a success. There were in attendance over 150, Frederick S. Dickson, of Cleveland, president of the United States Long-Distance Telephone Company, acting as toastmaster.

Comparison of New York and London Transit Systems.

United States Consul Halstead, Birmingham, England, states that Mr. J. Allen Baker, chairman of the highways committee of the London County Council, having on behalf of that committee visited New York, has made a report on the transit systems of that city. The comparison he makes between New York and London electric street-car systems, showing, comparatively, construction and operating costs, revenue, speeds, and the pay and hours of employés, which the London *Daily Mail* has extracted from his report, should be of general interest:

NEW YORK AND LONDON TRANSIT SYSTEMS.

Item.	New York.	London.
Gross earnings per car-mile	33 cents.	24 cents.
Operating costs per car-mile	15 cents.	14 cents.
Cost per track-mile for cleaning	$486.65.	$652.11.
Cost of construction line per car-mile of single track	$97,330 to $121,662.50.	$72,024.20.
Cost of feeder cables per mile	$15,572.80.	$7,290.75.
Cost of power stations per mile, single track	$28,225.70.	$28,409.02.
Average speed per hour	10 miles.	8 miles.
Hours of motormen and conductors	10 hours' labor in 12 consecutive hours.	10 hours' labor in 12½ consecutive hours, average.
Pay of motormen per day	$2.11 to $2.50.	$1.15 to $1.52.
Pay of conductors per day	$2.01 to $2.37.	$1.15 to $1.52.
Pay of conduit cleaners per day	$1.74.	$1.30.
Pay of car cleaners per week	$10.56 to $12.28.	$6.08 to $6.68.

The American Railway Appliance Exhibition.

The American Railway Appliance Exhibition, which will be held in Washington, D. C., from May 1 to May 14, 1905, in connection with the International Railway Congress, is getting ready for an elaborate presentation of still and moving railway apparatus. A plot of ground in what is locally known as Monument Park has been selected as the site. A federal act has been passed allowing the use of this portion of the district. The committee in charge of the American Railway Appliance Exhibition will fence in the exhibition ground, police it, and, in fact, have full charge of the site until the exhibits are all removed. It is interesting to note, in this connection, that the park must be left in exactly the same condition as it was prior to the building of the exhibit quarters. There will be one main exhibit building. This building will have a floor space of 21,000 square feet. In addition to this, however, the balance of nine acres of the park will be taken up by outside exhibits. At the present time very nearly all of the space in the main exhibit building has been sold, and 71,000 square feet of space outside of the main exhibit building. Power will be supplied by the power department of the Washington Railway and Light Company from the station at Fourteenth and B streets. Steam mains and electric conduits will be led under the street to plot 3 and plot 4, to the west of the main entrance at Fifteenth and B streets, where nearly all of the moving exhibits will be erected.

Mr. J. Alexander Brown, 160 Broadway, New York city, is secretary and director of exhibits.

An Alternator for 120,000 Cycles per Second.

In the *Philosophical Magazine* for March, 1905, Mr. W. Duddell describes a high-frequency alternator which was constructed in order to conduct some experiments on the resistance of the electric arc. The machine is of the inductor type. When first designed there were ninety teeth, but it was found impossible to obtain the high frequency that was desirable with this design, because of the impossibility of balancing perfectly the inductor. It was found feasible to run the shaft alone at from 30,000 to 40,000 revolutions per minute, but with the inductor in place the speed could not be above 600 revolutions per second. Upon replacing the old inductor with a new one having 204 teeth, a frequency of 120,000 cycles per second was obtained, the output at this speed being a tenth of an ampere. By means of this machine it was found that the solid arc behaved more and more as an ordinary resistance as the frequency was increased.

Digitized by Google

Electricity in the Anthracite Coal Mines—I.

The Application of Modern Methods in the Development of a Long-Established Industry.

By Robert Thurston Kent.

IN THE anthracite coal mines located near Scranton, Pa., many different systems of motive power are used. These include steam, compressed air, electricity and animal power. The use of electricity is comparatively recent, but is largely increasing. The method of working the coal beds is much the same in all the mines. Tunnels are usually driven from the foot of a shaft, and from these tunnels side-tunnels are driven into chambers in which the miners work. The coal is taken out by drilling and then blowing down a portion of the wall with black powder.

The coal, after being blown down, is loaded on cars which are hauled to the foot of the shaft by a small locomotive, cable haul or mules. It is then hoisted to the surface and taken to a breaker, where it is crushed and sorted into different sizes for the market.

In all the mines the hoisting of the cars up the shaft is done by steam engines driving hoisting drums. There are usually two cages in the shaft, one bringing a loaded car to the surface as the other cage carries an empty one back into the mine. The breakers, in nearly all cases, are driven by a pair of steam engines, though in some of the newer breakers electric motors will be installed. The cable hauls in the mine are driven, in some cases, by steam engines, and in others by electric motors. For hauling the loaded cars through the tunnels, electric locomotives, steam locomotives, compressed-air locomotives and mules are used.

MINES OF THE DELAWARE & HUDSON CANAL COMPANY.

Jermyn Colliery—The Delaware & Hudson Canal Company operates a large number of mines around Scranton. This company has but recently begun to use electricity. One of the mines in which electricity has just begun to displace the older and more primitive methods of handling the mined coal is the Jermyn mine, located at Jermyn, about sixteen miles from Scranton. The workings are about 200 feet below the surface, and extend a mile or more from the shaft. The loaded coal cars are brought from the various chambers to rope hauls, which bring them to the foot of inclined planes which slope to the foot of the shaft. The cars are hauled up the inclined planes by means of wire rope cables which are wound by steam engines. Two of these engines are located in the mine, and one engine is on the surface.

The engines in the mine are a pair of Lidgerwood ten by twelve-inch hoisting engines, driving a large drum, and another pair twelve by fifteen inches, also driving a drum. When the cars reach the foot of the last inclined plane they are drawn up to the foot of the shaft by means of a pair of engines which are located in a wooden house on the surface. These engines drive a drum on which the hoisting rope is wound. The rope is 3,300 feet long, and runs from the drum to the plane through a small hole bored through the earth.

When the cars reach the foot of the shaft they are hoisted directly to the breaker by an elevator driven by a pair of steam engines. The elevator has two cars, one of which ascends while the other is descending. The two cars counterbalance each other, and in addition to the cable joining them a cable goes from each car to the drum on the hoisting engines. The drums are seventy-two inches in diameter, and wind a one and one-half-inch cable. These elevators will hoist the cars at a rate greater than one a minute. As the empty cars reach the foot of the shaft they are taken by a chain haul to the top of a short incline. At the top they are switched to other tracks running down the inclined planes heretofore mentioned. They run down these tracks by gravity, and are hauled from the foot of the slope by an electric locomotive. The chain haul is at present operated by a small steam engine, but a seven and one-half-horse-power motor has been purchased to replace it. The motor is to run at 815 revolutions per minute at 230 volts, and will be geared to the sprocket of the chain haul.

In the same house with the engine driving the inclined plane rope haul is located the electric generating outfit of the mine. This consists of an eight-pole, 180-kilowatt, 300-volt, direct-current generator built by the Fort Wayne Electric Works, Fort Wayne, Ind. The generator is direct-connected to a 243-horse-power McEwen engine manufactured by the Ridgway Dynamo and Motor Company, Ridgway, Pa. The engine is sixteen by eighteen inches, and runs at 250 revolutions per minute. These machines furnish current for lights in the mine and breaker, and for operating three electric locomotives in the mine.

The switchboard is located directly behind the engine. It consists simply of oak uprights carrying a number of oak slats, to which the various instruments are secured. These instruments are an overload circuit-breaker, a Weston 1,000-ampere ammeter, a Weston 300-volt voltmeter, a double-pole, single-throw switch for the power circuit, a smaller one for the light circuit, and the field rheostat for the generator. A lightning arrester is inserted in the power line just after it leaves the switchboard. The power line consists of two cables, one of which is insulated, and the other bare. The bare cable is grounded immediately after leaving the power-house.

There are about 250 sixteen-candle-power lamps installed in the mine and the breaker. Those in the mine are in the main roads, which are white-washed, and give good illumination. In the chambers the only light is furnished by the oil lamps carried by the miners.

Two of the electric locomotives in the mine are used for shifting the cars from the main roads to the various workings. These locomotives are small, weighing about five tons each, and have a draw-bar pull of 1,200 pounds. The third locomotive is considerably larger, and hauls the cars from the point where they are gathered by the small ones to the foot of the rope hauls, which take them to the shaft.

The larger locomotive weighs thirteen tons, and is twelve feet long, four feet wide, and about three feet six inches high from the rail. It carries two fifty-horse-power motors geared directly to the axles. The locomotive is carried on four thirty-three-inch wheels, and has a gauge of twenty-eight inches. Its speed is about eight miles per hour, and the draw-bar pull 4,500 pounds. The equipment consists of a type R-37 General Electric controller, a screw brake and headlight at each end. The headlights are thirty-two-candle-power lamps set in parabolic reflectors. Current is taken from an overhead wire by means of a trolley. The wire is suspended from double-petticoated

Digitized by Google

insulators attached directly to the roof of the mine by a casting.

The two five-ton locomotives run further into the workings than the trolley wire does. When they reach the end of the wire the trolley is unshipped, and a cable carried on a reel on the locomotive is attached to the trolley wire. The locomotive is then enabled to go about 1,000 feet beyond the end of the trolley wire. The reel is connected by a chain and sprockets to one axle of the locomotive, and winds or unwinds the cable, according to the direction of the locomotive. The return circuit is through the track and ground.

The only other machinery in the mine are the drainage pumps, of which there are seven. One of these—a Jeannesville pump—runs continuously. This pump is a duplex fourteen by twenty-four by thirty-six inches, with outside-packed plungers. It has a capacity of about 145,000 gallons per hour. The other pumps are installed on three different levels, and are for emergency use only. These pumps are one Jeannesville, similar to the above, two single Cameron pumps fourteen by twenty-four by thirty-six inches, one single Cameron pump sixteen by twenty-four by thirty-six inches, and two Gould & Garrison single pumps twelve by fourteen by twenty-four inches.

Steam is furnished to the entire plant by a battery of six locomotive boilers located in a brick boiler house on the surface. The house is about sixty by forty feet, with a peaked slate roof. It has a pit underneath, into which the ashes are dumped directly from the fireboxes. They are then shoveled into cars run into the pit, and hauled away to the dump.

The boiler shells are sixty inches in diameter, and contain each 163 two and one-half-inch tubes. Each boiler is fitted with an Argand steam jet blower, and additional draught is furnished by means of a Sturtevant sixty-six-inch fan, which is driven by a small steam engine. A small water pipe runs into a shallow well in the smoke-box of each boiler, and all the cinders which come through the tubes are washed out. This obviates opening the front ends for cleaning. Feed water is furnished all boilers by an exhaust steam injector, which delivers water to a four-inch main, from which a two and one-half-inch feed pipe runs to each boiler. For emergency use there are also installed in the boiler house three live steam injectors. Each boiler delivers steam at a pressure of 110 pounds per square inch through a six-inch pipe to a twelve-inch header. The steam reaches the engines on the surface with but little loss of pressure. The pipes are well covered, and the steam is practically dry at the engines. The longest distance it is transmitted on the surface is about 1,400 feet. This line runs to a pair of engines driving ventilating fans at a distant part of the mine. There is considerable drop of pressure, however, between the boilers and the underground machinery, the pressure in the mine being only about eighty pounds.

The electrical installation at this mine was made in July, 1903, and is already proving a marked success. Previous to that time the cars in the mine were moved by mules, there being fifty-five mules engaged in shifting and moving the cars to and from the rope hauls. Under the most favorable conditions the mules could haul about three loaded cars, each holding between two and three tons of coal. The best speed that could be made was not over two and one-half miles per hour. The thirteen-ton locomotive alone can haul a train of thirty loaded cars at a speed of eight miles per hour, and is operated by one man. Each mule required a driver, so that the saving in labor alone due to the locomotives is considerable. A steam locomotive was used for some time prior to the installation of the electric locomotive, but it was very unsatisfactory on account of the exhaust steam and waste gases.

FOURTEEN-TON COMPRESSED-AIR LOCOMOTIVE, COAL BROOK COLLIERY, DELAWARE & HUDSON COMPANY.

Much time is saved also in switching the cars; the cars and locomotives being coupled and uncoupled much more quickly than was possible with the mules.

The lighting of the mine is also improved by the use of electricity. Formerly the only lights were the naked lamps carried by the men. While at present only the main roads are lighted electrically, the improvement has been so great that the use of electricity is being rapidly extended. The number of electric locomotives is also shortly to be increased, to displace all of the mules in service.

Coal Brook Colliery—At the Coal Brook colliery of the Delaware & Hudson company, located in Carbondale, the conditions are totally different from those at Jermyn. At the Wilson's Creek mine of this colliery there is no vertical shaft. The mine is located in a hill, and is entered by a horizontal drift driven in at the base of the hill, consequently there is no necessity for hoisting engines or elevators. The veins run at such an angle that the cars can be brought from most of the main workings to a central point by gravity. They are gathered by small compressed-air locomotives and hauled to the main road, where they are delivered to a larger compressed-air locomotive which brings them out of the mine.

The tunnels, being driven in on the level or on a slight up-grade, there is no necessity for pumps to remove the drainage water in the mine. Drains have been dug throughout, having a slight downward pitch, and the water runs out naturally. The only pumps installed are a few hand pumps which are placed in the chambers in which the miners are working, and into which the drains have not yet been extended. A few minutes work a day suffices to keep the chambers free enough of water to allow the men to work.

The smaller air locomotives are eleven in number. They weigh six tons each, and have cylinders seven by fourteen inches. The storage tanks consist of eight eight-inch steel pipes about ten feet long. These locomotives are able to haul five or six loaded cars at a speed of six miles an hour.

The larger locomotive weighs twelve tons. It has cylinders nine by sixteen inches, and carries two storage tanks thirty inches in diameter by fourteen feet long. The air in these tanks is under a pressure of about 800 pounds per square inch. This locomotive frequently brings forty loaded cars out of the mine, the grade in that case being slightly in its favor.

Charging stations are situated at various points in the mine, to enable the locomotives to renew their supply of compressed air. This has to be done frequently. The twelve-ton locomotive is charged every time it comes to the surface, and also when it reaches the end of its trip into the mine.

The compressor station is located at

Digitized by Google

the top of the hill, some three-quarters of a mile distant from the mouth of the drift. The station is a brick building seventy-five feet by thirty-five feet, one story in height, with a slate roof. In it are installed two three-stage compressors with steam cylinders twenty-two by twenty-four inches. The air cylinders are sixteen, thirteen and one-half, and five and five-eighths inches diameter, respectively. There are also two three-stage compressors with steam cylinders twenty by twenty-four inches, and air cylinders of eleven and one-half, nine and one-half, and four and five-eighths inches diameter, respectively. The compressors run non-condensing at 100 revolutions per minute, and compress up to 900 pounds per square inch with a steam pressure of 120 pounds. All four compressors were built by the Norwalk Iron Works, South Norwalk, Ct., and were installed at different times, the first being put in operation in April, 1897. The last compressor was installed in 1902.

Air is delivered directly to a five-inch pipe line which runs down to the drift. About every 300 feet the line is looped to take care of expansion and contraction. From the drift the line is divided into a number of smaller branches running to the various charging stations. In the compressor station there are also two plain slide-valve engines driving twenty-foot fans used for ventilating the mine.

The boiler house for the compressor station is situated near the compressor house, but further down the hill. Steam is furnished from six locomotive boilers with shells sixty-two inches in diameter by about twenty feet long. Each boiler contains 172 two and one-half-inch tubes. The grate surface is forty-two square feet. Feed water is supplied to the boilers by one exhaust injector and two live-steam injectors which are held in reserve. A Cochrane feed-water heater is being installed, and when it is put into operation the use of the exhaust steam injector will be discontinued.

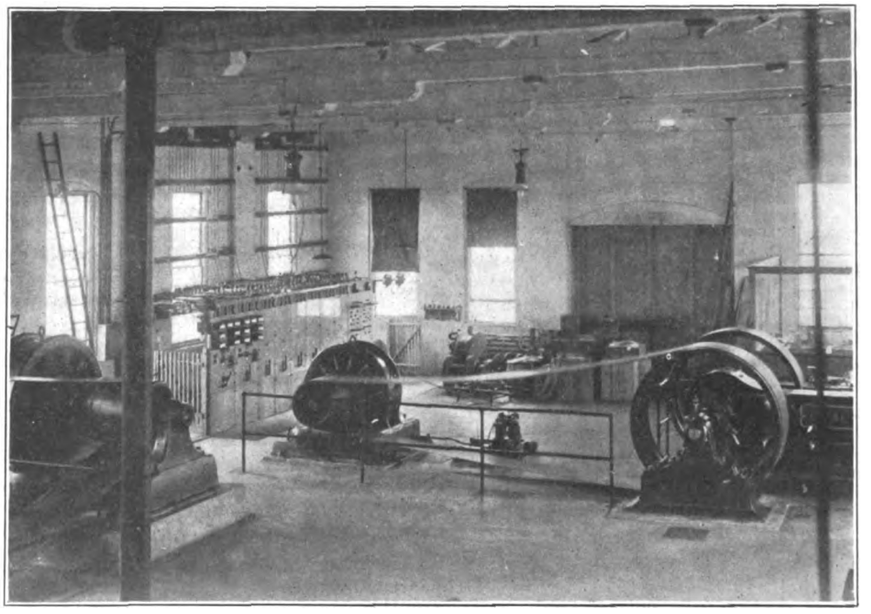
Water is drawn from a pond, made by damming a creek about 300 feet from the boiler house, by two Knowles pumps. These pump the water to a tank situated above the compressor house. Water is drawn from this tank to feed the boilers, and also to cool the compressors.

Coal is hauled up to the compressor station from the breaker, about three miles distant, by means of a narrow-gauge steam locomotive. The cars are run into the boiler house on a trestle and the coal is dumped from them to the floor, whence it is shoveled to the boilers. Steam from the boiler is taken to an eight-inch header. This is split into two six-inch lines, which run to the compressors. Draught is furnished the boilers by means of Argand steam-jet blowers.

The main power station of the Coal Brook colliery is located in Carbondale, about two miles from the mouth of the drift of the Wilson's Creek mine. Power is generated here for driving the ventilating fans and the breaker. The station consists of two buildings—the generator house and the boiler house. The generator station is a one-story brick building ninety-six by fifty feet, with a slate roof and concrete floor. In it are installed two twenty-six by twenty-four-inch hoisting engines directly connected to a hoisting drum two feet six inches in diameter. These engines hoist cars up an inclined plane leading from one of the mines located some distance from the station, there being 21,000 feet of rope on the haul. In addition to these two engines there is installed one twenty by eighteen-inch Ideal engine running at 214 revolutions per minute. This engine is belted to a 150-kilowatt, three-phase, sixty-cycle, 2,300-volt, alternating-current generator running at 1,600 revolutions per minute. The exciter unit is belted to the generator shaft. It is a two-pole, 110-volt, Thomson-Houston incandescent generator running at 2,400 revolutions per minute. This generating set furnishes current to operate a number of ventilating fans in the mine.

In addition to this unit there is also installed in the power-house a 400-horse-power, twenty-six by forty-eight-inch Greene engine running at eighty revolutions per minute. This engine is belted to a 300-kilowatt, 2,300-volt, three-phase, sixty-cycle generator running at 600 revolutions per minute. The exciter for this unit is also belted to the generator shaft, and consists of a seventy-five-ampere, 110-volt, two-pole generator. This machine furnishes current for lights in the breaker, in the railroad yards of the Delaware & Hudson Canal Company immediately adjoining, and in the various buildings about the plant. It runs only at night at present, but when additional electrical equipment which is contemplated has been installed it will be operated continuously.

The switchboard is located behind the 150-kilowatt generator, which is belted to the Ideal engine. It is of gray marble, and has ten panels, two of which are gen-



INTERIOR OF ELECTRIC POWER STATION, COAL BROOK COLLIERY, DELAWARE & HUDSON COMPANY.

erator panels, and eight outgoing feeder panels. The generator panels each carry four Thomson ammeters, one Thomson voltmeter, and two indicating wattmeters, a rheostat, a plug switch for the voltmeter, and a double-pole, single-throw field switch. On the back of the generator panels is an oil switch. Six of the outgoing feeder panels for motors and lights have only an oil switch, which is located on the back. The two remaining outgoing feeder panels are for arc lamps installed in the engine house, and around the yard. These are fitted with plug switches and an eight and one-half-ampere alternating-current ammeter. The switchboard equipment is completed by two ground detectors, a synchronizer, a volt-

Digitized by Google

meter, and integrating wattmeters on the outgoing panels.

In the rear of the switchboard are installed two constant-current General Electric transformers for the arc lights. These transformers are thirty-four-kilowatt, sixty-cycle machines, and operate with a primary voltage of 2,200, giving a secondary current of 7.5 amperes.

For ventilating the mine, in addition to the fans installed in the compressor station, there are one twenty-foot, two seventeen-foot and one ten-foot fans. These are driven by induction motors, the ten-foot and seventeen-foot fans being driven by twenty and forty-horse-power motors, respectively, at a pressure of 220 volts. To step the voltage down to this figure there are installed for the twenty-horse-power motor two ten-kilowatt, sixty-cycle, oil-cooled transformers, and for each of the forty-horse-power motors there are installed two twenty-kilowatt, sixty-cycle, oil-cooled transformers. The twenty-foot fan is driven by a fifty-horse-power induction motor, which operates at 2,200 volts directly from the line.

DODGE BREAKER, BELLEVUE COLLIERY, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

This comprises the entire electrical equipment at the Coal Brook colliery, though an increase is contemplated in the shape of electric locomotives. It is anticipated that these will have many advantages over the compressed-air locomotives now in use, as there is considerable annoyance caused and much time lost in charging the compressed-air locomotives, which also give trouble by freezing. It is necessary to carry a coal fire underneath the valves at all times, and it is sometimes necessary to wrap burning oil-soaked waste around various parts of the machine to thaw it out. The loss in transmission of electrical energy will also be much less than the loss in the compressed-air pipes.

The boiler equipment for the electric station at the Coal Brook colliery consists of six horizontal return tubular boilers seventy-two inches in diameter and eighteen feet long. There are no domes on these boilers. Each boiler is rated at 250 horse-power and contains seventy-six three-inch tubes. The boilers operate at 110 pounds pressure per square inch. Steam is taken from each boiler through a six-inch nozzle, and passed into a sixteen-inch header running the entire length of the boiler house. From this header it is taken to the electric station, to the breaker, and to other engines about the works. Feed water is forced into the boilers through a Jeannesville duplex pump ten by six by twelve inches. Before entering the boiler it passes through a Cochrane feed-water heater. This boiler plant has replaced an equipment of plain cylinder boilers. The horizontal return tubular boilers have proven much more satisfactory than the plain cylinder boilers, responding to a sudden demand for steam much more quickly. Considerable trouble, however, has been encountered with wet steam, there being no dry pipe in any of the boilers.

COAL MINES OF THE DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The Delaware, Lackawanna & Western Railroad Company operates about fifteen coal mines in and around Scranton and Wilkesbarre. This company has adopted electricity in the operation of the mines more extensively than any other company in the anthracite coal region, and some of its plants represent the most modern practice in electrical engineering. A study of the different collieries of this company shows the progress which has been made in electricity in the past few years. All classes of generating units and transmission lines are to be found, although the earlier types are being discarded. In one plant there are working side by side a slow-speed engine belted to a direct-current generator and a rotary converter which converts alternating current generated at a distant power station by a revolving-field generator driven by a Curtis turbine. In the same station is a high-speed engine direct-connected to a direct-current generator.

Three typical plants have been selected for description, as showing the progress that has been made along the lines above indicated. These plants are: the plant at the Bellevue colliery in Scranton, the Hampton central power station in Scranton, and the new Nanticoke central power station near Wilkesbarre. This last station is not yet in operation, but is nearing completion, and will probably be started by the middle of May.

Bellevue Colliery—The Bellevue colliery is located within the city limits of Scranton, on the Bloomsburg branch of the Delaware, Lackawanna & Western Railroad. Power is generated here for use in the Bellevue mine and breaker and in the Dodge breaker near-by. The power-house is a frame building built on the side of a hill, with a floor at two different levels. On the upper level of the floor are located the hoisting engines used for raising and lowering the cage used by the miners in entering and leaving the mine, and also for taking in supplies. The main shaft through which the coal is brought from the mines is located some distance from the supply shaft, and the cages in it are operated by a separate and larger pair of engines. On the same level with the hoisting engines is a slow-speed engine belted to a 100-kilowatt, 275-volt, direct-current generator. This was the first machine to be installed at this mine, and its use is soon to be discontinued.

On the lower floor level is a 330-kilowatt, 275-volt, direct-current generator, direct-connected to a twenty-four and one-half by twenty-two-inch, 500-horse-power McEwen engine running at 250 revolutions per minute. The engine was built by the Ridgway Dynamo and Engine Company, Ridgway, Pa. In addition to

Digitized by Google

the two engines and generators, there is a 150-kilowatt rotary converter which converts three-phase alternating current transmitted to the station from the Hampton central power plant some two miles distant. Three oil-cooled transformers in the station step the line voltage from 2,300 down to 104 volts for use in the converter. This converter was installed temporarily about a year ago to help out the engines. It will be transferred to some other locality when a new brick substation now building is completed.

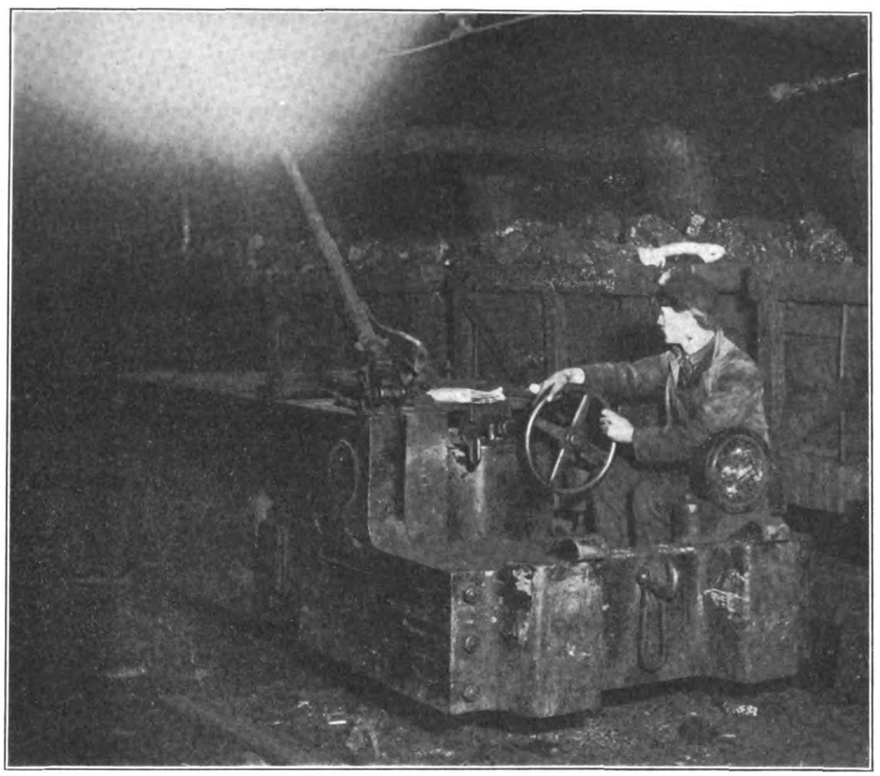
Steam is furnished to the two engines in the station from a boiler plant located about 1,000 feet distant. This plant, which also supplies steam to a number of other collieries in the vicinity and to steam pumps in the mine, consists of a battery of ten 313-horse-power Babcock & Wilcox boilers. The steam pressure carried varies from 150 to 125 pounds per square inch.

It is proposed to furnish all current to this colliery from the Hampton power plant, and to this end there is now under construction a brick substation located a few hundred feet away from the present power-house. In this station will be placed a 300-kilowatt, six-phase rotary converter which will furnish direct current at 275 volts to the various motors. The six-phase current is obtained from the three-phase line current obtained from the Hampton plant by means of phasing transformers. There are three of these, oil-cooled, sixty-cycle and each of 110 kilowatts capacity. They step-down from 2,310 line voltage to 104 volts.

The 500-horse-power McEwen engine now in the present plant is to be transferred to the substation after the rotary converter is in operation. It will be used to help out the converter in case of heavy overloads, and also to furnish current to the pumps and locomotives in the mine in case it becomes necessary to shut down the central station.

On the opposite side of the room from the converter and engine will be placed the switchboard. This will have five panels, namely: one alternating-current incoming panel, one alternating-current rotary converter panel, one direct-current converter and generator panel, and two outgoing feeder panels.

The leads from the central station will enter the building under the eaves and directly above the switchboard. A large rectangular opening has been left in the wall, into which a heavy soapstone slab will be inserted. Holes will be bored in this slab at points at which it may be desired to bring the wires through, and porcelain insulators inserted. The wires will come down the wall behind the switchboard from this slab to the floor, and then rise to the switchboard. From the switchboard they will be carried to the various machines through terra-cotta ducts laid underneath the floor.



THIRTEEN-TON ELECTRIC LOCOMOTIVE, BELLEVUE MINE, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The current generated at this station is used for furnishing lights in the mine and breaker, and for operating the various locomotives, hoists and pumps in the mine. There are eight locomotives, having an aggregate of 700 horse-power. The locomotives are of two sizes, weighing thirteen, and six and one-half tons, respectively. The thirteen-ton locomotives are each equipped with two fifty-horse-power motors, and the six and one-half-ton locomotives with two twenty-five-horse-power motors. The locomotives were built by both the General Electric Company and the Westinghouse company. Current is taken from an overhead wire by means of a trolley, and a track return is used. The smaller locomotives carry a cable reel similar to those on the locomotives in the Jermyn mine, which enables them to travel some distance beyond the end of the trolley wire.

The hoists in the mine are three in number. They operate rope hauls for drawing the loaded coal cars up inclined planes which are too steep for the locomotives. The grade on these planes varies from six to ten per cent. The hoists vary in size, and are equipped with two motors, each of varying size. The total motor horse-power on the hoists in this mine is 244.

Water is removed from the mine by a few steam pumps and by seven plunger pumps which are motor-driven. These plunger pumps are of the horizontal triplex, quadruplex and quintuplex types, and are each driven by a single electric motor of suitable size. A total of 248 horse-power is developed by the motors driving the drainage pumps in the mine.

In addition to the above equipment there are installed about the mine four other motors for miscellaneous purposes, aggregating about thirty horse-power. The total horse-power represented by motors installed at this colliery is about 1,200. The generating capacity of the station is 580 kilowatts, including the rotary converter.

A system of electric signaling connects the different shafts to the engine houses, and a telephone system furnishes a communication between the different levels and stations in the mine and the engine house.

The repair shop of the coal department of the railroad is located at this colliery. This shop contains a number of machine tools, stockrooms and facilities for rewinding electrical machines. Repairs are made here for all the collieries controlled by the company.

(To be continued.)

Digitized by Google

CONTROL OF ELECTRIC LOCOMOTIVES.

BY WILLIAM COOPER.

The Century dictionary gives two definitions of the word "locomotive":

1. Moving from place to place; changing place, or able to effect change of (its own) place.

2. Having the power to produce motion, or to move (something else) from place to place.

An electric locomotive in the common acceptance of the term is a piece of apparatus embodying all the functions defined by both of these definitions. That is, it must be able to move itself from place to place and at the same time move something else. The notion that it must move something else besides itself implies that it must develop not only power enough to move itself at any desired speed, but enough more to pull the desired additional load. The additional load being in the form of cars or vehicles of some sort, it follows that the locomotive must be coupled to them in some manner.

It is the application of the surplus power of the locomotive to this coupling that will be considered.

Where the load to be hauled is small or where a very considerable portion of the power of the locomotive is consumed in propelling the locomotive itself, the method of regulating the pull on the coupling is not of as much importance as where the power required to propel the locomotive is but a small part of the total power developed by the locomotive.

There are two principal factors that control the maximum allowable pull on the coupling:

First, the strength of the coupling.

Second, the comfort of the passengers, if passengers constitute a portion of the load to be hauled.

Usually where passengers are carried the second condition is the limiting one rather than the first. This, however, is largely regulated by the uniformity of the application of the power, especially in starting the train from rest and accelerating to full speed. If the draw-bar-pull be absolutely uniform it can be very much greater than if it is irregular or unsteady. That is, if the accelerating force be applied steadily it can be made very much greater, without discomfort to the passengers, than if applied irregularly or jerkingly. The same is true, in a less degree, in accelerating a train in which the comfort of the passengers is not a consideration, but the strength of the coupling only is the limiting factor.

The accelerating force if applied steadily can be as great as the maximum amount if applied unsteadily, consequently the average will be greater. From this it follows that the more uniform the application of the power the better the results.

Since the draw-bar-pull of an electric locomotive is produced by the torque of the motors and the torque is produced, in turn, by the current in the armatures, it is by the regulation of the armature current that the draw-bar-pull is controlled.

The desideratum of electric locomotive control is to keep the armature current steady. That is, it must not rise or fall suddenly to any great extent. To accomplish this result and at the same time increase the impressed voltage on the armature, during acceleration, is the problem of electric locomotive control.

There are two general methods of accomplishing this result: that of inserting resistance in the armature circuit and that of controlling the impressed voltage by some sort of a transformer. In the use of direct-current motors the transformer takes the shape of a motor-generator, the fields of the generator being manipulated to give the desired gradation of voltage. In the use of alternating-current motors the transformer assumes a more simple form. In either case the control of the armature current is absolute and ideal, a condition that can not be secured by the use of resistance. In the use of resistance, from the very nature of the case, the voltage on the armatures must be changed in steps, the value of which is determined by the total number of steps in the whole cycle. Thus in the use of resistance acceleration is accomplished by a series of blows or impulses rather than by the steady application of a uniform force.

To get a maximum draw-bar-pull with a given tractive weight these impulses must be made very small. The smaller they are the greater the maximum effort that can be used in accelerating. It is not necessary that a locomotive should be able to give a draw-bar-pull greater than the strength of the couplings to be able to break them. If too great an amount of energy be imparted suddenly to the mass of the locomotive its weight will be accelerated more rapidly than the mass composing the train to which it is attached by reason of the elasticity of the coupling and will thus act as a battering-ram upon the coupling.

In the control of a heavy locomotive, capable of developing a heavy draw-bar-pull, this point requires special attention.

An ordinary trolley car is not generally classed as a locomotive, but when used to haul a trailer or trailers it comes under the definition. It is well known how a trolley car behaves when through bad handling of the controller, faulty adjustment of the resistances or incorrect design of the controller. The power is applied irregularly, causing the car to advance by jerks. It is also well known that this effect is exaggerated in the trail car or cars. It does not require any great stretch of the imagination to see that if the power of the trolley car be increased ten or twenty times that this jolting and jerking would easily break the couplings.

While it is desirable to have perfect control of the power of any self-propelled vehicle or locomotive, it becomes an absolute necessity in a locomotive capable of developing a heavy draw-bar-pull.

In addition to the two principal methods of control mentioned, there has been brought out from time to time various other schemes of more or less value. Most of these have been attempts to obviate the loss of energy due to the use of resistance in the control of direct-current motors. There have been, also, different schemes proposed contemplating the use of induction motors for traction purposes. All these different schemes are based on some sort of transformation of energy, either between the supply of electric power and the motor, or between the motor and the driven axle.

Of all the schemes proposed in connection with direct-current motors and a direct-current supply of power, none has passed the experimental stage. Notwithstanding this, until quite recently direct-current motors, in connection with a direct-current supply of power, have held almost undisputed possession of the traction field as the motive power, and rheostatic control the method of regulating that power. The single-phase series motor, however, from all appearances is about to become a very strong rival for these honors.

Thus it seems that there is but one practical method of controlling the application of the power to the locomotive when direct current is the source of power: that of rheostatic regulation. Rheostatic regulation implies, in the abstract, that a maximum energy will be drawn from the line when the minimum work is being done, that is in starting. This is not strictly true, however, for by working the motors in series and parallel combinations the starting current may be very much reduced. In this connection it is a noticeable fact that the system of series parallel operation is universal when

Digitized by Google

more than one motor is used. This is true even where four or more motors are used.

It seems to have been taken for granted that the increased complication of the controlling mechanism necessary to handle the four motors in series, series parallel and parallel combinations would more than off-set any gain that might be made. This is not necessarily true and in fact with the larger types of locomotives the amount of controlling apparatus required, for a given scale of resistance adjustment, is less. For instance, assume that it is desirable to have thirty-five points or steps in the cycle from the start to full parallel. If the combinations are made with unit switches thirty-seven steps can be secured with the same number of switches, in the series, series parallel, parallel arrangement that would give thirty-five in the series and parallel arrangement. This is assuming that the "bridging" system of transition from one combination to another is used.

The "bridging" system has so many advantages over the "open-circuit" system that it is the only one worth considering in connection with the control of a heavy locomotive driven by direct-current motors. In this system the circuit after being once established through the motors in series is not interrupted at any time during acceleration to full parallel, and the maximum fluctuations are those due to cutting out the different sections of resistance. In the manipulation of the control or single-phase motors these troubles in regard to securing a uniform and steady application of the accelerating force are not encountered. Regulation by the induction regulator gives a nicety of control equal to an infinite number of steps in a rheostatic control. It also results in a greater saving of power than can be secured by any possible arrangement of series-paralleling of the motors when using rheostatic control.

While absolute control of the accelerating force is necessary to the successful handling of large locomotives, it is desirable, and almost a necessity, in the handling of even the smallest trolley car. Rapid accleration is the great feature of heavy electric traction.

If a certain rate of acceleration is desired and motors have been selected that are capable of giving and maintaining the necessary torque, the result may be a dismal failure if the accelerating force is not properly applied. This is not a matter of fancy, but a matter of fact.

In a special case a summary of a great many readings taken showed an average acceleration 1.24 miles per hour per second, the maximum is often as high as 1.62 miles per hour per second. This is a very important matter, not only from the loss in the rate of acceleration, but it is an actual loss of energy, to say nothing of the comfort of the passengers. If the particular conditions will permit of the application of an accelerating force sufficient to give an acceleration of 1.62 miles per hour per second without slipping the wheels, there is absolutely no reason why this rate should not be maintained and there is every reason why it should be maintained. It is more agreeable to the passenger to maintain an acceleration of 1.62 or even two miles per hour per second than to have the acceleration vary from 1.20 to 1.62 miles per hour per second. Also, very much less energy will be required to do a given work in a given time, or more work can be done in a given time with the same energy. This phase of the proposition is especially pronounced in the design of locomotives that are locomotives and nothing else. The question of first consideration is the maximum draw-bar-pull required. This determines the weight to be placed upon the driving wheels, due consideration being given to whether the accelerating force can be applied with absolute uniformity or not. The amount of variation of the accelerating force determines the additional weight that must be added over and above what would be required if there were no variation. For instance, suppose the accelerating force varies between seventy-five per cent and 100 per cent of the maximum, which would not ordinarily be considered excessive. This means that the locomotive can not haul within 12.5 per cent of the load it ought to haul with a given acceleration or 12.5 per cent additional weight must be carried on the driving wheels. Of course the difference can be made up by taking more time in acceleration, but in no case is this a desirable thing to do, as the gains to be made by rapid acceleration are too great to be omitted from the calculations.

The Infection of Laboratories by Radium.

When attempting to make some delicate electroscopes in the physical laboratory of McGill University, Mr. A. S. Eve found that at first it was impossible to prevent what then seemed to be leakage. It was afterward shown that the trouble was not pure leakage across the sulphur, which was used as an insulating material, but was due to an infection by radium of the laboratory. The natural leak was large, and was unaffected when the upper support of the sulphur insulating bead was raised to a higher potential than the gold-leaf system. The rate of discharge was not altered when the electroscope was entirely surrounded by lead one inch thick. Removal to another building produced no effect on the leak of the electroscope. This seemed to indicate that the trouble was due to the radioactivity of the materials from which the electroscope had been made. To check this conclusion, a rude instrument was made in a private house, of crude materials. This was found to give much better results than the most carefully constructed instrument which could be put together in the laboratory. Electroscopes were next made in the chemical laboratory, using materials which had never been in the physics building. These showed low rates of discharge. By means of the latter instruments, materials taken from various parts of the physical building were tested, and it was found that all were infected with excited activity. Sheets of mica, lead-foil, iron, zinc and tin were all active when taken from drawers or cupboards. About ninety per cent of the excited activity of the metal could be removed by treating it with strong hydrochloric acid. This transferred the activity to the solution. The natural leak of an electroscope was increased to a considerable extent when the mica window was replaced with one cut from a sheet of mica kept in the physics building. Supposing that the supply of emanation is arrested at the present time, the activity of the materials deposited in this building will rise to a maximum in two or three years, and then gradually decay, but would reach half value only after forty years. Should the supply of emanation in the future equal that in the past, the activity would continue to increase in magnitude for the next hundred years or so. While this excited activity can be removed largely by acids, the infection will at present cause no serious difficulty in the majority of experiments on radioactivity, particularly as the leak arising from it remains almost constant for weeks or months; but when an electroscope with a small natural leak is required, it will be necessary to employ fresh materials which have not been exposed to emanation. It appears desirable in the case of laboratories not yet infected to keep radium in sealed vessels, and to blow the emanation into the open air.—*Abstracted from Nature (London), March* 16.

Digitized by Google

POWER CAPACITY OF A RUNNING STREAM WITHOUT STORAGE.[1]

BY WM. G. RAYMOND.

When a stream is to be developed for power, it is usual to examine such records of its flow as exist, and to take a few measurements of the minimum flow, if this is possible, as a basis on which to compute the probable minimum capacity and the probable ordinary capacity of the stream. The development is usually considered at some one point on the stream where a definite known head is available. When there are no records of the flow of the stream it is usual to examine its drainage area, compare it with that of some other stream for which there are flow records, compare also the rainfall on the two drainage areas, modify the percentage of rainfall running off from the area for which there are records, and determine the probable flow of the stream under consideration from its rainfall and these modified percentages.

While rainfall records are usually kept for each day, the published records are more commonly those of the calendar months, and this is true also of the flow records. In determining the percentages of flow on a given stream, it has been usually customary to average the flow for a number of years for each calendar month, and to compare this with the rainfall for the same calendar month for the same period. Among the streams of the eastern United States, it is found that as a general average about half of the rainfall runs off in the stream, the percentage varying in different years, according to the condition of the ground and according to the distribution of the rainfall. It is usual to say that the average conditions for power development will be shown by the average run-off or flow of the several calendar months of the year. And it is customary to determine what is called the ordinary flow, which is variously defined by different engineers, but which is understood usually to mean that flow for which it is wise to develop the stream for power.

If the calendar months are arranged in the order of their average yield, and the yields of these months are plotted to scale, a more or less irregular curve is the result, usually showing periods of regularity of from three to five months, broken by considerable differences of flow between these more regular periods. If, now, it is proposed to develop a stream for which such a plot has been made, and it is desired to determine for a given power development what portion of the year there will be sufficient water for the operation of the complete plant, and what portion of the year there will be shortage of water, and also the aggregate shortage for the year which must be made up by steam if a plant is to run continuously, the quantity of water necessary to supply the required power with the given head is determined and marked on the diagram. All those months which fall below the line of required yield will be short of power, while those months above will furnish full power, unless there be loss of head during extreme high water. Such a diagram, or such process, purports to show the conditions that will obtain as an average for the period of years that has been considered. The minimum flow at any one time indicates the maximum amount of power to be supplied by steam, and so, on such an investigation, a plant would be designed with a full water-wheel capacity and an auxiliary steam plant equal to supplying the maximum shortage of power. In estimating the cost of operating such a plant through a period of years, the average that has been mentioned would be considered.

It is a fairly well-known fact that most plants that have been developed on such an investigation as this have proved disappointing in that the amount of water power available throughout the year has almost invariably fallen short of what was promised or expected, and consequently the auxiliary steam plant has been run at greater capacity and for longer periods than was estimated in the beginning. Indeed, some plants have been designed and built with the expectation that no auxiliary steam power would be required, while the first year's operation has developed the fact that considerable additional power would be needed.

The reason for this disappointment is not difficult to determine. If the records of flow are carefully examined, it will be found that there is no year of any considerable period of years in which there is not one or more months yielding considerably less water than the lowest average calendar month; thus, if by averaging the calendar months for a period of years, it is shown that July yields the smallest amount of water, it will be found to be true that in each year there will be one or more months, not always July, sometimes January, sometimes September, sometimes May, sometimes some other month, which will yield less than the average for July.

If there is no storage on the stream to equalize its flow, the more rational way of arranging the monthly records for power development is to average the lowest of the months of all the years, the next lowest, and so on; that is, the months of each year should be arranged in their order of flow, and the average of all the lowest months, next lowest, etc., taken. Such an arrangement of the months has been suggested by Professor Mead in his "Notes on Hydrology," which has just appeared. This is the first suggestion of this method of arrangement that the writer has seen, and this was not known until the notes for this paper were prepared.

The average of the months in their order of flow will show for the months of low flow a much less yield than the average by calendar months, and as the total flow must be the same, the averages of the high months are materially greater

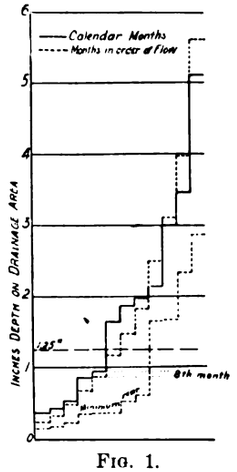


FIG. 1.

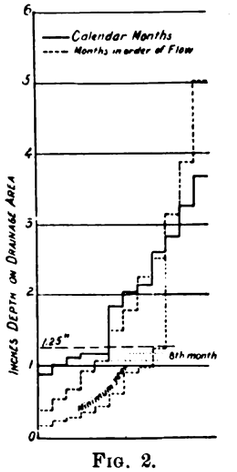


FIG. 2.

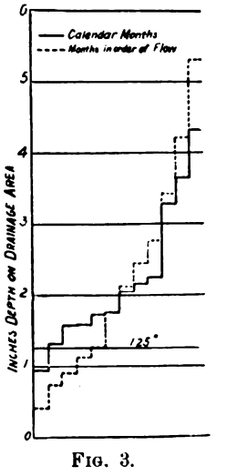


FIG. 3.

Fig. 1.—Average monthly flow from the Sudbury drainage area for twenty-three years, in inches of depth on the area. Fig. 2.—Average monthly flow from the Perkiomen drainage area for fifteen years, in inches of depth on the area. Fig. 3.—Average monthly flow from the Perkiomen drainage area, for 1887, '88, '89, '90, '91, and '93, in inches of depth on the area.

[1] From proceedings of the seventeenth annual meeting of the Iowa Engineering Society.

Digitized by Google

than the averages of the high calendar months.

A diagram showing the two methods of averaging for the Sudbury drainage area covering a period of twenty-three years is shown in Fig. 1. The full line represents the calendar averages in order of volume discharged, the dotted line the averages of the months arranged in order of flow.

A similar diagram for the Perkiomen creek, one of the streams that has been considered as a possible source of water supply for the city of Philadelphia, is shown in Fig. 2, the records extending over fifteen years.

Sometime since, in the writer's practice, it became necessary to determine what portion of time a plant requiring about 170 cubic feet per second for its full power development would be without full power. This plant was located on a stream not unlike the Perkiomen and of approximately the same drainage area. One hundred and seventy cubic feet per second is equivalent to one and one-fourth inches on the drainage area of the Perkiomen. Drawing the horizontal line on the diagram representing one and one-fourth inches, it is seen at once that by the average of calendar months there will be some shortage of power during five months of the year, and if the shortages for the several months are summed, it will be found that the total shortage is equivalent to full power for about three-quarters of a month. The dotted line showing the average of months in order of flow indicates that there will be a shortage for the same period, but that the aggregate shortage is nearly three times that shown by the average of calendar months.

If, now, instead of a developed plant, it be desired to consider the development of a new plant under the not uncommon rule of development, up to that flow that can as an average be counted on for eight months of the year, the diagram shows that it will be safer to develop by the dotted curve, since the eighth month by this record is lower than by the record of calendar months, and it is also plain that it will be best to compute the shortage by the record of months in order of flow.

The record by calendar months would show a proper development corresponding to a run of 1.17 inches, while the curves showing the months in order of flow indicate that the development should be for 1.09 inches, a not very great difference. But if the stream be developed for a flow of 1.17 inches, the calendar record indicates a shortage aggregating only fourteen days of full power, while the record arranged in order of flow indicates a shortage aggregating nearly two months of full power, or about four times the shortage shown by the calendar arrangement. Even with a development of only 1.09 inches of run off, the months arranged in order of yield show a shortage aggregating 1.7 months of full power.

This, it will be understood, is an average condition, but it will be well to examine what may occur in a minimum year. The record of the lowest year in the fifteen recorded, is shown on the diagram, and indicates that whether the development be for 1.17 inches or 1.09 inches, there will be eight months in which there will be less than full power. And if the development be for 1.17 inches, the aggregate shortage will be equivalent to 4.6 months of full power. The record further shows that this may approximately occur for two or three years in succession. As this period may very likely accompany a period of business depression, it must be fully taken into account in advising the utilization of a given water power.

The diagram for the Sudbury drainage area shows the same general condition, but the difference is less marked. If developed on a basis of the calendar month record, the shortage shown by the calendar month diagram aggregates one and two-third months of full power, as against two and one-fifth months shown by the diagram of flow arranged in order of volume.

If the stream is developed on a basis of the lower curve, there will be a shortage aggregating two months of full power. As before, the minimum year shows a shortage extending over eight months; and if the stream be developed by the calendar record, this shortage will aggregate 5.2 months of full power; while, if developed by the record arranged by months in order of flow, the shortage will still aggregate nearly five months of full power.

It is seen from these considerations that the far more reliable method of arranging run-off records for determination of power when there is to be no large storage on a stream, is to arrange the monthly records in the order of flow rather than by calendar months. But even this is very far from the most desirable method. Particularly in the low months is the record of a whole month affected by the run-off of one or two days during or immediately following heavy storms. So that the monthly record never shows less than the power available in the stream, and practically always shows more power than can be used, since during the two or three days which bring up the total flow of a month the discharge is far in excess of that that can be used, and the greater portion of the water goes to waste.

The smallest unit of time which it is probably wise to consider is the day. Only a few daily records were available for the preparation of this paper. The best that were at hand were the records of six years of flow on the Perkiomen, the years being from 1887 to 1893, inclusive, excepting the year 1892, which was lacking. Judged by its monthly flow, the record of which was available, the year 1892 was perhaps the lowest of the seven years, while the year 1899 was one of the two highest years observed in fifteen. The omission of the year 1892, therefore, from the

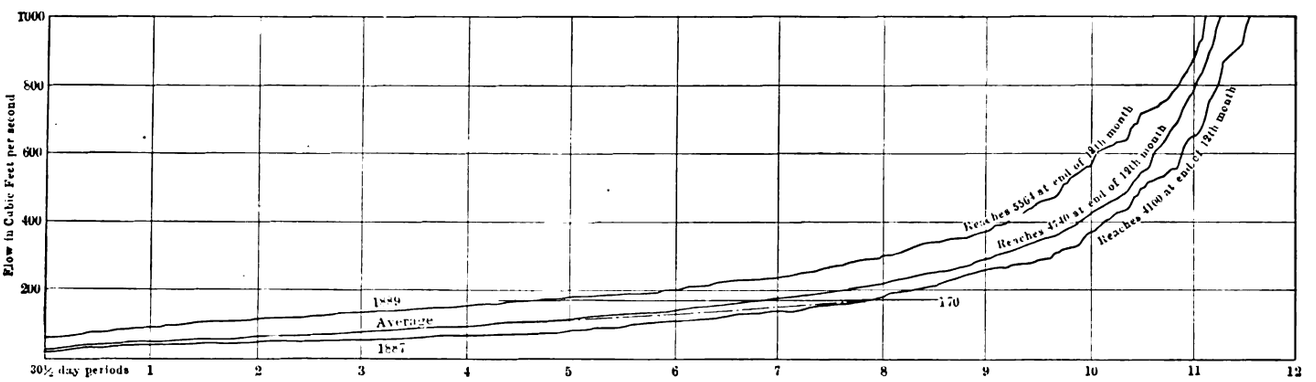


FIG. 4.—HIGHEST, LOWEST AND AVERAGE DAILY FLOW FROM 1887 TO 1893 OF PERKIOMEN CREEK.

Digitized by Google

record leaves the average daily flow for this period too great, but for the purpose of comparing monthly and daily records the omission is perhaps not serious.

Selecting these six years, and treating them as has been already done for the fifteen-year period of the Perkiomen, and considering for the time being only the power available for the particular plant assumed previously, namely, one requiring 170 cubic feet per second or one and one-fourth inches of run-off from the drainage area, the calendar month arrangement shows (Fig. 3) that there will be a shortage of power for one month only, aggregating seven days of full power, while the arrangement by months in order of flow shows that there will be a shortage during four months aggregating about one month and thirteen days of full power, or nearly six times as much power to be supplied by steam as is indicated by the calendar month record.

But how is it when the daily record is examined? For this examination the daily flow of each year has been arranged in order of magnitude. The resulting record for the lowest year, the highest year, and the average for the six years is shown in Fig. 4. Considering again the particular plant already assumed using 170 cubic feet per second, the diagram shows there will be a shortage extending over 208 days, or about 6.8 months instead of four months as by the monthly method, and that this shortage will aggregate about three and one-fifth months of full power, nearly thirteen times the amount of power to be supplied by the calendar month arrangement, and over twice that to be supplied as indicated by the monthly record arranged in order of flow.

Even this average does not tell the exact truth, because when the record of any day in any year exceeds 170 cubic feet per second all the flow above this volume tends to lift the average of the six years, but is itself unavailable for power; and to get at the exact truth, it is necessary to make an average in which the flow in every year for each day that has a larger value than 170 cubic feet per second, must be taken as only 170 cubic feet per second, until the flow of that year in which the low flow extends furthest reaches 170 cubic feet per second. Making such an average for these six years, it is found that the shortage will extend over 237 days instead of 208 days, giving an aggregate of about 100 days of full power to be supplied by steam.

The addition to the aggregate determined from the straight average is not large, but the cost of supplying this power is not in proportion to the amount of power supplied. If the steam plant were run constantly with not too large variations in power, the cost would perhaps be somewhat nearly proportional to the amount of power supplied, being determined largely by the quantity of fuel consumed. But where the amount of power to be supplied is very small, the labor item becomes relatively large, and the cost per horse-power an hour becomes relatively greater than during those days when the steam plant is run more or less nearly up to its full capacity.

The general purpose of this paper has been to show that for streams on which there is little or no storage, the only proper way to estimate the power available for any development is to estimate it from the daily rather than the monthly flow; and to show the very considerable discrepancy that exists between the commoner method by monthly flows and the suggested method by daily flows.

LETTERS TO THE EDITOR.

Induction Motors and the Fire Hazard.

To the Editor of the Electrical Review:

I notice with interest an editorial on page 446 of your issue of March 18, 1905, entitled "Starting Resistance for Induction Motors."

There is one point not brought out in this editorial which is extremely important from the fire hazard standpoint, and which I think should be given publicity in the hope that it may cause discussion and lead to the solution of the difficulty.

The point is this: the induction motor, without starting devices other than the switch, takes anywhere from two to six times full load running current with full load torque.

In order that these large inrush currents may be secured, it is necessary to make the fuses of much greater carrying capacity than the wires which they are placed to protect. In other words, a wire which, according to the underwriters' tables, will carry 100 amperes will be fused with a cutout capable of carrying two or three hundred amperes. Now if the induction motor is placed at a considerable distance from the mains or feeders and a long branch circuit is run from these mains or feeders to the motor, we have the condition of a long line of a defined carrying capacity protected by a fuse which is very much larger in carrying capacity than the conductors which it is designed to protect. If a sprinkler pipe or any other metallic conductor should come in contact with these wires of the branch circuit, there might be caused a partial short-circuit sufficient to produce a considerable arc, but not sufficient to blow these large fuses. Immediately there develop a fire risk and the possibility of a serious conflagration.

The remedies for this starting current have been placed near the motor; this arrangement, however, does not protect the branch circuit from the motor and autostarter to the mains or feeders. Under the most favorable conditions, at the present time, there will be required fuses of about twice the carrying capacity of the wires they are placed to protect.

The above is the general situation, and one which the underwriters' representatives, as well as the municipal authorities, are seeking a solution of.

George F. Sever.

New York, March 27.

Maintenance of Electric Automobiles.

To the Editor of the Electrical Review:

In your issue of February 11 you quote from the *L'Eclairage Electrique* an article on the cost of maintenance of electric automobiles. On just what style of carriage the author of this article based his conclusions we do not know, but whatever the carriage I can not believe the figures of $218 per month.

It is, of course, possible that some trucks in the early days, when tires were not properly proportioned to the service asked of them and batteries were not understood, have cost several hundred dollars in a month, and indeed so have gasoline carriages when engines have been almost entirely spoiled by misuse. In this particular, I have sold both gasoline and electric and kept one of the largest garages in the East, and know whereof I speak.

Few garage managers would care to offer a maintenance contract to the owners of gasoline automobiles, but there are a number of stations we know which offer a maintenance contract on the electric carriage. This instead of being $218 per month is but $50 per month and this sum includes all battery replacements, all repairs of whatever nature except due to collision, and includes also the regular storage expense, housing, washing, cleaning, delivering and charging of the batteries. You may be sure that the agent does not offer a contract of this kind unless he figures he is on the safe side, and as a matter of fact, in stations where such an offer is made, comparatively few take up with this proposition, preferring to run their chance on what it will cost.

This is pretty good evidence that the electric vehicle can be and is maintained

Digitized by Google

in large cities where the expense for storage, etc., is the highest, for less than $50 per month, which includes as above all battery replacements and even tire repairs. Of course, these figures are reduced very greatly where storage, cleaning, charging and all such items are cared for by the owner in his own stable, and the comparison given is only to be made with carriages stored in a city garage. It is hardly worth the trouble to enquire in order to get the answer that no garage man would make such a contract on a gasoline vehicle, which to be on a par with the above mentioned contract would have to agree to replace the engine, transmission and tires and all other parts as fast as they wore out or broke, excepting, of course, in case of accident as mentioned above.

In the case of the electric, the "engine" is really renewed completely as the battery renewals leave the battery at any stated period after renewal, in exactly as good condition as when new.

The cost of maintenance all "depends" and I have bona fide cases where electrics have been run for a whole season with an outlay, including everything, of less than $10, but in this case the men cared for their vehicles themselves and the electricity was obtained from generators belted to their own power plants, so they could not even tell they were using it. Such instances, however, only serve to deceive the public as to the real cost, but such a comparison as made above, wherein the garage man will give all the services I have mentioned for a fixed sum, is a comparison which can be considered fair. This, as stated, shows a smaller cost for the electric than for the gasoline vehicle, day by day, and it is safe to say that where the contrary is found true, it is in cases where the people think the electric is so simple that they will not even take the trouble to find out what little there is to know about the very small but necessary care of the batteries.

HERBERT H. RICE,
Manager Waverley department Pope Motor-Car Company.
Indianapolis, Ind., March 28.

[The quotation referred to in the above letter was entitled "Electric Automobiles." It was abstracted from an article by M. R. de Valbreuze, and described the various types of electrical equipment which have come into use for automobiles. It concluded with the sentence, "The total cost of keeping an electric automobile is given at $218 per month." As this last sentence is the only reference to cost in the above quotation, it may be of interest to give a little more fully what M. de Valbreuze says. In arriving at this figure the author says he has endeavored to guard against the tendency to underestimate costs. He thinks that possibly these figures may be in excess, but he believes that they are very nearly correct. They refer to a first-class public carriage. The expense of caring for the battery, which includes washing and replacing the plates, is found to average $33.50 per month; the cost of charging and repairs to the battery, $36 per month; garage expenses, including washing, oiling, etc., $18 per month; tire expenses, $12 per month; depreciation, upkeep and repair of carriage body, $20 per month; depreciation, maintenance and repair of chassis, $24 per month; license $6 per month; mechanician, $40 per month; mechanician's uniform $3 per month; miscellaneous expense, $6 per month, a total of $198.50; for general expenses, ten per cent, or $19.85, making a total of $218.35. M. de Valbreuze says that these figures would be reduced somewhat by the use of more robust positive elements, and if the cost of charging were less. It will be noticed that he includes the cost of many items not usually counted, such, for instance, as the mechanician's uniform. The figure quoted, however, was said to be the total cost of keeping an electric automobile.—ED.]

IN THE EARLY DAYS.

BY FRANK B. RAE.

Back in the days of the first electric roads, when the 100-kilowatt generator was considered a big machine, the required output of the power station increased as the larger roads were equipped much more rapidly than did the size of the generating units. It, therefore, became necessary to operate several of the machines in parallel.

In these early days, too, some of us were obliged to do our experimenting in the field, or, more correctly, in the customer's station, for want of factory facilities at home, and the "getting together" of four or five generators connected in multiple on the bus-bars, for the first time, was something of a stunt.

The road at Saginaw, Mich., called for the large output of 400 kilowatts; four immense machines of 100 kilowatts each were required to be operated in multiple.

Moreover, these massive generators were compound machines. Now, most any one could put a lot of plain ordinary shunt machines in parallel, but the compound machine was a different bird, and they flocked together only when domesticated, so in this first attempt, at Saginaw, the engineering department was liberally advised, and as the switchboard progressed to completion in the factory every one from the fireman to the general manager had suggestions to offer, which if they had been carried out would probably have wrecked the machines and the station, too, and put the road out of business.

But there was one bright and shining light in the shop that did get his work in, however, one Thompson, I think, known as the "electrician" by the erecting force and called "Sir William" in the draughting room. Thompson had, he told the general manager, put compound machines in multiple for the Mather company, and the well-known success of the Mather machines was due, he inferred, to his genius in operating them in multiple. He had, he said, looked over the switchboard arrangements of the engineering department, and while they were all right as far as they went, there was one small detail lacking, which, if not supplied, meant the instant ruin of the machines if thrown in multiple. What was needed, he insisted, was a "teaser circuit" connecting all of the leads from the series coils together with fused switches. These fused switches were to be closed first; if the fuse did not blow, everything was all right and the main switches could be confidently manipulated.

Well, the fused switches were made as per Thompson's design on orders from the front office, erected on the board as per diagram and the "teaser circuit" carefully connected, then one night Frank Talbot, one of the twenty-four-hour-a-day workers of the old guard, and the writer went to the station about 2 A. M. to make the trial.

Would the machines go together or wouldn't they? Could we report success in the morning or would it be necessary to wire for new armatures? The moment was considerably trying.

The machines were carefully brought to voltage with our Ayrton & Perry voltmeter (blessed possession). The switches on the "teaser circuit" were closed, one after the other, until all four of them were in, and nothing had happened. Then one machine was thrown on the bus-bars and given a load, a second machine thrown in and the load divided between them, as shown on the ammeters, perfectly. Then the third and fourth machines went on with equally satisfactory results; "good work," said Talbot, and one after another they were all thrown out, and again thrown in. We could report success! The road could pile on the load now, we were ready for it.

In the midst of our mutual congratulations, Talbot turned suddenly to the switchboard and took the cover off one of the teaser circuit switches and said "Hell! Rae, I forgot to fuse any of these things."

But it was too late! The "teaser circuit" had been open in four separate places, but the machines had been put together just the same.

Digitized by Google

THE BEST ECONOMY OF THE PISTON STEAM ENGINE AT THE ADVENT OF THE STEAM TURBINE.[1]

BY PROFESSOR JAMES E. DENTON.

Stationary engines at the date of discovery of cylinder condensation were affording the maximum economy in simple condensing cylinders expanding steam of from sixty to eighty pounds pressure six times, with a vacuum of about twenty-seven inches, which afforded a water consumption of about nineteen pounds per horse-power-hour.

The first noteworthy improvement upon this degree of economy was obtained in the Leavitt pump, at Lawrence, Mass., which by expanding 120 pounds of steam sixteen times in two cylinders secured a water consumption of 16.5 pounds per horse-power. This, however, was a compound engine without a receiver, or what is known as the "Wolff" system, which does not divide the range of temperature due to expansion between the two cylinders, as the high cylinder is in connection with the low during the whole of the latter's expansion period. This fact and the slow speed of twelve revolutions per minute made the initial cylinder condensation forty per cent, or nearly twice that of the six-expansion, simple-condensing engines; besides which, live-steam jackets on both cylinders consumed ten per cent of the total steam.

The gain in economy over the simple engine was, therefore, due entirely to the influence of the high ratio of expansion aided by high initial pressure and so strong a reevaporative effect that the expansion line was outside of a Mariotte curve to the end of the expansion. The combined effect of these more than offset the negative influence of the high percentage of cylinder condensation. The engine was, however, the most economical of its time (1872) and it is interesting to note that its conditions of steam action were widely in contrast with that of the most economical Cornish pumping engine of 1840, which afforded precisely the same water consumption of 16.5 pounds by expanding thirty pounds of steam three and one-half times, with a complete avoidance of loss by cylinder condensation.

The first prominent advance in economy by division of the range of temperature was obtained about 1878 in the Corliss-Pawtucket compound pumping engine. This also expanded 120 pounds of steam sixteen times in two cylinders, but with a receiver between them; whereby, with the aid of a speed of fifty revolutions and only five per cent of jacket consumption, the cylinder-condensation loss was reduced to twenty-five per cent, and a water consumption of only 13.7 pounds resulted. This result led Corliss to introduce similar compound engines into mill practice, and they were then rapidly substituted throughout the world in all large power-using industries for the single six-expansion condensing engine. All makers of four-valve drop cut-off engines in both the United States and Europe obtained from them a water consumption of from 13.5 to 14 pounds per horse-power with about 125 pounds steam pressure and about sixteen expansions.

The gain from one division of temperature being thus established, triple-expansion engines were quickly introduced for mill and electric service by Corliss and Allis in the United States and Sulzer in Germany to obtain a further gain from two divisions of temperature. None of the triple-expansion engines succeeded, however, in reducing the water consumption below 12.5 pounds per horse-power, which was not a sufficient gain over the compound engine to offset the extra cost and care of the third-expansion stage. Its use was, therefore, quickly abandoned in mill and electric light service in favor of the compound engine.

Such a general readoption of the compound type resulted in a variety of cylinder ratios being used as involving possibilities of improved economy over the ratio of four to one introduced by Corliss. The first radical departure appeared in the Rockwood & Greene system, which was introduced into New England with a cylinder ratio of seven to one, and clearances of about two per cent, instead of the four per cent value previously prevailing. With 150 pounds steam pressure, live-steam jackets on either the heads or barrels of both cylinders, and a live-steam reheating receiver, such engines have afforded 12.45 pounds per horse-power with saturated steam expanded twenty-six times into about 27.5 inches of vacuum. Without the jackets and reheater in use about two per cent greater water consumption is obtained. The jackets and reheater, when in use, consume only about eight per cent of the total steam, with practically twenty-five per cent of cylinder condensation under both conditions.

This performance represents the best economy derived from the compound engine for mill and electric practice up to within a few years ago, and it has largely established the belief that a cylinder ratio of about seven to one, with so small a clearance as two per cent, is necessary to maximum compound-engine economy. During the last two years, however, the following records have been established:

1. With an 850-horse-power Rice & Sargent compound-Corliss engine running at 120 revolutions per minute, having a four to one cylinder ratio, clearances of four per cent and seven per cent, live jackets on cylinder heads and live steam in reheater, Professor Jacobus, of Hoboken, found for 600 horse-power of load, with 150 pounds pressure of saturated steam, 28.6 inches of vacuum, and thirty-three expansions, 12.1 pounds of water consumption per horse-power—a result produced with a cylinder-condensation loss of twenty-two per cent, and a jacket consumption of 10.7 per cent of the total steam consumption.

2. With a 250-horse-power Belgian Van den Kerchove poppet-valve compound engine, running at 126 revolutions per minute, with 2.97 to 1 cylinder ratio, clearances of four per cent, steam chest jackets on barrels and head, and no reheater, Professor Schröter, of Munich, found 117 horse-power of load, 130 pounds pressure of saturated steam, 27.6 inches of vacuum, and thirty-two expansions, 11.98 pounds of water per horse-power—a result produced with a cylinder-condensation loss of 23.5 per cent, and a jacket consumption of seven per cent of the total steam consumption in the high cylinder jacket and seven per cent in the low jacket.

3. With the Westinghouse twin low-cylinder, compound combined poppet-valve and Corliss-valve engine, at the New York Edison plant, running seventy-six revolutions, with 5.8 to 1 cylinder ratio, clearances of 10.5 per cent and four per cent, without jackets or reheater, Messrs. Andrew, Witham and Wells found for the full load of 5,100 horse-power, 185 pounds steam pressure, 27.3 inches of vacuum, and twenty-nine expansions, 11.93 pounds of water per indicated-horse-power, a result produced with an initial condensation of about thirty-two per cent.

These facts show that the minimum water consumption of the compound mill engine and electric light engine of the present date, using saturated steam, is not dependent upon any particular cylinder ratio and clearance nor upon any system of jacketing, but that the essential condition is the use of a ratio of expansion of about thirty, above which the cylinder-condensation loss is liable to prevail over the influence of the law of

[1] Abstracted from a paper presented before the mechanical section of the International Congress of Arts and Sciences at St. Louis, September 23, 1904.

Digitized by Google

expansion. The conclusion appears warranted, therefore, that if this ratio of expansion is secured with any of the current cylinder and clearance ratios, and with any existing system of jackets and reheaters, or without them, a water consumption of 12.4 pounds per horse-power is possible, and that a variation of four-tenths of a pound below or above this figure may occur by the accidental favorable, or unfavorable, jacket and cylinder-wall expenses which are beyond the exact control of the designer.

In order to compare the economy of the piston engine with that of the steam turbine, we must use the water consumption per brake horse-power, since no indicator card is possible from the turbine; and furthermore, we must use the average water consumption for the range of loads to which engines are subject in practice.

In all the public turbine tests to date, with one exception the output was measured through the electric power of a dynamo whose efficiency is not given for the range of loading employed, so that the average brake horse-power is not known. This exception is the Dean and Main test of a 600-horse-power Westinghouse-Parsons turbine using saturated steam at 150 pounds pressure, and a twenty-eight-inch vacuum. We may compare the results of this test with that of the 850-horse-power Rice & Sargent engine, and the 250-horse-power Belgian engine, by assuming that the power absorbed by friction in these engines is three per cent of the indicated load plus the power shown by friction cards taken with the engine unloaded. The latter showed five per cent of the rated power in the case of the Rice engine and eight per cent in the Belgian engine; so that the assumption regarding the load friction is a reasonable one.

The results are given in the following table, which shows the average water consumption per horse-power, for from forty per cent to 125 of full load, to be 14.55 pounds and 14.64 pounds for the two piston engines, and 14.51 pounds for the turbine, or practical equality.

AVERAGE STEAM CONSUMPTION PER BRAKE HORSE-POWER OF PISTON ENGINE VS. TURBINE.

	Lbs. Water per Brake H.P.-Hour.		
Per Cent of Full Load.	600-H.P. Turbine.	850-H.P. Rice Engine.	250-H.P. Belgian Engine.
125	13.62	13.78	15.10
100	13.91	13.44	14.15
75	14.48	13.66	13.99
41	16.05	17.36	15.31
Average 85	14.51	14.56	14.64

As an indication of the gain in economy of the turbine with increase of size, we may use the Elberfeld test of a Parsons turbine at the full load of 1,500 electric horse-power, with an allowance of five per cent for attached air-pump, and an assumed minimum generator efficiency of 0.95. Its saturated steam consumption, with 150 pounds boiler pressure and twenty-eight inches of vacuum, is then 13.08 pounds per brake horse-power, which shows a gain of four per cent over the 600-horse-power machine.

The 5,400-horse-power Westinghouse compound engine at the New York Edison station, whose friction under full load was cleverly determined at about four per cent, affords a brake-horse-power consumption of 12.5 pounds for 185 pounds boiler pressure. Crediting the turbine, therefore, with the possible influence of the difference in size and steam pressure, there is again practical equality in economy between it and the piston engine for equal horse-power.

The Milan Exposition.

The programme of the international competition for prizes which are to be awarded by the Association of Italian Manufacturers for the Prevention of Accidents in Factories, and which will be held during the Milan exhibition of the year 1906, has been issued.

The prizes are: A—A gold medal and 8,000 lire for a new appliance for preventing accidents arising from contacts between primary and secondary windings in alternating-current transformers. The appliance must fulfil the condition that no disturbance in the action of the transformer must arise in case of atmospheric discharges or abnormal increase of potential. B—A gold medal and 1,000 lire for a novel system of hand crane or winch fitted with a simple and practical contrivance to prevent the possibility of the handles revolving during the descent of the load. C—A gold medal and 500 lire for a safety appliance, to be simple, strong and reliable, to stop trucks automatically on an inclined plane on the hauling rope snapping. The appliance must be adaptable to existing plant. D—A gold medal for a system of absorption and collection of the dust produced in sorting and cutting rags by hand without giving rise to draughts detrimental to the health of the workpeople. E—A gold medal for a system to carry off by suction the dust generated by carding flax, hemp and jute without detriment to the neighborhood. F—A gold medal for a system to prevent the diffusion of dust in lime and cement works.

The conditions to which all competitors are subjected are as follows: applications to compete must be sent in not later than July 31, 1905, addressed to the presidency of the Association of Italian Manufacturers for the Prevention of Accidents in Factories, Foro Bonaparte, 61, Milan, Italy.

All appliances entered for competition for the prizes A, B, C, must be exhibited at the competitor's expense, in such dimensions and conditions as to allow of their being practically tested, at the Milan exhibition of the year 1906 in such time as may be determined by the exhibition committee.

No charge for space will be made to competitors who intend to exhibit their appliances in the space allotted to the association; they must, however, in their applications to compete, state the exact area they require. The acceptance of all applications to compete is reserved to the presidency of the association.

Competitors who elect to exhibit in other sections of the exhibition must allow a notice to be attached to their appliances stating that they form part of the competition founded by the association.

They must forward to the association not later than January 1, 1906, a properly executed detailed drawing of their appliances which the association will exhibit in its own section.

Competitors for the prizes D, E and F, must have their appliances at work in works in Italy, they must also forward to the association, to be placed in their exhibit, a detailed drawing, a small model and a full description of their appliances.

All appliances presented for competition are the property of competitors; the association will, however, retain the drawings, models and descriptions. All rights connected with the appliances are the exclusive property of their owners who must, however, take all necessary steps to guarantee their rights.

The association reserves the right to publish at the close of the exhibition the description and drawings of all the appliances.

A committee appointed by the council of the association will examine all appliances presented for competition. The appliances approved of on principle will be subjected to tests after which they will be classified according to their merits. The council of the association will award the prizes in accordance with the report of the committee; no appeal against their decisions will be entertained.

Further information will be supplied upon application to the director of the Association of Italian Manufacturers for the Prevention of Accidents in Factories.

Digitized by Google

Method of Protecting Against Voltage Rises for Transmission Systems.

At a recent meeting of the Société Internationale des Électriciens, M. E. Dusaugey read a paper discussing the conditions which throw unusual voltages upon transmission lines, and describing the apparatus which has been devised for preventing damage. Voltage rises may be due to four causes: atmospheric influences, resonance, effect of a quick break in the circuit, or accidental contact with systems carrying a higher voltage. The protective devices are classified accordingly as they operate continuously or intermittently. The intermittent devices usually provide one or more air-gaps, across which a discharge may take place. These devices are, in general, provided with certain accessories which limit the current that may flow after a discharge has occurred, and which extinguish the arc that has been formed. Apparatus operating continuously consists of some form of high non-inductive resistance. This may be a wire, or a liquid. The following schemes have been adopted in various European plants for protecting the systems:

The Société d'Énergie Électrique du Littoral Méditerranéen, which distributes power at 10,000 volts and at 30,000 volts, was, when it first went into operation, much troubled by atmospheric charges. It has placed on the line lightning arresters which have sixteen air-gaps in series, each gap being one and one-quarter millimetres in length for the 10,000-volt lines. For the 30,000-volt lines three times as many gaps are used. The gaps of these arresters are connected in series with eight carbon resistances, each having a resistance of 250 ohms. This gives 2,000 ohms resistance for the 10,000-volt circuits, and 6,000 ohms for the 30,000-volt circuits. These arresters are placed in the generating stations and at transformer stations. Where an underground cable is attached to an overhead line, an oil-break switch has been placed, and an overvoltage switch for limiting the voltage between the wires. This device resembles the arresters mentioned above, but there are only nine air-gaps, each one and one-half millimetres in length. There are four resistances, each of 2,500 ohms, giving a total of 10,000 ohms.

The Société d'Énergie Électrique de Grenoble et Voiron distributes energy at 15,000 volts. For the first seven months of operation, atmospheric charges interfered much with the station. During this time some of the early types of lightning arresters were distributed along the line, but they offered little or no protection. The following arrangement has since been adopted, and has entirely prevented the interruptions due to atmospheric charges. Lightning arresters of the horn type are connected one between each circuit and the ground. Between these arresters and the ground is placed a resistance of 8,000 ohms, formed of wet sand. These arresters are placed outside of the station, and are protected against the weather. Between them and the machines is an arrangement for preventing voltage rises. This consists of three spark-gaps of the horn type, connected in delta between the three wires, and each in series with a non-inductive resistance of from 14,000 to 15,000 ohms. The discharge gaps in these devices are each seven millimetres in length. In the substations a system of lightning arresters similar to those just described is installed, but the overvoltage circuit is not provided.

The Société Hydroélectrique de Vizille is operating a distributing system about twenty-five miles long, at 10,000 volts. The country through which this passes is subject to severe storms. At the station an overvoltage discharge circuit is provided and kicking coils are placed in the alternator circuits. At the transformer substations there are lightning arresters of the horn type, connected to the earth through ohmic resistances. These resistances consist of earthenware tubes eighty centimetres long, filled with water. The device for limiting the voltage at the stations consists of three earthenware tubes, each two and one-half metres long and fifteen centimetres in diameter, fixed on a cast-iron pipe five metres long and twenty centimetres in diameter. This is connected to the earth. Through it water is forced, which passes up through the earthenware tubes and flows out at the top. This arrangement was adopted to keep the water cool. The current flowing is about 0.3 of an ampere per tube. The energy used is about five kilowatts.

Some tests made recently by M. Graizier, director of the electrical system of Geneva, show the value of the non-inductive resistances when used in connection with an air discharge gap. To the terminals of the alternator were connected two water resistances. In parallel with these a short-circuiting was arranged. When this circuit was closed, it was found that the tubes of mica insulating the armature coils were frequently punctured by the sudden rise in voltage. Connecting a non-inductive resistance across the terminals of the machine had the effect of preventing entirely the puncturing of the tubes.

The Compagnie Vaudoise des Forces Motrices des Lacs de Joux et de l'Orbe operates a three-phase system at 15,000 volts. It protects its lines and machines by arresters of the divergent-horn type and by a water-jet discharge device constructed as follows: each line is connected to a metallic cup placed above a tank. Above the cups is a second tank kept filled with water by means of a pipe. From the bottom of the upper tank the water flows out through nozzles in three streams, falling into the cups, and issues from the latter by a second series of nozzles, falling into the receiving tank below, which is itself connected to the ground.

The Société Hydroélectrique du Guiers, when it first started operations, was considerably inconvenienced by atmospheric discharges. When it adopted the water-column discharging circuits this trouble disappeared. The water used is three litres per minute, and the power lost, about three kilowatts. The discharging device adopted by the Société Méridionale d'Électricité consists of a water pipe fitted with nozzles which throw out jets of water. These jets strike against terminal plates which are connected to the line. The water pipe is itself connected to the ground.

The following arrangement of protective devices is proposed: before the line enters the station, lightning arresters of the divergent-horn or magnetic blowout type are connected between the wires and the ground. Between these arresters and the station is placed an overvoltage discharger, which consists of a number of spark-gaps connected in series, and which is connected to the ground through a high non-inductive resistance. The value of the resistance will depend upon the apparatus employed. If they are of the divergent-horn type, at least one ampere should be allowed to pass through the resistance; if of the magnetic blowout type, half an ampere will be sufficient. The length of the air-gap should be regulated so that a rise of fifty per cent above the normal voltage of the line will cause a discharge to take place. Between this discharger and the machinery is connected a high-resistance circuit, which discharges to the ground. This circuit should allow normally from 0.2 to 0.5 of an ampere to flow. Next should be placed a kicking coil, and this is followed by the high-voltage switches. Beyond these high-voltage switches are three sets of dis-

Digitized by Google

charge gaps connected in delta between the three wires of the system, the gaps being connected to each other through non-inductive resistances. Beyond this voltage-limiting device are other kicking coils, connected directly to the terminals of the machines.

It is advisable to connect the cases of all these devices to the ground, as this will give the best protection to the station hands.

To protect the line, first the insulators should be strong and capable of resisting several times the normal voltage of the circuit. All the insulators should be tested separately at these high voltages. None of the crude, older types of arresters should be allowed on the lines. These are useless when installed at regular intervals. In fact, they become the source of many accidents. At points particularly exposed to atmospheric discharges, discharging circuits of the types described should be installed. These points can not always be designated beforehand, but they are soon found after operation has begun. Where aerial lines are connected to underground cables, it is necessary, in general, to install a lightning arrester, a voltage-limiting device, and a kicking coil.

High-Tension Underground Hauling Gear.

An interesting instance is here given of the adaptability of electric hauling, and of a complete change of system brought about because the electric system of underground hauling seemed necessary for one particular point of a mine. The extensive mines operated by Bolckow, Vaughan & Company, in the county of Durham, England, were formerly operated by steam engines in use underground. Steam haulage was satisfactory as long as the seams were level and the working faces did not extend further than 3,000 yards or so from the bottom of the shaft. At the Auckland Park colliery, however, at a distance of two and one-half miles from the shaft a dip in the seam was encountered, forming a long and heavy incline. Horse haulage on this slope proved unsatisfactory, and as the sinking of a new shaft was out of the question, it was decided to install electric hauling gear, not only at this point, but throughout the entire collieries. The latter are so widely scattered that, for power supply purposes, they were divided into groups, the Auckland Park and Winchester collieries being the first two groups to be equipped. Each group has its own central generating station, at which steam is raised from the waste gases of the exhaust coke ovens. A three-phase, high-tension system of distribution was decided upon, and the first plant put in at each of the stations consists of a pair of compound, three-crank Willans engines, direct-coupled to three-phase alternators. The latter have an output of 200 kilowatts at 2,400 volts. The boilers are of the Lancashire type, heated by coke-oven gas, as mentioned. They supply steam at 150 pounds at the engine-stop valve. Overhead bare copper transmission lines are employed above ground, while in the shafts and galleries the current is carried by armored cables. These cables are supported every six feet by special clamps attached to the buntings. In the galleries they are carried by hempen slings hung from miners' nails driven into the pit props or cemented into the roof. There are about five miles of overhead line, and fifteen miles of cable underground. At present the electrically driven plant consists of five 110-horse-power main haulage gears, two thirty-horse-power, one forty-six-horse-power, one sixty-horse-power haulage gears, and two eighty-five-horse-power staple pit winding gears. All motors are of the three-phase induction type. There are, in addition, several motor-driven pumps and one fan. On the surface, coal-washing, screening and handling machinery is electrically driven. The lighting of the collieries, both above and below ground, is, as far as possible, done electrically. Current is transformed down to either 220 or 110 volts by a seventy-five-kilowatt transformer at each station, and by several one-kilowatt transformers below ground. Two of the main haulage gears are more than two miles away from the shaft. One of these is designed for working the heavy inclines. At the present time it drives a single-drum gear, though it is designed for a double drum. It hauls a maximum load of thirty trucks each way, eight hundredweight empty and twenty-eight hundredweight loaded, up an incline of twenty-five per cent, about a thousand feet long, at a speed of from six to seven miles an hour. The drum is four feet in diameter, and is driven through a double reduction gear and a flexible coupling by a 110-horse-power motor. The latter is of the slip-ring type with starting and controlling resistances. The controller has two mechanically interlocked drums operated by one hand wheel, one drum controlling the stator, and the other drum the rotor. Each is immersed in its own oil box. There are twenty-five steps in the starting resistance. The furthest point to which electricity is conducted is three miles from the shaft. At this point there is a high-tension motor with liquid starter, which is installed to work an endless haulage. Two miles from the shaft a thirty-horse-power motor drives a fan to improve the ventilation. The power from the Auckland Park station is also carried to several other collieries in the neighborhood, where it is used for hauling, pumping and other work.—*Abstracted from Engineering (London), March* 17.

The Siemens & Halske Oscillograph.

A description is given in the February issue of *Electro,* Brussels, of a practical form of oscillograph brought out by the Siemens & Halske company. The instrument is a modification of the Blondel oscillograph, which is a special form of D'Arsonval galvanometer. The present instrument is arranged so that curves may be viewed directly, or photographed. The beam of light which is reflected from the oscillating mirror comes from an arc lamp. The entire apparatus is enclosed in a light-tight box. The light from the vibrating mirror falls upon a drum mounted upon one end of the shaft of a four-pole synchronous motor. When it is desired to photograph the curve, sensitive paper is attached to this drum. The drum is so arranged that it can be shifted automatically while rotating. Thus, a series of curves is obtained, corresponding to thirty revolutions of the little motor. On the other end of the shaft of the motor is placed a reflecting prism. The light is thrown against the latter by means of a system of mirrors. When the light falls on this reflecting prism it revolves and is observed. The curve is represented by a white line on a black background. By pressing a button, the reflecting mirrors are thrown out of the way, and the beam of light falls on the rotating drum. By this arrangement one can instantly examine the character of the curve, and a record is made only of those which are desired. The instrument may be fitted with a single or two oscillating systems. In the first a series is used in studying the voltage curves, and a shunt in studying current curves, two curves being taken consecutively. With the double system both curves are obtained at the same instant.

Digitized by Google

BOOK REVIEW.

"Steam Turbines," with an appendix on gas turbines and the future of heat engines. Dr. A. Stodola, professor at the Polytechnikum in Zurich. Authorized translation from the second enlarged and revised German edition, by Dr. Louis C. Loewenstein, Department of Mechanical Engineering, Lehigh University. New York. D. Van Nostrand Company. Cloth. 434 pages. 7 by 9½ inches. 241 cuts, 3 lithograph tables and 3 large folded charts. Supplied by the ELECTRICAL REVIEW at $4.50.

This book is the first one that has come under our notice that gives a thorough and comprehensive theoretical treatment of the steam turbine, both from a mechanical and a thermodynamic standpoint. The work bears about the same relation to the steam turbine that Rankins's classic work bears to the old form of steam engine. Those students that enjoyed reading Rankins's chapter on thermodynamics will also enjoy this book. It is not easy reading. It requires very thorough acquaintance of the calculus; differential equations, theoretical mechanics and thermodynamics, including the use of the entropy-temperature diagram, before it can be read with satisfaction. To the student or designer who has the preliminary training necessary the book will be found not at all difficult. It contains a vast amount of information and the writing of it must have occupied the author some years. The book begins with elementary theory of the turbine, starting with flow of steam through an expanded nozzle and treating of the reaction of the steam from blades of different shapes and angles, and of the speeds and powers thereby generated. The work of friction and loss of kinetic energy therefrom are then considered. Some space is then given to discussion of experiments with flow of steam in nozzles, the theory of steam shock, influence of the enlargement of cross-section, and experiments with turbine blades. The laws of energy of the steam turbine are then considered from a thermodynamic standpoint, and application of this theory is made to different types of turbines. Methods are given for the choice of a peripheral velocity, angles of the blades, steam velocity, number of stages and blade dimensions. The steam friction of rotated discs is discussed and tables or curves showing experimental results are given. What has been described above occupies the first 140 pages of the book. Part iii then treats of the construction of the most important turbine parts, including the form of blade, length and width of channels, method of designing a blade, guide apparatus, wheel drums, disc wheel of variable thickness, disc of uniform strength, stresses and materials of construction, the mass-balancing of rotating bodies, flexible shaft of De Laval, deviation of a rotating disc due to shaft bending, critical velocity and the period of oscillation due to elasticity, critical angular velocity of a multiple loaded shaft, bearing for steam turbines, stuffing boxes, and regulation. Part iv treats of steam turbine types. The following types are briefly described and illustrated: De Laval, Seger, Riedler-Stumpf, Zolly, Curtis, Rateau, Parsons, Schultz, Lindmark and Gelpke-Kugel. A brief historical review follows; then a statement of latest suggestions for the improvement of the turbine, including the Fullager turbine, the scheme of Dolder and C. A. Parsons double-motion turbine, are given. The author does not treat of the immense number of constructions that have failed entirely, although a knowledge of these failures would undoubtedly save the beginner much useless inventive labor. "It is not too emphatic a statement to say that there is hardly to be expected a greater number of misconceptions than already exist in steam turbine construction." The comparison is made between the steam turbine and the reciprocating engine. The author concludes from study of results of experiment that the steam turbine working with moderate superheat has exceeded the compound reciprocating engine in steam economy. All signs point to the fact that with high superheating this comparison will not change. It is different with the triple-expansion reciprocating engine. This shows that with small powers up to 1,000 kilowatts (such a small consumption) that its efficiency, taking also in consideration the consumption of oil, space required, etc., may be said to place it far in advance of the turbine. With very large powers, on the other hand, these relations are reversed. The best results obtained by Brown, Boveri & Cie., in Frankfort, from a steam turbine, about 3,000 kilowatts, which is equal to about 4,660 indicated horse-power, gave 9.6 pounds of steam per indicated horse-power hour. On the other hand, the triple-expansion steam engine of the Berliner Electric Works, 181 pounds per square inch boiler pressure, 597.2 Fahrenheit temperature of superheated steam, and 2,550 indicated horse-power, gave a consumption of 8.93 pounds per indicated horse-power per hour with hardly more than one-half the power. The triple expansion steam engine has therefore still an advantage of about eight per cent of the steam consumption. Part v treats in a mathematical way of a few special problems of steam turbine theory and construction, including distribution of pressure in a cross-section of an expanding gas or steam jet; pressure distribution in a turbine blade channel; deflection of a horizontal disc of variable thickness due to its own weight; straightening out of a horizontally rotating disc by its own centrifugal forces; the stresses in disc wheels due to unequal heating; critical velocity of a constant and uniformly loaded shaft with variable diameter; sympathetic vibration of the foundation; conditions for stability of equilibrium beyond the critical velocity; critical velocity of the second degree caused by the deflection of the uniform shaft due to its own weight; the transmission of heat through the casing and shaft of a many stage turbine; the differential equation for pressure distribution in a many stage axial reaction turbine. An appendix treats of perpetual motion of the second type and the second fundamental law of thermodynamics; the Carnot cycle, integral of Clausius, entropy, etc. It concludes with the latest suggestions for obtaining the maximum economy of heat engines in general, some of which the author shows to be fallacious. The gas turbine is treated to the extent of a few pages, but the author does not appear to have much hope for its ultimate success. Professor Stodola's work will undoubtedly be a classic on the subject of steam turbines for many years to come. The translation appears to have been done with great accuracy and there appear to be very few errors of English or of typography. On page 95, tenth line from bottom, "as" should be "a." Page 319, second line from bottom, "data is" should be "data are." On page 342, it appears that the word "vertically" in the title of Fig. 71A should be "horizontally." In connection with the discussion on entropy diagram, three large folded charts are put in an envelope in the binding giving entropy diagrams for steam in French and English units. While the author and translator are to be congratulated on the production of a magnificent treatise, it must be said that there is something lacking to make it entirely satisfactory either to the student or to the practical designer. What is wanted is either an appendix or a supplementary volume which will contain: (1) a condensed summary of the equations which are needed in practical design, omitting the mathematical work by which these equations are derived. (2) A set of tables constructed from the formulas showing the numerical values of the several variables within ranges likely to be used in practice. (3) Several examples of design making use of the formulas and tables. (4) A table of equations used in the summary. If such a supplement were furnished it would be practicable for an engineer with ordinary skill in designing to proceed to design a turbine with some facility, and for a student also to obtain practice in designing on a drawing-board without spending the immense amount of time necessary to make a thorough study of the subject which the book in its present shape requires.

Digitized by Google

The Faraday Society.

The annual general meeting of the Faraday Society was held on Monday, March 6, 1905, at the Institution of Electrical Engineers, London, England. The treasurer, Dr. F. Mollwo Perkin, occupied the chair.

The new council, which was elected at the meeting, is constituted as follows: president, Lord Kelvin; past-president, Sir Joseph Wilson Swan; vice-presidents, Professor A. Crum-Brown, Sir William Huggins, Sir Oliver Lodge, Ludwig Mond, Lord Rayleigh, Alexander Siemens, James Swinburne; treasurer, Dr. F. Mollwo Perkin; council, George Beilby, Bertram Blount, W. R. Cooper, Sherard Cowper-Coles, Professor A. K. Huntington, Dr. R. A. Lehfeldt, W. Murray Morrison, Dr. W. S. Squire, Dr. O. J. Steinhart, Professor Ernest Wilson.

Votes of thanks were passed to the retiring president, Sir Joseph Swan; to the honorary auditors, Messrs. L. Gaster and T. M. Lowry; and to the Institution of Electrical Engineers for its hospitality in granting the society the free use of its library for the monthly meetings.

The twelfth ordinary meeting was subsequently held. The minutes of the previous meeting having been duly confirmed, Mr. F. W. Harbord read a paper on "Recent Developments in Electric Smelting in Connection with Iron and Steel." The paper embodies the principal results of the investigations made by the commission sent to Europe last year by the Canadian government for the purpose of reporting upon the different thermoelectric processes for the smelting of iron ores and the manufacture of steel at work in Europe, together with some additional information bringing the subject up to date. The author acted as metallurgist to that commission. The reading of the paper was illustrated by means of an interesting series of lantern slides.

Electric smelting furnaces are divided into three main classes—induction furnaces, resistance furnaces, and arc furnaces. The first type is specially adapted for melting rather than smelting; the others can be adapted for either purpose.

I—INDUCTION FURNACES.

The best known furnace of this type is the Kjellin furnace. That is, in effect, a step-down transformer, in which the contents in the hearth form the secondary circuit of the transformer. Any grade of steel, from 0.10 to 1.50 per cent carbon, can be produced in this furnace, but high-class materials must be used, as there is no elimination of impurities. The furnace at Gysinge, in Sweden, which has been in operation since 1900, is now of 175 kilowatts capacity, and its output is 5.2 to 5.5 tons per twenty-four hours. The furnace absorbs from about 0.13 to 0.16 electric horse-power-year per ton of ingots, according to the carbon content of the product.

II—RESISTANCE FURNACES.

(*a*) The Héroult Furnace—A four-ton furnace at Kortfors, in Sweden, and a somewhat smaller one at La Praz, in France, are producing high-quality steel on a considerable scale. The furnace is a tilting one, and is basic-lined; two large adjustable electrodes pass vertically through the roof. In this furnace ordinary steel scrap can be converted into steel of the highest quality, the impurities being removed by suitable fluxes. Steel varying from 0.079 to 1 per cent carbon is made with perfect ease. At La Praz an alternating current of 4,000 amperes and 110 volts is used. The furnace absorbs about 0.111 electric horse-power-year per ton of ingots in the case of low-carbon steel, and about 0.17 electric horse-power-year for high-grade carbon steel.

(*b*) The Keller Furnace—This is similar to the Héroult furnace, differing only in details. The author saw tests made with a thirty-five-hundredweight experimental furnace at Livet. Common scrap was the raw material, and the energy absorbed was about 0.120 electric horse-power-year per ton of ingots.

(*c*) The Resistance Furnace for Direct Smelting from the Ore—Experiments made at Livet in the Keller furnace demonstrated the possibility of making pig of the most varied composition. The type of furnace is identical with that used for making iron alloys, such as ferrochrome, ferrotungsten, and ferrosilicon. The furnaces at Livet are vat-shaped, and connected at their lower ends by a central well; four are usually grouped together. The current used in the trial runs varied between 10,600 and 12,000 amperes, at voltages from sixty-three to sixty-eight, and the energy absorbed was 0.25 horse-power-year per ton of pig for a white iron containing little silicon and manganese, and 0.53 horse-power-year for a gray iron more silicious. The coke used averaged 767 pounds per ton of pig iron produced, and the estimated cost of electrodes was three shillings and sixpence per ton of iron.

At Livet, forty-five to sixty per cent ferrochromes and twenty-five to eighty per cent ferrosilicons are made regularly. For such high-grade alloys the electric furnace is more economical than the blast furnace.

The Gin Process—In this it is proposed to dispense with carbon electrodes, using instead large water-cooled block terminals, which lead the current into a long, basic-lined, narrow channel, forming the furnace hearth. The author does not know whether the process has been tried on a commercial scale.

III—ARC FURNACES.

The heat is obtained from direct radiation from the arc, and by reflection from the roof and sides of the furnace.

(*a*) The Stassano Furnace—The latest type at Turin is a five-ton furnace (per twenty-four hours), and absorbs 4,900 amperes at 150 volts, the current being distributed between two arcs (and therefore four electrodes) which meet at the centre of the furnace. The furnace is lined with magnesite bricks. Steel is produced direct from the ore (pure hæmatite) in one furnace. Reduction is effected only by the carbon, which, with the ore, is moulded into briquettes, and a practically pure iron can be obtained. The energy consumption is 0.186 electric horse-power-year per ton of steel, and the consumption of electrodes five kilogrammes per ton of steel.

(*b*) The Harmet Process—In one form of furnace the inventor melts oxides of iron in a vertical shaft by means of producer gas, and reduces them by solid incandescent carbon; in another form carbonic oxide is his chief reducing agent. The process has not yet been experimented with on a commercial scale.

GENERAL CONCLUSIONS.

(*a*) Steel, equal in all respects to the best Sheffield crucible steel, can be produced in England, either by the Kjellin, Héroult, or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel, assuming electric energy to cost £10 per electrical horse-power-year.

(*b*) At present, structural steel, to compete with Siemens or Bessemer steel, can not be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes.

(*c*) Speaking generally, the reactions in the electric smelting furnace are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature by varying the electric current, any grade of iron, gray or white, can be obtained, and the change from one grade to another is

Digitized by Google

effected more rapidly than in the blast furnace.

(*d*) Pig iron can be produced on a commercial scale at a price to compete with the blast furnace, only when electric energy is very cheap and fuel very dear. With electric energy at $10 (forty-one shillings and eightpence) per electrical horse-power-year, and coke at $7 (twenty-nine shillings and twopence) per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace. Under ordinary conditions, where blast furnaces are an established industry, electric smelting can not compete; but in special cases, where ample water power is available, and blast-furnace coke is not readily obtainable, electric smelting may be commercially successful.

In the discussion which followed M. Adolphe Minet communicated some further particulars of the Héroult process, giving a sketch of its development. About 3,000 tons of steel have up to the present been made. The process was an advance upon others and upon the crucible furnace, because it allowed of a complete elimination of sulphur and phosphorus, and common raw materials, costing seventy francs a ton, can be used. The current consumption at present is 120 kilowatt-hours per ton of steel. M. Minet also gave some tables of tensile strengths and summed up the special advantages of this process, and he exhibited some specimens of steel and ferroalloys made in the Héroult furnace.

Mr. B. H. Thwaite in a communicated discussion described a scheme for the production of high-quality ingot steel in Canada, suggested by him in 1903. The anthracite had to be imported from the United States, and it was proposed to briquette the raw materials to effect the reduction in a particular design of arc furnace. The gases evolved were to heat an open-hearth furnace in which the steel was to be made, additional electric heating also being available. He considered that both the Keller and Héroult processes were available for the useful employment of the power-producing resources of the blast furnace, now mostly going to waste.

Mr. Bertram Blount in a communication insisted that now is the time for steel-makers in England to adopt electrical methods of working for making the special steels used in the construction of such articles as guns, safes, motor-cars, cutting-tools, etc., which have individual properties easily obtained when those are employed.

Mr. W. Murray Morrison agreed that the Keller and Héroult seemed at present the only practicable furnaces as far as England was concerned. M. Héroult had recently reduced his energy figure to 0.15 electrical horse-power-year per ton of steel, starting with scrap, and to the remarkable figure of 0.0114 electrical horse-power-year (equivalent to two shillings and fourpence a ton), starting with molten metal; he was now constructing a 300-ton mixer and a fifty-ton furnace, in which still better results were to be hoped for.

Mr. R. S. Hutton pointed out that electric heating was only economical when very high temperatures were desired, and that it was not, therefore, desirable to use electric furnaces for melting. One of the advantages of the Héroult furnace arose from the fact that it was an arc as well as a resistance furnace. The two sources of intense heat caused convection currents in, and hence intimate mixture of, the molten charge.

Mr. R. L. Gamlen, speaking as one interested in the production of cheap power, was of the opinion that the limiting figure of £10 per electrical horse-power-year mentioned by the author could be considerably lessened by the producers of power on a large scale. In considering this question of cheap power too much stress was usually laid on fuel costs; capital costs were an even more important item. These were very large in the huge gas engines required by low-thermal value gases, such as blast-furnace gases, and steam power was therefore more economical even if the gas cost nothing.

Dr. O. J. Steinhart drew attention to the difficulties of making low carbon ferrochromes, especially in arc furnaces. The value of these was very high compared with those of higher carbon content.

Mr. T. V. Hughes said that a sober presentment of the possibilities of electric smelting, such as Mr. Harbord had given, was of great value as not tending to inflate the public mind.

Professor E. Wilson thought that the figure of £10 per electrical horse-power-year could be diminished for large supplies of power.

The chairman in moving a vote of thanks to Mr. Harbord remarked on the enterprise of the Canadian government in appointing a commission to study this very important question. He wished that some of the English manufacturers would see the desirability of becoming alive to the possible future of electric smelting, and making experiments on the subject.

THE NEW ROLLING ROAD AT CLEVELAND, OHIO.

BY D. A. WILLEY.

The application of the electric current as a motive power has been demonstrated in a somewhat novel manner in the city of Cleveland, Ohio, where it is utilized in connection with what is called a rolling roadway. A considerable area of the manufacturing section is situated on the lowland adjacent to the Cuyahoga river, and ranges from sixty-five feet to seventy-five feet lower than the centre of the city. Obviously there is a large amount of traffic between the two sections, but such is the ascent that all of the thoroughfares connecting the upper and lower portions have a very high percentage of grade, and extra teams are usually required to assist in pulling loaded vehicles up the various inclines. In fact, some are so steep that the time required for an ascent ordinarily is fully thirty minutes.

The rolling roadway in question has been installed on Factory street, one of the most direct routes between the upper and lower parts of the city, and a thoroughfare having one of the heaviest grades—a rise of no less than sixty-five feet in 420 feet, or over fifteen per cent. The roadway is 420 feet in length, and consists of an endless belt and platform made of planks eight feet long, placed traversely of the roadway and bound with angle irons. They are supported on a metal framework and are securely fastened together in "trucks" of two planks each. The adjoining trucks are connected by heavy links to form the continuous roadway. The roadway really runs on four thousand small wheels in which, to reduce friction and wear, a special type of Hyatt roller bearing was successfully introduced. At the upper end the roadway revolves around an immense sheave, the returning belt running underneath on idlers to a similar sheave at the lower end.

As the weight of the mechanism itself is considerable, the roadway portion representing no less than 106 tons, it was necessary to devise some means to prevent the surface from being depressed out of line, and to sustain the additional weight of loaded vehicles. The roadway has been set in an excavation of suitable dimensions. At the upper and lower ends of the excavation the sheaves are placed in pits of masonry, each pulley being sustained in a massive framework of cast iron. The wheels on which the roadway travels are set into an inclined plane or

Digitized by Google

fixed platform, which, it might be said, is placed within the conveyer, so that the upper portion when in motion is passing directly over it. This platform is held rigidly in place by iron posts, attached to the sides at regular intervals, and extending to the bottom of the excavation in which the roadway is set.

THE NEW ROLLING ROADWAY AT CLEVELAND, OHIO.

Despite the magnitude of the apparatus and its comparatively great weight, all the movements are readily controlled by a single operator, owing to the system employed. The electric current which supplies the actuating force is secured from one of the municipal lighting plants and conveyed by wiring to four Westinghouse motors. These are installed in pairs at the upper and lower extremity of the roadway and connected to the axles of the sheaves. The motors which have a capacity of twenty-five horse-power are controlled by a Westinghouse R-7 controller, placed in the operating station at the top of the roadway. The arrangement is such that the motors can be operated independently or in a series. Consequently, the power applied can be regulated according to the load which is to be moved.

It is needless to say that the motion of the roadway can be stopped at any time. Consequently, vehicles can be driven upon it with but little delay, and its operation made practically continuous if necessary. At either end a platform has been constructed which overlaps the roadway. As it is used almost entirely for ascending the hill, the wagon to be moved is driven upon it by means of the overlapping platform, and the wheels securely braced to prevent them from slipping backward. Then a signal is given to the operator in the controlling station who starts the motors. As soon as another wagon reaches the lower end, the mechanism is stopped long enough to take it on and the operation repeated. When the first wagon reaches the summit, it can be driven off without stopping the motors if desired. As the roadway is eight feet in width, it is sufficiently capacious to accommodate the heaviest wagons utilized in this portion of the city. It is designed to hold twenty vehicles, representing with their loads five tons each, and has carried at one time six loaded wagons.

Considering the amount of horse-power required, the speed of this novel roadway is such that it will make a complete revolution within five minutes, and at a maximum rate of speed averaging three miles an hour. In short, it may be called an enormous endless belt or conveyer, and forms an excellent illustration of the value of the electric current for the purpose which it serves.

The cost of the roadway is understood to have been about $100,000, but considering the fact that it can be employed in moving traffic on city thoroughfares where the grade is so steep as to seriously interfere with the movement of vehicles, this sum would not be considered excessive. The roadway at Cleveland is the design of Mr. Isaac D. Smead, an engineer of Cincinnati, Ohio. It has been in operation for several months, and is depended on largely for moving merchandise which must be carried from the upper to the lower sections of the town.

UPPER END OF THE NEW ROLLING ROADWAY AT CLEVELAND, OHIO.

Digitized by Google

High Pressures in Electric Railroading.

At the recent meeting of the American Institute of Electrical Engineers, Mr. C. O. Mailloux, of New York, contributed the following communication to the discussion of high pressures in electric railroading:

"The subjects discussed and suggested for discussion in the papers presented this evening are, undoubtedly, of great importance at the present time. If the statement be true that the question of the hour, in electric railroad engineering, is the extension of electric traction into the field which has hitherto been preempted and occupied exclusively by steam, then the question of the first half hour, to say the least, will be, of necessity, the question of conveying electrical energy in large amounts safely and conveniently from a stationary conductor to an electric locomotive or motor car. Indeed, I have had the conviction for some time that material progress in the direction of that general supplanting of the steam locomotive by the general locomotive, which we, as electrical engineers, wish so fondly and ardently to see, must wait for progress in methods adequate for the purpose just stated, and which will bear repetition as constituting fundamental requirements, if not *sine qua non* conditions, for any system of electric traction intended to supplant steam traction, namely, to convey electrical energy, in large amounts, safely, conveniently and successfully from a stationary line to a moving locomotive. It was this very conviction of the necessity of further progress, and of radical departures from the then existing and available methods, which led me to undertake, last spring, a trip to Europe, for the specific purpose of examining the results and studying the possibilities of certain methods of conveying high potential alternating currents to electric locomotives or motor cars. I arranged my itinerary so as to include a visit to every installation, experimental or commercial, presenting interest and capable of furnishing information in regard to, first, electric traction with alternating-current motors in general; second, electric traction with single-phase alternating-current motors in particular; and third, means of conveying electric current at high potentials to such motors.

"Before I left I was somewhat sceptical in regard to the feasibility of raising above 3,000 volts the potential difference which may be applied direct to the motors, even though I knew that 3,000 volts had been used successfully in this manner for a year or more on the Valtelinna line in northern Italy. I am pleased to say that my doubts on this point were soon dissipated by what I saw, especially on the Spindersfeld line, near Berlin, and the experimental line which has since become a working line built in Switzerland by the Oerlikon Company near Zurich. I have returned a firm believer in and a strong partisan of high-potential contact lines. I use the words "contact lines" in a sense which would include trolley lines or even third-rail conductors, both of which are terms of restricted meaning, destined in my opinion to disappear.

"I endorse strongly Mr. Damon's view in favor of higher line contact potentials for alternating-current railway motor cars; and as between 3,300 volts and 6,000 volts, I am inclined to favor 6,000 volts as the standard which should be adopted for interurban lines. I think I would disagree with Mr. Damon, however, in regard to the form of line construction. I will return to this point later.

"I also agree fully with Mr. Damon that for steam railroad conditions a line contact pressure of at least 15,000 volts is desirable. One of the important results of my European trip of investigation is the evidence which I was able to obtain, as the result of personally conducted tests and experiments, of the feasibility of contact line potentials of at least 15,000 volts.

"I wish at this point to pay high public tribute, both of praise and of thanks, to the officers and technical staff of many manufacturing and operating companies, whose installations I had occasion to visit. The uniform courtesy with which I was received everywhere and the facilities for investigation which were placed at my disposal in almost every instance were, indeed, most gratifying and are certainly worthy of emulation here, for I am afraid that we are not ourselves always quite as courteous and obliging as these gentlemen were to me.

"I will pass over many interesting points which are not immediately related to the discussion in hand or which have already been touched upon in the papers or in the discussion. The contact line having catenary suspension, which was a novelty at the time of my trip to Europe, has recently been introduced here and has already, judging from the data contained in Mr. Damon's paper, reached a high stage of development. I may say that the catenary contact line used on the Spindersfeld line with 6,000 volts potential difference worked satisfactorily in every respect so far as I could observe or ascertain. Nevertheless, it would seem that either on account of municipal restrictions or for other reasons, not readily apparent, the catenary contact lines for other projected alternating-current, single-phase railroads, which came to my notice, were limited to 2,400 volts. I surmise that notwithstanding the fact that so few breakdowns of the contact line have occurred at Spindersfeld, and that none of these breakdowns caused any accident, there is still some feeling of unrest associated with the thought of a contact line of 6,000 volts placed directly over the car or locomotive, and even though the probability of accident is very remote, yet so long as the possibility thereof still remains, the unrest and the objection will doubtless persist. The double catenary, as Mr. Damon states, has the advantage of keeping the contact wire from swaying, but its increased cost does not appear to be always justified. With the tower method of construction, using long spans, the double catenary would probably be indispensable. With the ordinary trolley line form of suspension, where the distance between poles is not excessive, the single catenary would seem adequate and satisfactory for all purposes. At Spindersfeld, the poles are placed about thirty-nine metres (about 128 feet) apart. Both the single and the double catenary suspension have been tried, and both have proved adequate and satisfactory. The reference made by Mr. Damon to spectacular sparking when the contact line was coated with ice or sleet, emphasizes a very strong, and, in my opinion, a radical inherent defect of any contact line arranged to deliver current from its lower side instead of its upper side. The fact that the sparking increases with the frequency of the trolley supports in the cases observed by Mr. Damon proves conclusively, it seems to me, that ordinary trolley-line construction using a trolley wheel for the contact is wholly unsuitable for high-potential contact lines. With the catenary suspension, even in the case of a trolley wheel, the sparking ought to be independent of the number or frequency of the line supports. The necessity of employing higher potentials for the transmission lines will obviously depend on the potential of the contact line. When this potential difference is as low as 3,000 volts it would undoubtedly be still necessary to employ higher transmission potentials in most cases for interurban lines; but if the potential difference at the contact line is raised to 6,000 volts there are many cases where this potential would be sufficiently high for both transmitting and distributing purposes. When the contact line potential

Digitized by Google

is raised to still higher values, say, for instance, 15,000 volts, the same potential difference will suffice in a large number of cases for both transmitting and distributing purposes. Indeed, if it were not for the convenience of subdividing the total line into blocks or sections, the contact line itself could serve as the feeder. Mr. Huber, of the Oerlikon Company, mentioned to me a project for the equipment of a steam line in Switzerland, where it was proposed to supply fifty miles of track in both directions from a central station without feeders, simply using a duplicate contact line, one on each side of the track. This method has the advantage of providing a duplicate-line equipment which can still answer the purpose at lower efficiency, though without materially crippling the service in case of defect or derangement in either of the two contact lines."

Foreign Scientists to Lecture at Columbia University.

It has been announced that two distinguished European scientists have accepted appointments for the year 1905-1906 to lecture at Columbia University. The gentlemen are Vilhelm Friman Bjerkness, professor of mechanics and mathematical physics in the University of Stockholm, and H. A. Lorentz, professor of physics in the University of Leyden.

Professor Lorentz is one of the most distinguished mathematical physicists in Europe. He has had much to do with the development of the modern electromagnetic theory, and is the winner of the Nobel prize for research on electromagnetic phenomena. Professor Lorentz's discoveries and theories will form the subject of his lectures at Columbia in April and May of next year.

Professor Bjerkness will lecture on the field of force. His researches in this subject have brought about some remarkable results, and some of these not yet discussed will be taken up for the first time in the lectures Professor Bjerkness will give at Columbia University in November and December of this year.

A Magnetic Survey of Japan.

The Japanese have been accused of being too utilitarian in their methods of education, and also of being deficient in originality, but both of these charges have been made by men who were not very fully acquainted with the facts of the case. A perusal of the memoirs published in the *Journal of the College of Science* of the Imperial University of Tokio disproves both charges. It would be exaggeration to say that these memoirs reached the highest standard of similar publications, but, taking into account the short time which has elapsed since Japan took the systematic study of western science, we can safely say that the progress which has been made in scientific investigation has been simply wonderful. The last part issued of the above mentioned journal is a record of systematic observations and methodical arrangement of which no learned body in any part of the world would have any reason to be ashamed. It describes a magnetic survey of Japan, conducted under the authority of the earthquake investigation committee during the four successive summers 1893-96, and it is the voluntary work of members of the staff of the University of Tokio, and of other institutions in Tokio. The reporter, Mr. A. Tanakadate, is professor of physics in the University, and is remembered by many in this country as a very earnest student and a painstaking investigator. The report extends to 347 pages of letter-press, with the addition of a large number of diagrams, plates, and maps, so that it would be quite impossible, even if that were desirable, to enter into details. This is not our object. We wish simply to direct attention to the nature and quality of the work which is being done in Japan, and no doubt those who are interested in the details of it will have opportunities of making themselves acquainted with them. The University of Tokio is very liberal in the distribution of its transactions, and these can be consulted in the chief public libraries in this country; and no doubt if scientific men wished to obtain copies of special reports for their own use, the University authorities would endeavor to meet their wishes as far as possible. The object of the survey which is described in the volume under consideration was to get a closer view of the distribution of magnetic force in the country than hitherto has been done, in the hope that some insight might be obtained into the tectonic character of the country which might throw light upon the distribution of earthquake disturbances with regard to time and space. The object was twofold: first, to obtain a general, or normal, as it is sometimes called, distribution; and second, to get the extent and nature of local disturbances in special districts. With the first point in view, a comparatively large number of stations were taken in places which were apparently free from disturbances of any great magnitude; and, with the second point in view, observations were made in volcanic regions, or in places where violent geological changes are supposed to have taken place. A good deal has been done toward the first of these objects, but for the second a much more extended series of observations is needed, although some of the prominent points are brought out by the present survey. The report gives an interesting account of the equipments and methods of procedure of the investigators, descriptions of some of the special apparatus, and of the methods of observation. The appearance of the volume has been much delayed by various circumstances under which the writer had to work. In the course of the preparation he had to make two official trips to Europe to attend important congresses, and to take half a year's rest between these two on account of his health, besides having to attend to the special business of several committees. These facts give us some idea of the strenuous life which is led by some of the scientific men in Japan.—*Engineering (London), March* 17.

Magnetic Change Speed Gear.

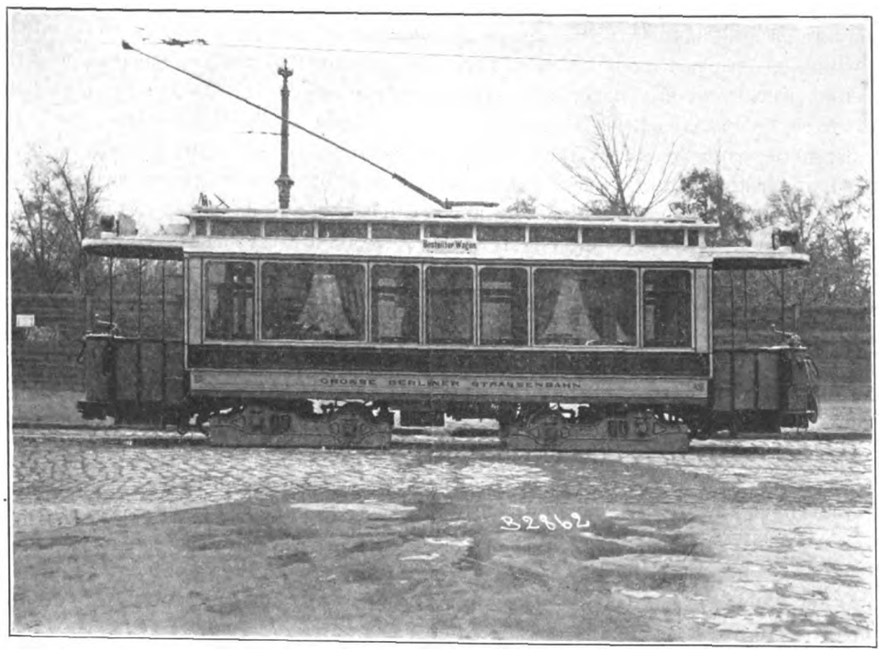
A speed-changing gear in which the mechanical clutch is replaced by magnetic clutches is described in the *Electrical Engineer* (London), for March 17. In this the change-speed lever is dispensed with, the speed being regulated by an electric controller which replaces the sliding gear. The device consists of two steel plates for each speed, the plates being located opposite each other, with a short interval between them. One is hollowed out to contain the coil, through which it is magnetized by a dynamo or storage batteries. This causes attraction between the plates, which adhere to each other. The pinions remain in gear, but are free to revolve around the first speed shaft, except when the two plates corresponding to each speed are attracted toward each other. The first speed pinion is attached to one of the plates, the other plate being attached to the first speed shaft, so that when the two plates adhere to each other, the first speed pinion corresponding to them become solid to the first speed shaft and drives the second speed shaft which, in turn, actuates the differential gear. This method has been found to facilitate greatly changes of speed, which are accomplished without shock or noise. It is said that the change can be made from the third speed to the reverse motion without any difficulty or danger, the reverse motion in this case acting as a brake until the car has stopped and reversed.

Digitized by Google

NEW TESTING CAR OF BERLIN TRACTION COMPANY.

BY C. L. DURAND.

The tramway lines of Berlin, Germany, which comprise the extensive system known as the Grosse Berliner Strassenbahn, are now using a model testing and inspection car which is specially equipped for making all the necessary measurements upon the running of the lines in the different details. It has already proved a valuable aid in the operation of the system in Berlin, owing to the thorough tests upon the track and the rolling stock which have been carried out for some time past.



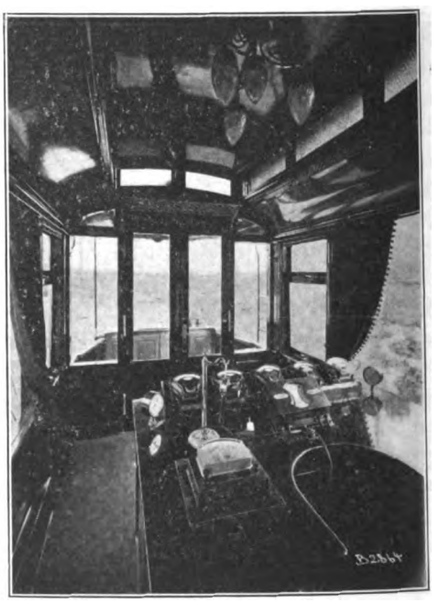
NEW TESTING CAR OF THE BERLIN TRACTION COMPANY.

The new testing car, which is shown in the engravings in exterior and interior views, is divided into two main compartments by a partition in the middle. One of the compartments is used for making the different measurements, while the other serves as an office for checking up the results and making calculations while en route. In external appearances, the testing car does not differ materially from the standard type of car which is now in use on the Berlin traction system and has the same dimensions, namely, length of car body, 7.5 metres; length over all, 11 metres; width of car, 2.15 metres; distance between driving axles, 5.5 metres; distance between axles of truck, 1.3 metres; weight of car, 14.5 tons. It is mounted on double bogies, built at the Bergischen Steel Works, Remscheid. The electric outfit of the car has been supplied by the "Union" Electric Company, of Berlin, and consists of two series motors of the G. E. 52 pattern; also two B-8 controllers, with the usual outfit of switches, lightning arresters and fuses. The axles of the testing car are arranged so that all the different types of motors which are in use on the Berlin tramways can be adapted to them in case it is desired to make special tests. The car has three independent brake systems, hand brakes, magnetic brakes on the Sperry system, and an air brake of the H. H. Böker type. By the use of the different brakes on the same car a comparative test can be easily made between the several types of brake and a very complete set of data for each can be obtained by means of the measuring instruments which the car carries.

Two views in the measuring room are shown. This room is equipped with a great number of instruments, electrical and mechanical, for making the tests upon the running of the car in all the different details. These instruments are mounted partly upon an upright marble switchboard panel, while the remainder are placed upon an operating table. The two sets of instruments are placed opposite each other, with a space in the centre for the observer, who can thus read all the instruments. The apparatus which is placed on the upright switchboard are used mainly for the rapid and more summary tests, and are provided with large and easily read scales. The instruments on the flat table are of greater precision and are employed for more thorough and special tests.

On the upright panel are mounted the following instruments: (1) a main automatic circuit-breaker for the main motor current, also a number of ammeters, voltmeters and speed counters. (2) Two watt-hour-meters of the Union Electric system, which are used for measuring the energy which is furnished to the motors. These are mounted close together, so as to be easily read at the same time. (3) A watt-hour-meter of the Allegemeine Electric system, which is used for measuring the energy supplied to the electric heaters on the car. (4) A set of registering instruments for voltage, current and speed. The latter instruments, which were supplied by Siemens & Halske, are of an improved pattern, and show all the small variations of current and voltage with great precision. The speed counter, from the firm of F. Schuchardt, of Berlin, is arranged so as to indicate the number of kilometres per hour at any given time. The mechanism is electrically operated from a small dynamo which is placed on the axle of the car, and the voltage of the dynamo shows the speed.

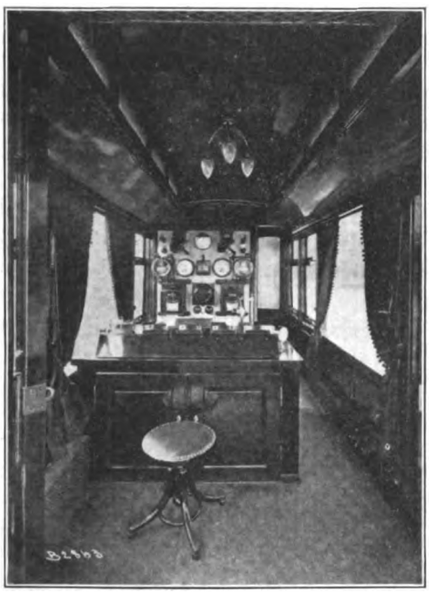
A detailed view of the measuring table will be observed, with the various instruments. (1) A high-grade combined instrument for taking the voltage and current of the main line circuit. (2) A standard ammeter for each motor of the car. (3) A voltmeter for each of the two motors, giving the difference of potential at the brushes. (4) A standard ammeter for taking the current supplied



INTERIOR OF INSTRUMENT ROOM, NEW TESTING CAR OF THE BERLIN TRACTION COMPANY.

Digitized by Google

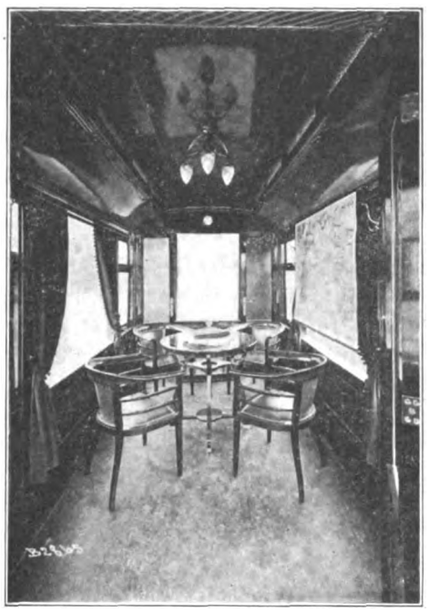
to the magnetic brakes. These instruments were supplied by the European Weston Company. (5) A track meter, which indicates the length of track which the car has passed over, from a determined starting point. Each revolution of the car wheel is indicated by a counter which works on a pneumatic system from the wheel. (6) An inclinometer, which shows the exact grade of the track at any moment. It is operated by a balanced weight or pendulum and the angle is magnified and shown on a large scale by a transmission device. (7) A pressure-gauge, which shows the pressure in the reservoir of the air brakes, and a second gauge indicating whether the air-compressor is running empty or under load. A stop-watch completes the set of measuring apparatus. The table also contains a loud-speaking telephone set for communicating with each of the car platforms, for use in making different tests. A traction dynamometer is placed between the main car and a trailer, when desired, so as to make the necessary measurements. An insulation-testing apparatus is also used. The car carries several other devices which are worthy of note, such as an instrument for taking the resistance of the rail joints, another for measuring the exact gauge of the track at any point, a third for the radius of the curves, etc.



INTERIOR OF INSTRUMENT ROOM, NEW TESTING CAR OF THE BERLIN TRACTION COMPANY.

The car contains a complete set of plans regarding the track and the electric circuits, disposition of the feeding points, etc.

It will be seen that a testing car of the above description is a valuable aid in securing all the data as to the operation of the tramway lines, and it also serves for training the inspectors of the road. The conditions of running are obtained at all points of the track and upon the different grades and curves, especially the amount of current which the motors re-



INTERIOR OF CALCULATING ROOM, NEW TESTING CAR OF THE BERLIN TRACTION COMPANY.

quire. Any defects in the track are easily located or any points where the consumption of current is unduly heavy. The floor of the car can be removed in some places, so as to observe the working of the motors and also the performance of the car wheels, especially to find out whether the latter slip upon heavy grades. The working of the brakes is also observed. In this way the new inspection car not only gives a valuable series of data under the normal working conditions, but also assures that the lines and track are kept in good order, by pointing out any faults which may occur. The car has now been in use on the Berlin lines for some time and is greatly appreciated by the company.

Electrical Combinations in Germany.

The seven principal electrical combinations in Germany have with their affiliated financial and construction companies a total capital of $109,106,000. Some of these companies have branches in Russia, Austria-Hungary, Switzerland, Italy, Spain, the Netherlands, and the Balkan states. These branch companies have given a strong impetus to Germany's electrical business. The companies have $34,500,000 in mortgage loans outstanding against them. From this must be deducted $9,000,000, which represents the accumulated reserves.

Electric Motor Cars for British Railways.

United States Consul Halstead, Birmingham, England, states that at the directors' meeting of the London, Brighton & South Coast Railroad Company, February 1, the report to the shareholders showed that there had been a decrease during the half year of nearly 1,500,000 third-class passengers carried, due mainly to street-car competition, though partly to stagnation in trade. The chairman announced that steps were being taken to have electric traction on one section of the railway. This subject, he said, had been under consideration for some time with the view of meeting the competition of tramways and to give relief at the termini for the more rapid handling of trains. The section of their South London railway between Battersea Park and Peckham Rye stations has been selected as a convenient piece on which to make the initial trial of electric working, and the overhead system will be used. He said the overhead system involved the introduction of other novel features, and the working would be watched with much interest, not only by the shareholders of the company, but by all who were concerned with the question of electric traction on railways. The chairman said the officers could not have taken electric traction in hand earlier with a reasonable certainty of adopting a system which would have been satisfactory, and added that they were considering the question of having self-propelled cars running on the rails to give a more frequent local service to the town of Worthing

The Great Central Railroad will soon introduce a service of steam motor cars on the section of its Liverpool & North Wales division between Seacomb and Wrexham. These vehicles, it is expected, will be worked at a cost ranging between fourpence halfpenny and sevenpence (nine and fourteen cents) a mile as against one shilling (twenty-four cents) per mile of the ordinary steam-driven train, and if the working of the cars between these stations justifies expectations and promotes a speedy, frequent, and economical local train service, the use of cars of this kind will be extended to other sections of the road. The cars are designed to accommodate twelve first-class passengers and their baggage. The steam engine is to be fitted with a vertical boiler of the multitubular type.

Digitized by Google

Economy in Recharging.

Mercury arc rectification of the alternating current for accumulator recharging was the subject, says *Motor World,* of the lecture delivered recently before the Automobile Club of America by Alexander Churchward, who explained the workings and advantages of the apparatus by a demonstration of a standard thirty-ampere rectifier in connection with a set of lead cells and an Edison battery.

There are several methods for recharging available to the owner of an electric vehicle who wishes to be independent of the charging station, such as a small gasoline-driven generator, a single-phase rotary transformer, a motor-generator set or chemical rectification, but all are open to the objection of requiring constant supervision. Alternating current presents so many advantages for power and lighting purposes, and particularly for long-distance transmission, that its use in smaller towns and cities is now almost universal, and recourse must be had to some method of transformation to direct current. But even where the usual 110-volt direct-current lighting circuit is available the use of the mercury arc rectifier is an economy in that no external resistance is necessary to cut down the pressure to that required by the battery.

The fact that alternating current is not available for recharging accumulators is probably too well known to call for comment, but the reason therefor is not a matter of such common knowledge, even on the part of many otherwise well informed. Alternating current, as its title implies, alternates in direction, first one way, then the other, the periods or cycles varying in number from 25 to 133 per second. The current supply for storage must flow continuously in one direction from the positive to the negative, thus liberating oxygen and hydrogen, which gases, in turn, combine with the chemical filling of the plates, and in some cases with the electrolyte or acid solution employed. By this means new chemical compounds are created, which in this instance means the storage of energy. These are reconverted to their original constituents by the discharge, so that it will be evident that unless the current flows in one direction, no chemical reaction occurs, and consequently no energy is stored.

The advantages and disadvantages of these various systems as compared with the mercury arc rectifier are as follows: the small direct-current generator set run by a gasoline engine is, of course, practical and economical, but requires constant supervision. The next best thing is the motor-generator set—an induction motor on the alternatng side direct-connected or belted to a small direct-current generator. Both this and the engine-driven set call for a comparatively large first cost, and in the latter the efficiency at full load is not as high, while on a light load it is very wasteful. Both, likewise, require considerable floor space.

The single-phase rotary transformer combines in one frame the alternating-current motor and the dynamo of the generating set. It is, however, not so flexible, as the motor side has to run synchronously with the supply circuit, an objection to which the motor-generator set is not open, owing to the use of the induction motor. It, however, calls for a smaller investment in the first instance, and has a much higher efficiency, even at light load. But skilled supervision is necessary in starting, this being done by turning it over as a motor from the direct-current side until its revolutions become synchronous with that of the supply—in other words, until it gets "in step" when the alternating current is thrown on. Once running, it does not require any more attention than the motor-generator set.

There is still another method, and that is the synchronous or mechanically driven rectifier, and while largely used abroad, it has not become popular here. It consists of a small alternating-current motor of the synchronous type, driving a specially constructed commutator to which the alternating current is fed, and from which the direct current is collected. This type of machine is comparatively small, but requires considerable attention, as the brushes collecting the converted or direct-current spark badly, and require constant renewals, adjustment and attention. Its efficiency at all loads is, however, high, as compared with the motor-generator set.

The chemical rectifier generally used is either of the Nodon cell or a modification of it. Its operation is based on the principle that aluminum and lead, or iron or carbon plates, placed in certain solutions, only permit the flow of current in one direction. The gases generated combine chemically with the solution and the aluminum plate, and a valvular action ensues which allows the current to flow only in one direction. Its advantages are low first cost as compared with any of the above mentioned methods, and small amount of floor space required, but, on the other hand, its action is not uniform or reliable and its efficiency is low under all conditions.

From this it will be seen that the mercury arc rectifier presents the advantages of lower first cost, simplicity and higher efficiency than any of the systems enumerated when used for the purpose for which it is specially designed; that is recharging in the private garage. Its action is based on a principle analogous to that of the chemical rectifier, that mercury vapor will permit a current to flow in one direction only. The apparatus consists of four important parts, namely, the panel, tube, holder and compensating reactance. On the panel are mounted the necessary instruments for indicating the voltage and amount of current used on the direct-current side, as well as the tube holder and all necessary switches, fuses and the like. A lamp is also provided to indicate that the starting resistance is in circuit, so that the latter may not inadvertently be left on after the arc is in operation.

The tube in which the transformation takes place is an exhausted glass vessel containing two anodes connected to the alternating side of the circuit. These are located at each side, a few inches above the bottom of the tube, and a cathode forming the positive of the direct-current side at the bottom of the tube on which the mercury rests. There is, further, a small starting anode, the function of which is to form an arc to start the rectifier. This is done by shaking the tube slightly from the top, and this auxiliary anode only remains in operation long enough to start the arc.

The compensating reactance is a most essential part of the apparatus. It is connected directly across the alternating-current supply mains and furnishes from this neutral point the negative side of the direct-current circuit. Taps are brought out from the reactance to a dial switch mounted on the front of the panel. By means of this switch the amount of current and the voltage may be varied within the limits of the capacity of the rectifier without the use of an external resistance which would tend to reduce the efficiency.

The tube is made of extremely thin glass in order to render the coefficient of expansion of the latter as nearly as possible equal to that of the platinum contacts, and it is exhausted until the most perfect vacuum obtainable is produced. Owing to the amount of mercury necessary, the tube must be handled with extreme care. At this point the lecturer was interrupted by interrogatories as to the life of the tube and as to how it

Digitized by Google

was possible to transport such a fragile article, owing to the fact that suddenly tilting it would suffice to cause the mercury to crash through the end of it. As to the first, the average life is about 400 hours, although one now in use has lasted 1,500 hours, and they have been known to give continuous service for 2,700 hours. The causes of dissolution are principally careless handling; that is, not of the tube itself, but of the current, such as throwing on the full load suddenly when the tube is very cold. The heat generated in the tube must exceed 360 degrees Fahrenheit, as mercury boils at this point, and it must do so to vaporize. Then, again, after continued service the mercury begins to form an amalgam with the platinum of the contacts, and thus bridges across the tube, preventing the formation of an arc. Or, if overloaded, the glass at the anodes becomes softened through the intense heat, and as owing to the vacuum there is an external pressure of practically fifteen pounds to the square inch, it is forced in and destroys the vacuum.

As to transporting the tubes, while the usual precautions in packing are taken, the admonition, "this side up," is further enforced by placing a glass bulb with colored water in it protruding through the top of the box, and the expressman, fearing acid, keeps it right side up and handles it gingerly.

The function of the compensating reactance, which is a winding on a heavy iron core similar to a transformer, is to allow one part of the wave to flow through the tap and prevent the other or alternating wave. The transformation process means the elimination of this zero portion or drop in the wave by causing it to overlap the next alternation slightly. The reactance does this, but unless properly built, it will not give satisfactory service.

As it is converted into vapor, the mercury rises into the bulb-shaped enlargement of the upper end of the tube, where it is condensed by the comparative drop in temperature and then flows down the sides of the tube in the shape of metallic mercury.

The standard rectifier has a capacity of thirty amperes at 220 volts, but experiments are now making to build outfits of double this capacity, though as yet they are not ready for the market. It is, however, adapted for use on alternating current at a pressure of 110, 220 or 330, and the direct current can be varied from 16 to 115 volts. When connected to a 220-volt supply the range of voltage on the direct-current side will be from 45 to 110 volts. Where a small number of cells are used, the pressure required is between sixteen and forty-five volts, and to obtain this the 110-volt alternating current has been found most satisfactory.

Where reliability is concerned, one of the chief advantages of the system is the possibility of using it for all night charging and of the absence of necessity for supervision, as any unusual drop in the current causes the arc to rupture and back pressure from the battery would do likewise. If an attempt were made to start below the voltage of the battery, the arc would not form, so that no combination of circumstances could damage the battery. If subject to frequent and violent fluctuations in the supply that would cause the arc to rupture, an automatic restarter in the shape of a magnet and armature to shake the tube is provided.

The efficiency of the rectifier as laid out for charging storage batteries is very high at all working loads.

Wireless Telegraph Licenses in Great Britain.

The postmaster-general of Great Britain, in accordance with the terms of the wireless telegraph act of 1904, has formulated the conditions to be complied with by those who wish to take out licenses for operating wireless telegraph stations. Three forms of license have been issued, entitled commercial, experimental and private business, respectively. The commercial license gives the licensee authority to install, work and use a system of wireless telegraphy. The experimental license authorizes the use of a system of wireless telegraphy for the sole object of conducting experiments, while the private business license authorizes the erection of stations as specified in the schedule to the license, messages to be transmitted only between these stations.

The commercial system is required to pay a royalty. The experimental licensee is not called upon to pay a royalty.

Those who are operating experimental or private systems must refrain from using their apparatus when they perceive that another system is in operation. Only British subjects may be employed in operating the commercial systems.

A Correction.

In the article entitled "Oil-Insulated *versus* Air-Blast Transformers," by M. A. Sammett, in the issue of the ELECTRICAL REVIEW for March 18, a misplaced line in the first paragraph of the third column on page 451 causes a misinterpretation of the text. The wording is as follows: "of the four banks of air-blast transformers burned out causing very transformers per bank delta-connected." This should read: "of the four banks of air-blast transformers operated in multiple, three transformers per bank delta-connected," etc. On page 450, in the middle of the first column, the words "total core loss, 408," should read "total copper loss, 408."

Suits for Infringement.

Under the title "Suits for Infringement," the *American Machinist* of March 30, prints the following editorial:

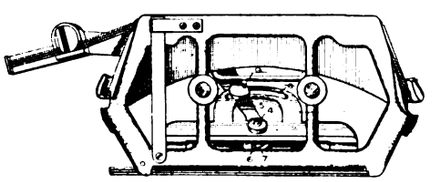
We have recently been receiving an unusual number of circular letters asking us to notify our readers that the firm of "A. B. & Company" or some other has brought suit against the firm of "X. Y. & Company" or some other, for infringement, and that all users of the devices made by the X. Y. firm, etc., will be "prosecuted to the extent of the law." Our readers may have noticed that this is a feature which is absent from the columns of the *American Machinist*. Some of our contemporaries publish such things apparently for no other reason than that a manufacturer has asked them to do it and quite often it occurs that in a subsequent issue they publish a contradiction or a modification of the article because the other side having been heard from, the case looks different. Long ago the *American Machinist* discovered that there is no telling when a lawsuit is ended, and that until it is ended and one side or the other has given up the fight, there is no telling what effect, if any, decisions of the courts will have upon the business concerned.

In many cases of these notices which are sent broadcast to the effect that suit has been brought, etc., we are convinced that they are little or no better than blackmail. They are simply attempts to prevent competitors from doing business, and we believe that in most cases purchasers of machinery should pay very little attention to them, especially when assured by the vendor, a responsible party, that no harm will come of the suit, and that purchasers will be protected. The fact that suit has been brought signifies in these days little or nothing, and the only significant thing is the final last decision of the highest court, or decision of a court which both parties accept as final. If a manufacturer wishes to use his advertising space for announcements to the effect that he has brought suit, etc., he, of course, has the privilege of doing it, but no litigant can use the reading columns of the *American Machinist* for publishing notices of that kind, the effect of which is to injure more or less the business of a competitor before the case has come to trial, and without reference to the fact that the final decision of the court may be in favor of the defendant, or, in other words, that there has been no infringement and that therefore the person sued has had a perfect right to make and sell the article in question. Of course it is quite natural and to be expected that litigants should be partisans and that each should be sure of the justice and confident of the ultimate triumph of his own side; but this confidence does not justify an impartial journal in publishing articles calculated to injure a person not legally adjudged guilty of infringement.

Digitized by Google

Electrical Patents.

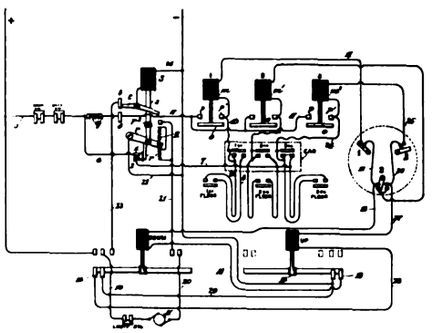
The General Electric Company, of New York, is the assignee of a patent recently granted to Julius W. Lundskog, of Lynn, Mass., on an improvement in winding-forms (784,799, March 14). The invention relates to forms for winding coils, and more especially those intended for armatures. These forms as usually constructed are capable of being used only for coils of certain specified character, that is to say, the number of layers and size of wire are the same in all cases. The object of the present invention is to provide a winding-form on which coils having different numbers of layers or turns can be formed or coils composed of conductors of different diameters. It is also the object to provide a form capable of giving to the coil the proper configuration in a single operation, which is so arranged that when the coil is completed it can be readily removed. In carrying out the invention, a base is provided having hooks secured thereto. A detachable plate also having hooks secured thereto is employed, the hooks on the plate cooperating with those on the base to form offsets in the finished coil. An adjustable plate is maintained parallel with the wire-



Winding-Form.

receiving surface on the base by means of guides, and a lever is employed for moving the plate after each layer is applied to make room for the next. The adjustable plate is clamped by suitable means.

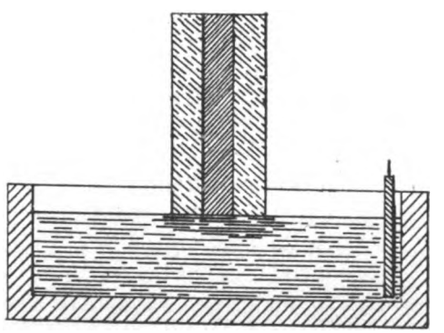
Nils O. Lindstron, of Jersey City, N. J., has assigned to Alonzo B. See and Walter L. Tyler, of New York, N. Y., a patent recently granted to him on an electric elevator control (784,869, March 14). The primary object of the invention is to provide a control system by which persons desiring to use the elevator may operate it themselves without the aid of an elevator man, and may travel from floor to floor without accident and without interference with the passengers already occupying the car and others that may endeavor to obtain the use of the car at the same time. For a perfectly safe system, it is necessary that after one passenger has pushed a button to bring the car to him, another can not interfere with the movement of the car in any manner until the first passenger has obtained the car, moved thereon to his destined floor, passed out of the car, and finally closed the shaft door behind him. If it is at all possible at any moment between the first push of the button and the final closing of the door at the destined landing for another passenger to interfere with the car, the system is un-



Electric Elevator Control.

safe. In the embodiment of the invention, a motor is employed and an armature-resistance solenoid. A main switch is adapted to close the circuit through the motor and the solenoid simultaneously. An auxiliary switch is provided, which is actuated by the resistance solenoid and adapted to direct current through the solenoid independently of the main switch. A manually operated control circuit is employed, and means whereby the resistance solenoid will hold the control circuit open while it is holding the auxiliary switch in a position to direct current through the solenoid.

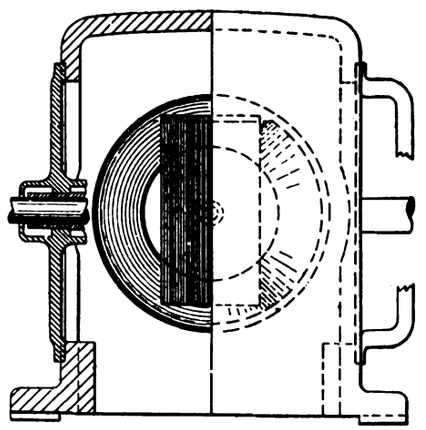
Edward L. Priest, of Oakland, Cal., is the inventor of a method of extracting ore from metals by electricity, in which the electric current is closed through the ore and a liquid body by the contact



Method of Extracting Metals from Ore.

of the two and the formation of an intervening arc, fusing the ore (784,885, March 14). The difficulty has heretofore been to properly complete the electric circuit through ore bodies when the latter are used in any considerable quantity to make the process commercially available. The invention has for its object the utilization of these methods with ore in any quantity, and in carrying out the invention a reducible comminuted coherent mass is prepared. A consumable electric conductor is connected with this mass. The body is then contacted with a liquid electrode, thereby creating an electric arc there between to reduce the body and consume the conductor.

An invention relating to dynamoelectric machines, and having for its object to provide a machine which shall be well ventilated, in which the various parts shall be readily accessible, in which a minimum amount of material will be required, and which will be compact and small in size for a given output, has been devised and patented by Mr. James Burke, of New York, N. Y., and he has assigned his entire interest in this patent to the Burke Electric Company, a corporation of New Jersey (784,103, March



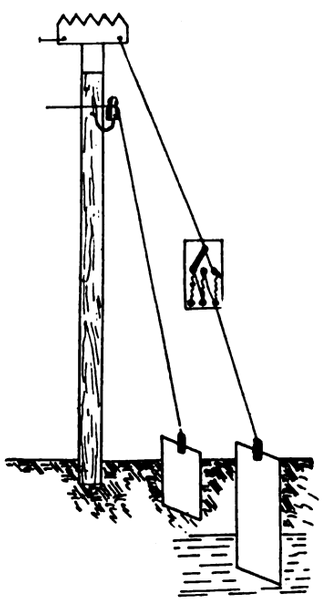
Dynamo-Electric Machine.

7, 1905). In the embodiment of the invention, a frame is employed which is provided with ventilating openings through its ends and a ventilating opening through the centre of its bottom portion. The opening at the bottom communicates directly with the space between the field-poles. These field-poles project radially inward from the frame and field-coils are carried by the poles. The ventilating air-currents have free access into the machine and through the same by reason of the bottom and end openings, a strong circulation of air being established through the same. Moreover, in building and repairing the machine all of the parts are accessible through the bottom opening, which enables the parts to be machined at less cost and to be readily assembled. At the same time, the field-magnet construction, as a whole, is easily cast and machined and utilizes to the fullest extent the metal in a given machine.

Eugéne Pilsoudsky and Eugéne Ra-

Digitized by Google

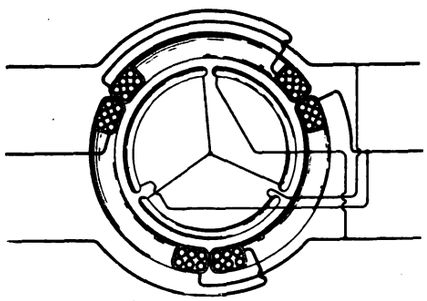
gozine, of St. Petersburg, Russia, have patented in this country a method of cultivating plants by electricity (784,346, March 7, 1905). A large number of attempts have been made to augment the productiveness of the earth and to accelerate the growth of plants by the use of electricity. These experiments have not, as a rule, proved successful, owing largely to the uncertainty of the effects produced and the lack of knowledge upon the part of the experimenters as to the real action of the electricity. Prior experiments have usually employed galvanic currents set up between electrodes of dissimilar metals with all the positive electrodes at one side of the field and the negative at the other side. The present invention consists in a method of cultivating plants by the combined use of galvanic currents and atmospheric electricity, and a long series of experiments conducted by the inventors has enabled them to formulate certain rules by following which successful results can be obtained with practical certainty. The process consists in subjecting adjacent parallel sections of the earth to be treated to the action of galvanic cur-



METHOD OF CULTIVATING PLANTS BY ELECTRICITY.

rents flowing in opposite directions between buried plates of dissimilar metals connected by overhead conductors, and simultaneously setting up in the circuits formed by these conductors plates and earth sections, currents induced by atmospheric electricity passing through parallel overhead conductors adapted to collect such electricity.

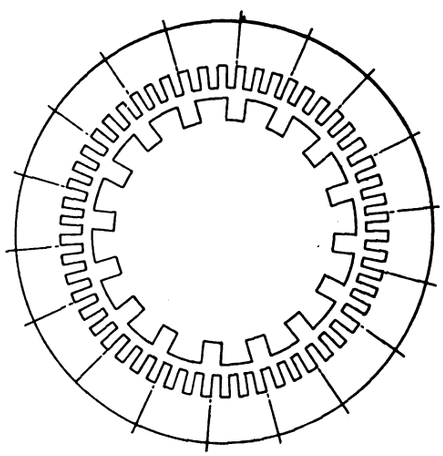
The General Electric Company, of New York, is the assignee of a patent recently granted to Pendleton G. Watmough, Jr., of Schenectady, N. Y., on a phase indicator (785,458, March 21, 1905). The invention consists of a novel form of phase indicator of particular value for use in connection with multiphase circuits for showing the phase difference between current and electromotive force.



PHASE INDICATOR.

The instrument itself comprises two relatively rotatable members, the windings of one of the members being connected in series with the polyphase mains, while the windings of the other member are connected in shunt. Two connections are so made that the windings of each member when traversed by current set up a rotary magnetic field; the direction of rotation of the fields being the same. The movable member of the indicator assumes a position such that the polar line of the magnetic field due thereto is brought into coincidence with the polar line of the magnetic field due to the stationary member of the instrument. Since the two magnetic fields revolve at the same speed, the two members of the instrument remain in fixed relation to each other so long as there is no change in the phase relation between the currents in the two members. As soon, however, as the current in the polyphase mains begins to lag or lead, the field due thereto shifts backward or forward to correspond, thereby causing the movable member of the indicator within the influence of this field to shift correspondingly. The angle of displacement of this movable member thus furnishes a measure of the phase displacement between the current and the electromotive force of the polyphase circuit.

Ernest F. W. Alexanderson, of Schenectady, N. Y., has assigned to the General Electric Company, of New York, a patent recently granted to him on a synchronous motor (785,532, March 21, 1905). The object of the invention is to provide a synchronous motor having a high starting torque and yet preserving the advantages of the polar structure, as regards economy of material. This is accomplished by giving the poles of the field structure a fractional pitch with respect to the armature poles, so that instead of having a field-pole opposite each armature pole, as in the ordinary synchronous motor, only a few poles at a time are directly in front of the armature poles, while the others are displaced by a greater or less amount. With such an arrangement as this the locking tendency which exists where the pitches of the field-poles and armature poles are equal is completely destroyed, and as a result, the motor may be designed for a high-starting torque. Another feature of the invention consists in so connecting the coils on the different poles that the field winding may act as a short-circuited polyphase secondary for the armature, so that a high-starting torque may be obtained. The invention also consists in varying the number of



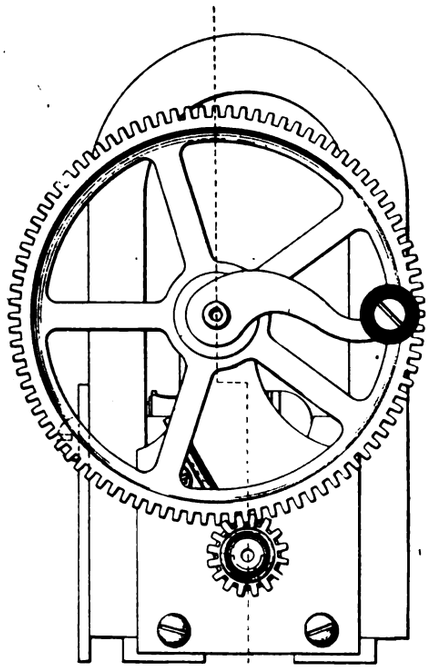
SYNCHRONOUS MOTOR.

poles of the armature in such manner as to obtain a multispeed synchronous motor without varying the connections of the field.

An electric generator is the subject matter of a patent recently granted to William Kaisling, of Chicago, Ill., and assigned by him to the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. (785,499, March 21, 1905). The invention relates particularly to generators of the peculiar type commonly used in telephony for purposes of signaling. The principal object of the present invention is to provide a generator which may be cheaply manufactured and easily assembled, but which shall be efficient, durable, and reliable in operation. In the embodiment of the invention, an armature is mounted upon an armature shaft. A pinion also mounted on the armature shaft has a driving-gear meshing therewith, and a driving washer is also securely mounted upon the end of the armature shaft. A spiral spring is

Digitized by Google

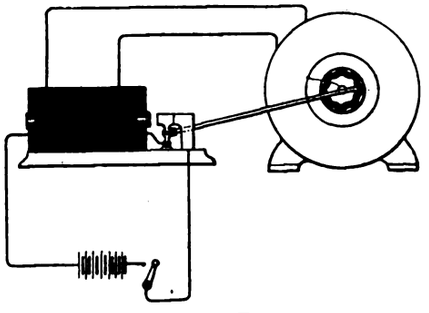
connected at one end with the pinion and at the other end with the driving washer, the spring lying in an annular groove in the pinion, and a projection on the pinion resting within a notch in the



ELECTRIC GENERATOR.

periphery of the washer and the width of the notch being such as to permit a slight relative movement between the pinion and the armature shaft.

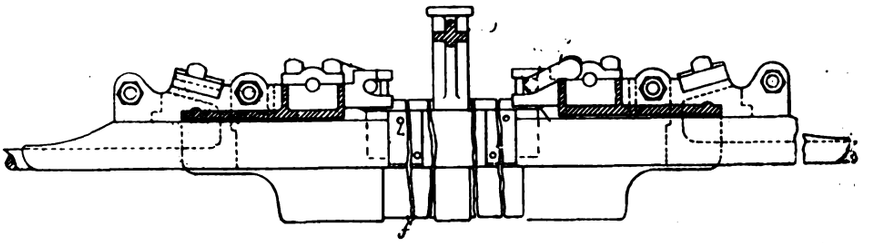
A means for converting electrical currents for induction motors is the subject matter of a patent recently granted to Christian F. Heinkel, of Cleveland, Ohio (785,731, March 28, 1905). The invention relates to means for converting electrical currents for induction motors, and the invention comprises an induction coil



MEANS FOR CONVERTING ELECTRIC CURRENTS.

and a source of continuous current therefor. Make-and-break mechanism is located in the primary circuit of the coil, and an induction motor is electrically connected with the secondary winding of the coil. Means are provided for operating the make-and-break mechanism in timed movement with the motor.

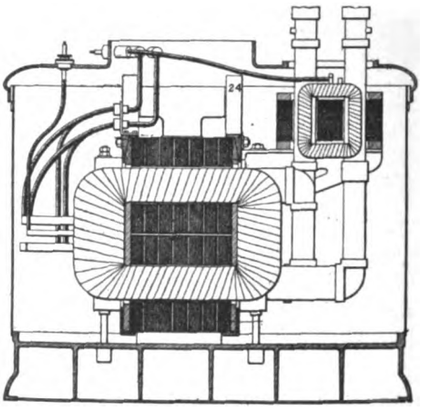
John M. Anderson, of Boston, Mass., has assigned to the Albert & J. M. Anderson Manufacturing Company, of Portland, Me., a patent recently granted to him on an electric-conductor support (785,700, March 28, 1905). The present invention has for its object to improve and simplify the construction of section-line insulators, so that the piece or bridge of insulating material which separates the line terminals may be secured to these



ELECTRIC CONDUCTOR SUPPORT.

terminals by means which permits the bridge to be secured and removed from the line terminals substantially in an instant and with a minimum of labor and trouble. The device comprises line terminals and interposed strain insulators connected to the line terminals. A hanger is connected with the strain insulators. An insulating bridge is interposed between the line terminals and is provided with metallic end-pieces. Rotatable shafts are supported by the line terminals above the end-pieces of the bridge and are provided with cranks which are adapted to be brought into engaging and disengaging position with relation to the end-pieces by the rotation of the shafts.

A patent on means for regulating electric circuits has been assigned to the General Electric Company, of New York, by the inventor, Mr. Walter S. Moody, of Schenectady, N. Y. (785,970, March 28, 1905). The present apparatus is particularly useful for varying the voltage of current delivered by alternating-current transformers. The invention, however, possesses various features capable of useful application in numerous other relations. In practice, occasion frequently arises for varying the voltage of current supplied to alternating-current transformers. This may, of course, be accomplished by varying the ratio of transformation of the transformer or by the use of an induction regulator, both of which are recognized methods of accomplishing the desired result. In some instances, however, they possess disadvantages either as to cost of construction or difficulties of operation, such as to render them undesirable. The inventor has discovered that the result desired may be secured through the use of a boosting or auxiliary transformer, the primary of which is supplied with a variable voltage and is located in inductive relation to leads or terminals extending from the main transformer, which leads or terminals constitute the secondary of the boosting transformer. By varying the voltage impressed upon the primary of the boosting transformer, and thereby as a consequence varying the magnetomotive force of the primary, a corresponding regulating voltage is produced in the leads of the main transformer. Depending upon the polarity of the current which is sent through the primary of the regulating transformer, this regulating voltage



MEANS FOR REGULATING ELECTRIC CIRCUITS.

may either add itself to the voltage of the main transformer or counteract a portion of the voltage of the same, thereby permitting a variation of the voltage of the apparatus as a whole through a considerable range of operation.

Hardening Copper.

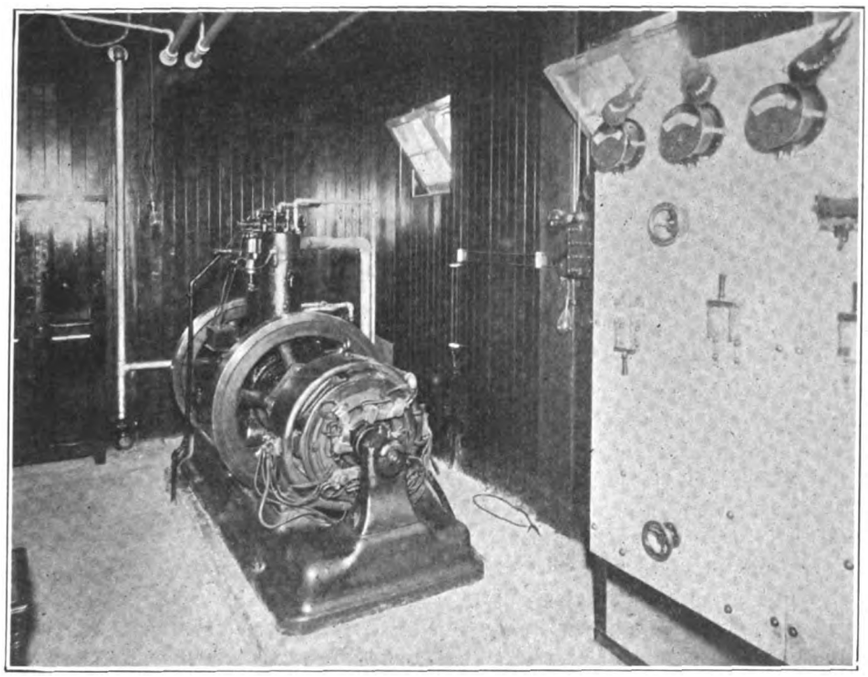
United States Consul W. R. Holloway, at Halifax, N. S., reports that a method of hardening copper has been invented by two men of Chester, Nova Scotia. The inventors state that the metal can be hardened to any desired degree. A razor has been made with this hardened copper which was found to work very satisfactorily.

Digitized by Google

A MODERN ISOLATED ELECTRIC LIGHT PLANT.

BY GEORGE W. FROST, M. E.

A storage battery plant recently installed at the private residence of Mr. L. Wolf on Washington Boulevard, Chicago, Ill., merits special consideration as the equipment is representative of the latest method of installing an outfit of this kind, and, in addition, the storage battery is of an unusual design.



DIRECT-CONNECTED GAS ENGINE AND GENERATOR, RESIDENCE OF MR. L. WOLF, CHICAGO, ILL.

Two illustrations of this plant are given. One is a view of the switchboard and battery, and the other shows the direct-connected gas engine and generator.

The two-cylinder, throttling-governor gas engine is designed particularly for electric light work. The generator is connected to the engine by heavy leather links which give slightly at the instant of greatest acceleration of the flywheels.

With this outfit a one and one-half per cent regulation is readily obtained and when desired the lights in the residence can be supplied with current from the generator direct. The storage battery is connected to the switchboard so as to be charged in two sets in multiple-series and discharged in series. Each line of cells has a separate rheostat and ammeter so that the current in each half of the battery can be regulated and measured, one independently of the other.

On discharge, the double-pole, double-throw switch on the lower portion of the board is thrown over in the opposite direction so that the entire sixty cells are in series. The two rheostats are also in series with the battery, and, combined, they offer sufficient resistance to regulate the voltage of the battery on discharge. This avoids end-cell regulation and all the cells of the battery are charged and discharged uniformly.

A four-point, voltmeter switch is provided to read from one instrument the voltage of the generator, the storage battery on discharge, and each half of the battery when on charge.

The most unusual feature of the installation is the design of the storage battery. The cells are manufactured by the Dayton Manufacturing Company, of Dayton, Ohio, and are known as the Silvey type "R," in round glass jars. The plates are of the pasted type and are piled one on top of the other with two sheets of porous absorbent separating material between each pair of plates. Since the elements lie horizontally, it is practically impossible for the active material to fall from the plates and the cells never become short-circuited. Two heavy lead bolts, with lead nuts as spacers, serve to hold the various plates together and provide terminals for conducting the current to the elements. The separators hold about seven-eighths of the electrolyte required for a normal discharge so that in case a jar breaks the battery will continue to work for a considerable period or until a new jar can be inserted. The round glass jars are unusually strong. If it is desired to remove any particular cell from the line it is only necessary to remove the nuts on top of the connecting links, lift off the links and the cell can be taken from the shelf. At any time additional plates can be added to the pile of elements so as to nearly double the capacity of the battery, as the jars are only about half filled at present.

The equipment is located in the carriage house on the rear of the grounds and is readily operated by the coachman. A plant of this kind, when properly installed, can be operated by a man of ordinary intelligence, and it is by no means necessary to have an electrical engineer constantly at hand to look after the storage battery.

BATTERY AND SWITCHBOARD, RESIDENCE OF MR. L. WOLF, CHICAGO, ILL.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Electric Lighting of Railway Trains.

Reviewing the condition of train-lighting systems in France, M. R. de Valbreuze says that much harm has been done by ill-considered pushing of incomplete systems or poorly designed systems which have failed sadly. This has had the effect of setting back the progress of train lighting, because railway engineers have come to view such proposals with suspicion. There have, however, been a number of new systems developed in France during the past year which have some points of merit. These are described briefly. In those systems which depend upon accumulators entirely for lighting there has been but one change. The Hill system equips each car with a duplicate set of batteries, and runs through the cars a train-control system. This gives the man in charge of the train control of the lighting of the cars, control being secured by means of the electrically operated switches through the train-control line. Several systems have been brought out which employ a single dynamo, placed on the locomotive, for lighting all the cars of the train. Each car is then equipped with the usual small battery. In one of these systems the batteries are connected up in two sets, one set being charged while the other set is running the lamps. A number of systems employ a small dynamo mounted under each car. Some of these use a belt drive. One controls the voltage by automatically varying the resistance in the exciting circuit of the dynamo. In one an auxiliary exciter, connected in the field circuit of the generator in opposition to the main exciting current, maintains a constant voltage. This latter system is controlled automatically by a speed governor, which disconnects or connects the generator to the lighting or the charging circuits as the speed of the car changes.—*Translated and abstracted from L'Éclairage Électrique (Paris), March* 11.

Temperature Curves and the Rating of Electrical Machinery.

An abstract is here given of a paper read recently before the Institution of Electrical Engineers, of Great Britain, by Mr. Rudolph Goldschmidt, who has conducted a good deal of experimental work in order to determine the rating of electrical machinery. In this paper Mr. Goldschmidt describes the method of constructing the temperature curve, if one or two points upon it are known. Upon a base line, laid out in hours and minutes, and with ordinates laid out in degrees of temperature, a line is drawn from the origin through the known point. This line is extended until it meets a horizontal representing any convenient temperature, such, say, as fifty degrees centigrade, which may be taken as the limiting temperature. Upon the point where this extension cuts the horizontal line the latter is laid off in minutes of time. Then, from the point where the line drawn through the origin and the known point of the curve cuts the vertical line drawn from the first time division, a line is drawn to the end of the ten-minute division of the time scale just laid off. Where this second line cuts the second vertical from the twenty-minute point on the base, a third line is drawn to the end of the second, or twenty-minute, division of the upper time scale. This method of construction is continued, the result being a series of tangents to the temperature curve of the apparatus under consideration. This method of construction is based upon the rule that "if the temperature of the body has attained a certain per cent, say a of the final temperature, the increase of temperature per minute is 100-a per cent of the initial increase." Mr. Goldschmidt then discusses the use of this curve for rating motors which are subjected to intermittent work.—*Abstracted from the Electrician (London), March* 17.

On the Luminous Efficiency of the Carbon Filament.

A comparison of the figures usually given for the efficiency of the incandescent lamp filament with similar figures for other luminous sources indicates, Mr. C. E. Mendenhall believes, that the former are too high. The efficiency of the incandescent lamp as a source of light is given generally as between 3.6 per cent and six per cent. Mr. Mendenhall has therefore had the efficiency of the incandescent lamp filament redetermined by Mr. W. Kunerth. A slight modification of Angstrom's method was used. A straight carbon filament was enclosed in a brass cylinder provided with two windows, one closed with a plate of fluorite and the other with glass. The beam of light passing through the glass window was rendered parallel by a lens, and then reflected by a prism. A second lens focused it upon the slot of a spectroscope. The visible rays of the spectrum were then re-collected by a cylindrical lens and thrown upon one side of a Lummer-Brodhun photometer screen. The other side of this screen received the beam of light which passed from the carbon filament through the fluorite window. With this arrangement the source of light could be moved until a balance was obtained on the photometer screen, without in any way interfering with the amount of light received through the slit of the spectrum. After a photometric balance had been secured, the photometer screen was replaced by a Rubens thermopile which was connected to a sensitive galvanometer. A preliminary calibration with a rotating sector disc enabled the galvanometer deflections to be accurately interpreted in terms of radiant energy. The filament used in this case was from a 100-candle-power lamp. It was twenty-seven millimetres long, 0.43 millimetre by 0.95 millimetre in cross-section. Correction for the absorption of the flourite window was made by replacing the carbon filament with a Nernst glower. Readings were taken with and without the fluorite window, which gave the correction for absorption. This method assumes that the correction factor is the same for both the carbon and the Nernst glower radiation. The error due to this assumption is probably negligible. The correction was found to be 7.8 per cent. The results show that with an input of sixty-one watts the corrected efficiency was 2.38 per cent. With an input of 70.5 watts the corrected efficiency was 2.45 per cent. With an input of 75.5 watts the corrected efficiency was 2.63 per cent. With an input of 81.5 watts the corrected efficiency was 2.93 per cent. The input which corresponded to normal brilliancy was about seventy-five watts, for which the efficiency is about 2.6 per cent. By means of Wien's law for a black body efficiency it was computed that the temperature of a normal filament is about 2,150 degrees absolute, but this is undoubtedly higher than the actual temperature, on account of selective emission.—*Abstracted from the Physical Review (Lancaster), March.*

Digitized by Google

Some Economic Aspects of Electric Power Distribution.

Much of the complicated mechanism which we are pleased to call modern civilization has for its purpose the survival of the unfittest and the subversion of natural laws, says Dr. Louis Bell. The value of the achievements of modern science and industry depends not upon their proceeds in dollars and cents, but upon their effect upon the growth of humankind and the evolution of a sounder society. There has been a gradual tendency for manufacturers to concentrate in the larger cities. Natural advantages have little to do with the matter, for it is common to find manufacturing plants of a particular kind concentrated in a place that is only moderately good as a working point. A country consisting mostly of large cities, with merely incidental rural population, has taken a long step toward final disintegration. No country in which the productive forces are steadily being subordinated to an intricate mechanism of distribution can long remain prosperous. Starting with the condition that wide distribution of industries is desirable, in order to render more simple and efficient the mechanism of commerce, there are two prominent factors in the problem at hand. The first is improvement in the organization of transportation, so that needless work can be, in part, eliminated. The second is such an equalization of the industrial conditions that bear upon manufacture as shall minimize legitimate need for transportation. The importance of electric power distribution for economical manufacturing is already great, and will become greater. As at present we are chiefly dependent upon fuel for power, and as coal is not generally distributed throughout the country, there is a heavy transportation charge on power. To remedy this we must turn to water power. Of these, four-fifths are falls below 1,000 horse-power in capacity, and at the present time money can rarely be found for developing small enterprises of this kind. There are, however, water powers capable of furnishing cheap power for small industries by means of transmissions of short length, but these are cases for private investment, and not for financiering. For such locations to be successful, cheap transportation is necessary, and this can be furnished by electric railways, which may themselves make use of some of the power developed by the waterfall. Dr. Bell thinks that a factory located in a favorable position, within a short distance of such a water power, would have no difficulty in getting the necessary skilled labor; that its success would draw to it other industries. As the total output of the fall was taken up, another fall but a short distance away could be developed and tied to the first. These small plants will have an outlet in supplying the neighboring villages, as well as driving the factories. The system would naturally extend itself so as to tie together, by means of one system, a number of water powers, the total output of which would be utilized in a number of villages and for driving various factories. The improvement will not be limited to the villages alone, for the farming territory surrounding them would likewise be improved and become more valuable. The trouble heretofore in electric power business has been that men were hunting for big streams. They have overlooked scores of available small powers relatively cheaper to develop and with far nearer markets.—*Abstracted from the Engineering Magazine (New York), April.*

The Murnau-Oberammergau Single-Phase Railway.

This road was opened for operation about the first of the year. It utilizes the Siemens-Schuckert system. Murnau is a station on the branch of the Bavarian state railways. The railway which runs from this point to Oberammergau will develop the already considerable traffic between the mountainous region, in which the latter village lies, and the city of Munich. The line is about fourteen miles long, and is operated by power derived from the river Ammer. The power station is about five miles from Oberammergau, where a dam has been built. The water is carried from the dam to the power-house in a mill-race and a flume which is carried across the river bed. The power station is provided with two turbines directly connected to two generators arranged in tandem on the same shaft. One of each pair of generators is a single-phase machine, the others being polyphase machines, the output of which is used for lighting the neighboring villages. Single-phase current is generated at 5,000 volts at a frequency of sixteen and two-third cycles per second. It is fed directly into the line at this pressure. The return is earthed. The total drop in voltage when two trains are at the end of the line furthest from the power station is six per cent. The overhead wire is mostly single, but there are some experimental lines with catenary suspension, comprising one steel catenary with two copper wires. Certain poles which support the line are provided with lightning arresters, which seem to afford the necessary protection, although there are frequent violent thunder-storms during the summer and heavy snow-storms and intense cold during the winter. The collecting apparatus comprises two bows mounted on the top of each car, on frames insulated from the roof. The bows are held up by springs, and are pulled into position by an air cylinder fed from the brake reservoir. The high-pressure current is taken past a horn lightning arrester through a choking coil and fuse on the roof. It passes then to an automatic circuit-breaker under the car body. This switch is mechanically closed by the first operation of the controller. It is provided with two electromagnetic devices, one of which is in series with the primary of the transformer, and operates as a maximum cutout. The other is controlled by a local battery switch in the driver's cab, and enables the latter to open the main high-tension switch. The transformer is suspended under the car body, and is enclosed in an iron oil tank which is ribbed outside. The secondary coil of the transformer is connected at various points to the controller. The latter is provided with a magnetic blow-out. From the controller, current passes from reversing switches to the two motors. The reversing switches have three positions, the extreme ones for running on the road in either direction, and the central one for taking the cars into the car-shed, where a special low-pressure overhead trolley line is provided. The transformer reduces the voltage from 5,000 to 260. Each car is provided with two eighty-horse-power motors which are geared to the two end axles of the car through a single reduction gear having a ratio of 1 to 5.2. The running wheels have a diameter of thirty-one and one-half inches. These motors enable the car to maintain a normal full speed of twenty-five miles per hour when running either by itself or with a trailer. The motors are always in parallel. They are of the ten-pole single-phase commutator type. Special windings are employed for reducing the sparking. This motor may be arranged for running with direct current if desired. The cars have been tested on a grade of four per cent, when they were started with a gross load of fifty tons without any trouble whatever. It is reported that the Siemens-Schuckert company is now building a single-phase locomotive for the Swedish state railways, which will be capable of collecting current at 20,000 volts from the trolley wire. This company is also working in conjunction with the Allgemeine Elektricitäts Gesellschaft on the Hamburg-Altoona single-phase line.—*Abstracted from the Electrical Review (London), March 17.*

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Attachment Plugs and Fielding Receptacles.

The H. T. Paiste Company, Philadelphia, Pa., has placed on the market a new style of its well-known Fielding recep-

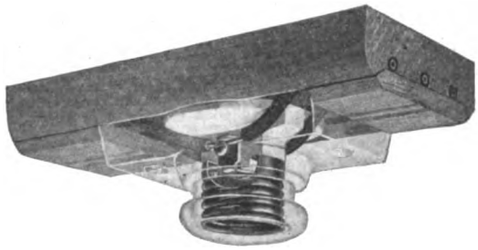


FIG. 1.—RECEPTACLE FOR THREE-WIRE MOULDING.

tacles—a design for three-wire moulding. It has been a problem for a long time to design this receptacle so that, although it was to be wired alternately on the

FIG. 2.—FOR STANDARD LAMP CORD.

negative and positive wires of the three-wire system, in each case the lamp opening should be central with the line of moulding. By an application of the

FIG. 3.—FOR REENFORCED LAMP CORD.

Fielding receptacle principle the company has now succeeded in bringing about this design, and has ready for the market the receptacle shown in Fig. 1.

FIG. 4.—PORCELAIN CAP.

This is designated as catalogue No. 36519. To accomplish this centering of the lamp opening after the receptacle is wired on either of the outside wires, it is simply turned end for end, as occasion may require.

The company also has ready its new line of P-K attachment plugs for 1905. These include a new style of the well-known brass cap type with a cap to take standard lamp cord. The full line now includes brass cap for standard lamp cord, Fig. 2, catalogue No. 494; brass cap for reenforced lamp cord, Fig. 3, catalogue No. 430, and porcelain, Fig. 4, catalogue No. 477. Samples of any of these will be sent upon request.

Some New Automatic Telephone Exchange Installations.

The Automatic Electric Company, of Chicago, Ill., which has built so many successful automatic telephone plants throughout the country, has recently closed contracts with the Hastings Independent Telephone Company, Hastings, Neb., the South Bend Home Telephone Company, South Bend, Ind., and the Wausau Telephone Company, Wausau, Wis., for automatic telephone systems in their respective cities. Descriptions of the different installations follow:

At Hastings, Neb., there is to be an entirely new plant and central office equipment installed in a new building, for which the contract has just been let. The Automatic Electric Company is to install an automatic telephone switchboard with an ultimate capacity of 5,000 subscribers and with an immediate equipment for 600 subscribers.

In addition to the switchboard the Automatic Electric Company is to put in a complete central office equipment. Power plant will have duplicate American storage batteries. Two ringing machines will be installed with busy and howler attachments.

Two charging machines will be installed; one will be a motor-generator to operate on the commercial power circuit and the other will consist of a gasoline engine connected direct to a small direct-current generator so that the plant will be entirely independent of any outside source of power.

The cross-connecting frame will be F. B. Cook's latest model with self-soldering heat coils. The Automatic Electric Company will also supply the telephones which will be its latest style wall and desk sets.

South Bend, Ind., is a different kind of a problem. There is now operated a multiple central energy manual board, equipped for 2,400 subscribers with an ultimate capacity of 3,600 subscribers. It is proposed to gradually change the plant over to automatic service and will start out with an automatic equipment for 500 subscribers with an ultimate capacity of 10,000, which will be put in the present central office. The Automatic Electric Company is to install this in such a manner that the present manual board and automatic board will be multipled together so that it will make it possible for any one who has an automatic telephone to call any one in the plant automatically and any one who has a manual telephone will be able to call any one in the plant manually. In other words, those who have a manual telephone will continue to get the same service they receive now and those who have automatic telephones will get the same service as they would secure if the entire plant was automatic. As the automatic board of the plant grows and the manual board is decreased, these two classes of service will be continued, that is, manual subscribers would get complete manual service and automatic subscribers will get complete automatic service. The entire apparatus for perfecting this interconnection of the two boards and that necessary to put the automatic board into complete operation is to be designed and furnished by the Automatic Electric Company.

At Wausau, Wis., the Automatic Electric Company is to install a board with an ultimate capacity of 5,000 lines and an immediate equipment of 700. In addition to the board it is to furnish the entire central office equipment. The power plant will consist of duplicate storage batteries. Two ringing machines with busy and howler attachments are included in the power equipment.

Two charging machines will be furnished and the customary power board equipped with ammeter and voltmeter, overload and underload circuit-breaker, etc. Main distributing frame will be F. B. Cook's make, equipped with self-soldering heat coils. The Automatic Electric Company is also to furnish new telephones.

At Wausau there is also a manual switchboard in operation but this is to be cut out of service entirely when the automatic equipment is installed. The automatic apparatus will be put in the same building as that which is now occupied by the manual plant.

Digitized by Google

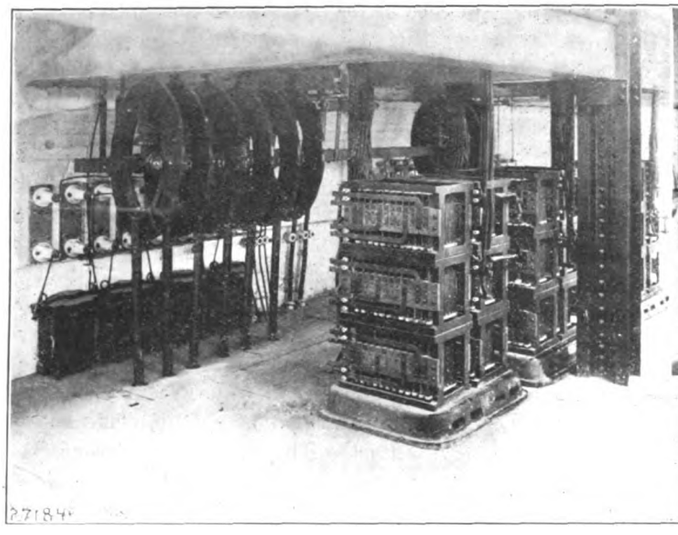
Dan River Power and Manufacturing Company.

The Westinghouse Electric and Manufacturing Company has made a careful investigation of a great many lightning arrester installations. One of these erected in the power station of the Dan River Power and Manufacturing Company, Danville, Va., is of particular interest.

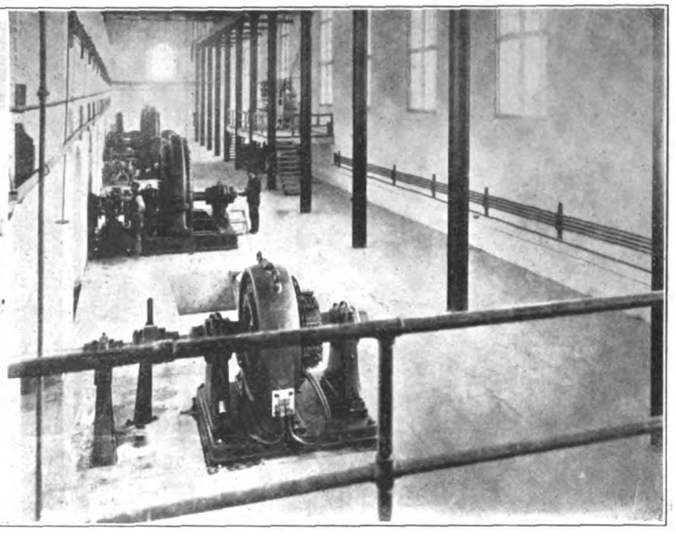
Three views of the station interior are shown; the lightning arresters, the choke coils, and a general view of the station.

There are two 750-kilowatt and one 500-kilowatt, 6,600-volt, three-phase, 3,000-alternation generators supplying one three-phase transmission line of three No. 0000 B. & S. solid conductors. Lightning arresters are installed at each end of this line. Those in the power station are admirably located for inspection, discharges being visible from the floor of the power station, while the condition of the cylinders can be inspected without difficulty. They are located immediately at the entrance of the wires to the building. Three single conductor cables would be more secure than the three-conductor cable shown. This cable is subjected to static strains as it is connected outside of the choke coils.

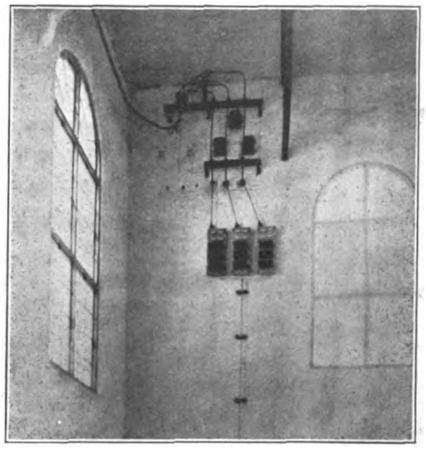
The choke coils are under the switchboard gallery. There is a set of choke coils for each generator, which gives the best protection of the generators from static strains caused by disconnecting the machines from the bus, one coil being permanently connected in each generator switchboard lead. The coils have large areas, thus providing large cooling surfaces so that deterioration of the insulation from heating is negligible. The design also allows of the maximum amount of insulation between the ends of the coils where the voltage set up by discharges are greatest. Supports and insulators are strong and rigid. Trouble might be experienced from the heat given off by the field rheostats, if the underside of the switchboard gallery had been enclosed, though, as it is, the ventilation is good and no trouble should ensue from this cause.



CHOKE COILS, DAN RIVER POWER AND MANUFACTURING COMPANY.



INTERIOR OF STATION, DAN RIVER POWER AND MANUFACTURING COMPANY.



LIGHTNING ARRESTERS, DAN RIVER POWER AND MANUFACTURING COMPANY.

Equipments Being Installed by the Allis-Chalmers Company.

The Allis-Chalmers Company, Milwaukee, Wis., has recently secured a number of contracts for new equipment. Some of these are described below:

The American Car and Foundry Company has ordered for its Chicago plant a power unit consisting of one horizontal, cross-compound Reynolds-Corliss engine, with cylinders fourteen and thirty-two inches in diameter and a thirty-six-inch stroke, and one 350-kilowatt Bullock engine-type generator. Allis-Chalmers Company will supply this machinery, and it has also been awarded the contract for the motors to be used on five new cars now being built by the Car company.

The Harrisonburg, Va., Electric Company has now in process of construction a very interesting and complete power transmission and lighting plant, with substations. The contract for the complete electrical equipment will include two 250-kilowatt Bullock generators and three 1,000-kilowatt Bullock transformers. This is a development of water power, nine miles from the city of Harrisonburg, for which it will supply lighting at night and power to operate manufacturing enterprises by day.

T. M. Sinclair & Company, a progressive packing company, will operate their plant at Cedar Rapids, Iowa, by electric power, the entire equipment for which has been ordered from the Allis-Chalmers Company and is to be furnished by its electrical department, the Bullock Electric Manufacturing Company, of Cincinnati. It will include one seventy-five-kilowatt engine-type generator, one 200-kilowatt belted generator and about forty motors ranging in size from one to forty horse-power, to be used for an individual drive system. The proposed change is brought about by the growing needs of the Sinclair plant, which already covers nearly 400 acres of ground and gives employment to 1,500 men.

The Dominion government is to take up the question of legislation for telephone systems. The postmaster-general has offered a resolution in the House that a committee be appointed to enquire into the methods in force in Canada and elsewhere and to report what changes are advisable in the methods of furnishing telephone service to the public.

Digitized by Google

Automatic Reversible Starters for Alternating-Current Motors.

The Automatic Switch Company, 131 Liberty street, New York city, has placed on the market the Whittingham reversible

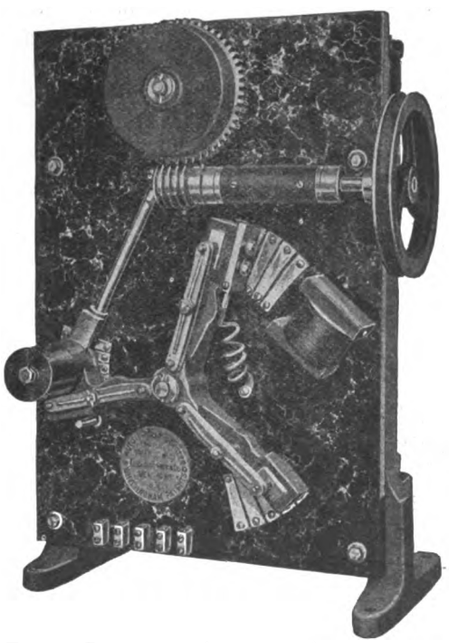


FIG. 1.—REVERSIBLE AUTOMATIC ALTERNATING-CURRENT MOTOR STARTER.

motor-driven automatic motor starter for alternating currents shown in Fig. 1. In this starter the resistance is divided into three sections, each of which is to be short-circuited in star or delta connection to reduce the resistance across the three leads of the secondary of an alternating-current motor. The magnet circuits are energized by a direct current obtained from the exciter circuit of an alternating-current generator or from a gravity battery circuit. If a battery is used, it must be of sufficient capacity to provide twenty watts continuously while the motor is in operation.

If an exciter circuit of direct current is not available, and it is not desirable to make use of a gravity battery to energize the magnets, the type of starter shown in Fig. 2 may be used. This is known as the Whittingham non-magnetic, reversible, automatic motor starter, and is similar in construction to the starter shown in Fig. 1, except that the use of magnets is avoided. The resistance arm has a vertical movement over three sets of contact segments, the resistance being placed in delta or star connection across the three leads of the secondary of a rotary to bring the motor up to speed. The worm shaft driving the clutch which lifts the resistance arm is driven by a belt or other means from the motor at a speed of about 300 revolutions per minute.

When the current is thrown on by the movement of a mechanically operated switch, that movement produces a clutching effect on an arm swinging from the stud which carries the worm wheel at the top of the starter, so as to attach the arm to the worm wheel, thereby lifting the resistance arm to the limit of its travel. When the arm has reached the limit, the clutch slips, as the worm continues to revolve as long as the motor runs. The clutch releases immediately when the switch is opened, allowing the resistance arm to fall to the starting position. Wear on the clutch and arm is prevented by means of ball bearings. The resistance in both types of controllers is made up of several units, each in a separate tube. The resistance wires are embedded in silicon, and are protected from contact with the iron tube in which they are packed by means of a glass tube completely surrounding the coil. The leads are carried out through heavy copper fireproof insulated conductors, securely soldered to connectors back of the contact segments. The contact segments on the face are renewable without disturbing the back connections.

The starter may be used with the alternating-current reversing switches shown in Fig. 3. In these switches the circuit is closed on a large butt contact of ample area to prevent heating, and without the sliding motion of a knife-blade and jaw contact. The two circular contacts at the top are provided with renewable carbons, and engage contacts of the same size secured to the slate, when the cams on the switch shaft permit the arms to close. Closing is effected by a spring in the barrel directly below the curved section of the arm. The two knife blades and each of the main contacts are for reversing, and do not move except when the switch is reversed. The centre or common wire of each phase is broken on a barrel contact when the switch is centered. It is closed before the main or outside contacts are closed, and opened afterward, and is therefore not subjected to arcing.

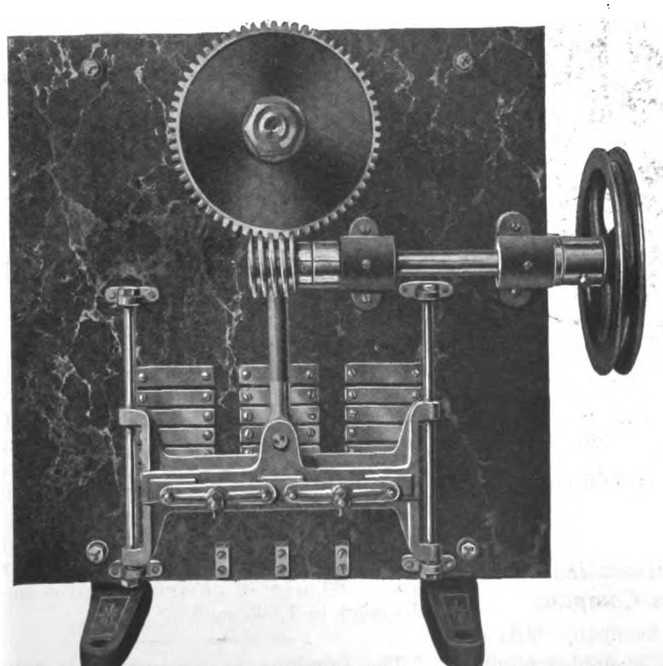


FIG. 2.—NON-MAGNETIC REVERSIBLE AUTOMATIC ALTERNATING-CURRENT MOTOR STARTER.

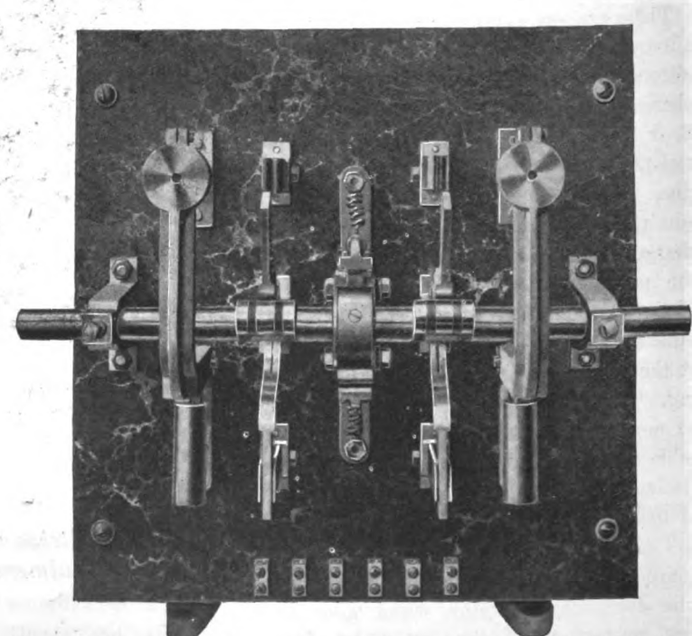
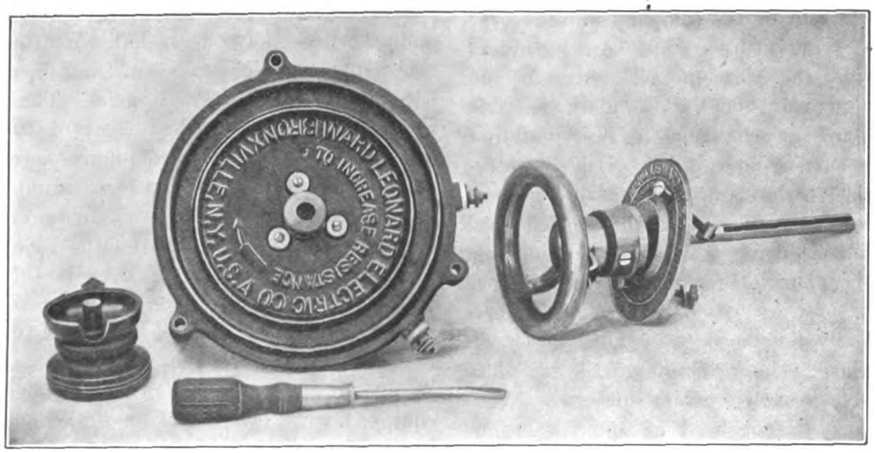


FIG. 3.—ALTERNATING-CURRENT REVERSING SWITCHES.

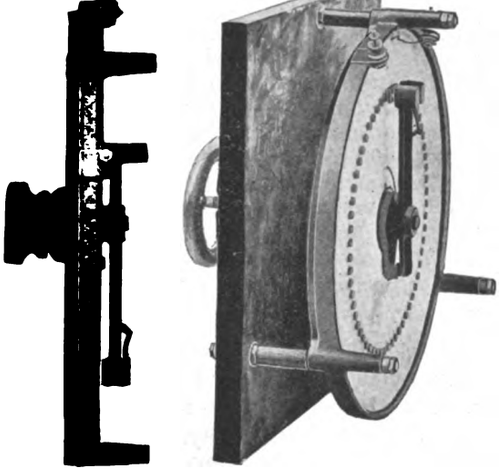
Digitized by Google

New Design of Field Rheostats.

The Ward Leonard Electric Company, Bronxville, N. Y., has so changed the design of its enameled field rheostats that a front-of-board type can be readily changed to a back-of-board type. In the past it has taken about two minutes to make this change, and it has been necessary to use several different kinds of tools. With the new arrangement, shown in the accompanying illustration, a rheostat



CONVERTIBLE TYPE ENAMELED FIELD RHEOSTATS.



CONVERTIBLE TYPE ENAMELED FIELD RHEOSTATS.

can be changed from a front-of-board type to a back-of-board, or *vice versa*, in less than ten seconds. It is only necessary to unloosen one screw with a screw-driver, remove the wooden handle, and insert the back-of-board shaft. The company has not cheapened its type of hand wheel or dial. The wheel is solid, and will not cut the hand when in use.

Valve Gear Used on Engines Made at the Nurnberg Works.

The Nurnberg Works in Germany desire it to be known that they use for their steam engines a trip-valve gear in accordance with their own patents (Marx Gear). For their gas engines they also use their own patent gear, which works as follows: the cut-off of the valve always takes place at the same time while the valve opens at different periods, *i. e.*, at full load sooner, at small load later. If the engine is entirely unloaded the opening of the valve takes place at such a late period that it coincides with the cut-off, so that the valve remains shut altogether; the opening point only is, therefore, controlled by the governor while it exercises no influence upon the cut-off mechanism.

Removal of General Offices of the Allis-Chalmers Company.

The Allis-Chalmers Company is removing its general offices from Chicago to Milwaukee. This is another step in the direction of carrying out the plans of the present administration, which are gradually being brought to completion. One of the first conclusions arrived at by President Warren, after assuming office a year ago, was that for every reason connected with efficient administration of all branches of the work, from designing to manufacturing, and from selling to collecting and accounting, the chief offices of the company, covering all the ramifications of its business, should be concentrated in one place. That place was logically Milwaukee; because, although the company has four other works in three other cities, the largest works are in Milwaukee, and Milwaukee is where all the future expansion of the company's operations will take place. Besides, at the Milwaukee suburb of West Allis it has the land to build upon.

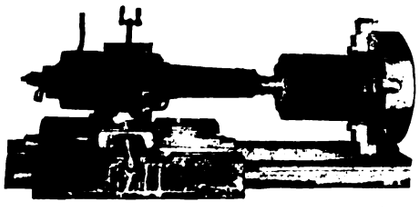
Instead of handling the several departments at long range, as under the old system, they will all be concentrated in one place, thus eliminating the necessity for constant traveling, effecting a great saving in time and expense, an enormous reduction in correspondence and, above all, the quickening of all movements of production.

Plans for the workshop extensions at West Allis, which involve the construction of several more units, are practically complete, and the extensions will be made in due course.

A Portable Electrical Internal Grinder.

The accompanying illustration shows the new portable electrical internal grinder placed on the market by the Hisey-Wolf Machine Company, 122 Liberty street, New York city. It is especially designed for grinding and finishing steam and air cylinders, grinding out dies, truing up bearings, and for internal grinding of all descriptions. Its value to engine builders and for machine shop use in general is apparent.

This tool has a gross weight of seventy-six pounds. Its motor will develop one horse-power. Its dimensions are six by twelve inches, with a spindle extension of twelve inches, as regularly made, but when ordered specially, the spindle can be made in lengths up to twenty inches. The tool is thus capable of grinding out the inside of a cylinder three and one-half inches in internal diameter to a depth of from twelve inches to twenty inches, as desired.



PORTABLE ELECTRICAL INTERNAL GRINDER.

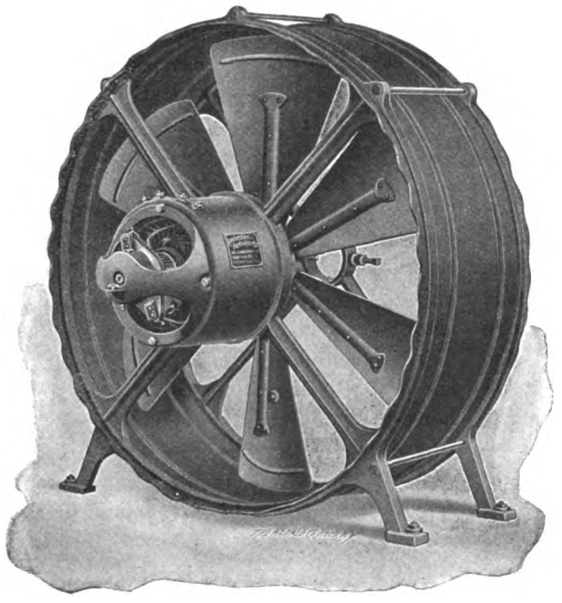
In operation, the grinder is bolted to the tool-post rest of a lathe by means of an angle plate, and has a vertical adjustment to bring it in line with the centres. The motive power is derived from any direct-current incandescent lamp socket, and the motor can be wound to run on any voltage from 75 to 250.

Digitized by Google

Fan Outfits.

The Rochester Electric Motor Company, Rochester, N. Y., is the manufacturer of a noiseless type of wing fan. The curved blades have an expanding pitch, increasing the volume of air moved, reducing slippage and churning, and obviating noise. The blades are adjustable, and can be set to suit the conditions under which the fan is to operate. An important feature of the fan is in the shape of the blades. These are so designed that the passage of light is unobstructed.

The motor attached to this fan was designed especially for use with the wing fan, for continuous duty. The two most important points in the motor for this work are probably the bearings and the brushes. The bearings are of liberal size,



Motor-Driven, Noiseless Type, Wing Fan.

of phosphor bronze, and flooded with oil by rings of large diameter and a special system of spiral grooving. They are interchangeable for motors of the same size.

The brushes are designed so that the current density involved never exceeds twenty amperes per square inch, and the temperature rise, under normal conditions, is twenty-five degrees centigrade.

Every outfit is rigidly inspected and tested before shipment, and both fan and motor are fully guaranteed. The size of fan runs from eighteen inches to ninety-six inches in diameter, and the speed from 800 to 2,000 revolutions per minute. The horse-power used ranges from one-eighth to four horse-power. The capacity ranges from 3,400 cubic feet of air per minute to 6,300 cubic feet of air per minute.

Some Recent Installations of Water-Wheels.

The Abner Doble Company, of San Francisco, reports a substantial and increasing business in tangential water-wheels, particularly in large units, the percentage increase in horse-power of wheels sold by the company in 1904 over 1903 being 116 per cent. Among orders recently taken are the following: for the Electra plant of the Standard Electric System the company is now building three 7,500-horse-power Doble water-wheels, each being of the same general design and capacity as the Doble wheel installed during the last year in the de Sabla plant of the California Gas and Electric Corporation and which has repeatedly developed 8,000 horse-power on overload. One of the large Electra units will operate under a 1,250-foot head at 400 revolutions per minute, the water being delivered through a seven-inch nozzle. The other two 7,500-horse-power wheels will be directly connected to one 4,000-kilowatt generator, forming a double unit for utilizing water from two separate sources under different heads. The design of this unit is an unusual one, inasmuch as each wheel has sufficient capacity to drive the generator at full load. One of the wheels will be driven by a six-inch jet under a head of 1,465 feet, the water being taken directly from the main gravity conduit. The other wheel is to be driven by a seven-inch jet under a head of 1,250 feet, the source of supply being a large reservoir at the end of the main conduit. This arrangement permits the operation of the generator at full load by running either wheel at its full capacity or by running both wheels under partial load, according to the conditions of the water supply. These operating conditions are made possible by the use of Doble needle regulating nozzles which regulate the quantity of water delivered to each wheel. The speed of all three Electra wheels is unusually high, considering the size of the machines, but is permitted by the use of specially designed Doble bearings, similar to those so successfully introduced in the large de Sabla wheel. Each of the three Electra wheels will be operated from a Doble needle-regulating and deflecting nozzle, the deflecting element in each case being controlled by a suitable hydraulic governor. A 200-horse-power Doble exciter wheel to operate under a head of 1,465 feet at 720 revolutions per minute will also be furnished for the Electra plant.

Two 800-horse-power Doble main unit wheels and two forty-horse-power Doble exciter wheels have been built for the new Santa Ana No. 2 plant of the Edison Electric Company of Los Angeles. These wheels will operate under a head of 305 feet, the speed of the 800-horse-power wheels being 176 revolutions per minute. Two seventy-five-horse-power Doble exciter wheels have been built for the Pike's Peak Hydro-Electric Company, of Colorado, to operate at a speed of 975 revolutions per minute under a head of 2,100 feet, the highest in the United States. A 300-horse-power double Doble wheel equipped with two Doble needle-regulating nozzles has been ordered by the Hilo Electric Light Company, of Hawaii. For the Nevada City plant of the California Gas and Electric Corporation, three 570-horse-power Doble wheels have been supplied to operate under a head of 190 feet. The California fish commission ordered a Doble wheel to work under the low head of twenty-three feet. The Braden Copper Company, of Chile, has ordered four 340-horse-power Doble wheels for operation under 930 feet head, three for belt-drive and one for direct-connection to an electric generator. Doble twelve-inch laboratory water motors have been built for the University of Illinois and the University of Texas. An interesting order recently received calls for a complete sawmill outfit to be installed in the Philippine Islands, the machinery to consist of a Doble water-wheel operating under 400 feet head and directly connected to the mill. The order included the sawmill, as well as the riveted steel pipe for the pipe line.

Special Commutators.

The Homer Commutator Company, Cleveland, Ohio, makes a specialty of producing commutators. Over ten years ago Mr. F. L. Homer began the manufacture of commutators as a specialty. The most skilled workmen were employed, and pure lake copper bars and the best mica insulation secured. As the business grew, new facilities were secured for producing an exclusive line of commutators. In street railway work only pure lake copper drop-forged bars are used. For lighting plants, where price is so often an object, and the commutators too large and too heavy to have dies made for forgings, the demand is met by using roll drop lake copper bars.

Considerably more information is contained in an elaborate folder which the Homer company has recently published, and which may be had upon request.

Digitized by Google

New Alternating-Current Apparatus.

The American Electric and Controller Company, 12 Dey street, New York city, has added to its direct-current work a department devoted entirely to the manufacture of alternating-current apparatus. Fig. 1 shows a new switch which the company is placing on the market, designed to be operated from any point of an alternating-current system of distribution. The illustration shows a three-phase switch of 100 amperes capacity. The solenoid is actuated by a push-button or small snap switch, which can be located at any distance from the point where the switch is installed. The switch is so designed as to take advantage of the peculiarities of the alternating-current solenoid, at the same time combining the advantages of simple construction of a small-sized solenoid with a positive and reliable action. This switch is designed to be peculiarly valuable to users of small induction motors in connection with cistern pumps in hotels, apartments and office buildings, or for ventilating systems.

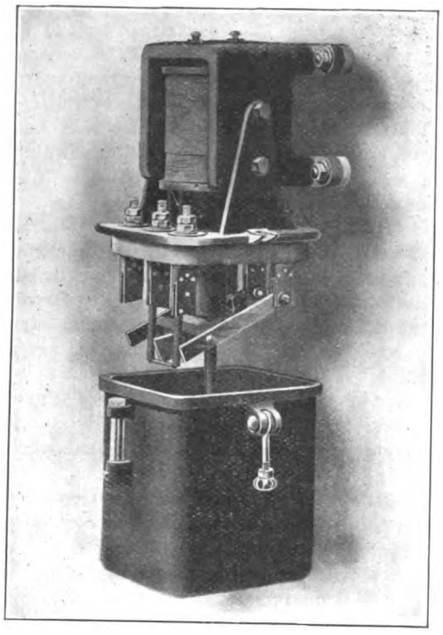


FIG. 1.—THREE-PHASE SOLENOID SWITCH.

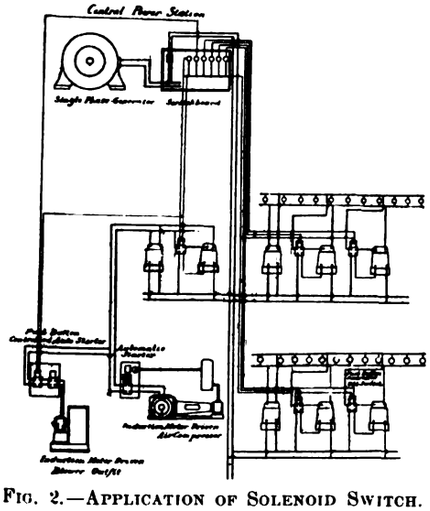


FIG. 2.—APPLICATION OF SOLENOID SWITCH.

Another important field for this apparatus is the throwing in and out of one or more transformers when there are several in a bank, and which, during certain periods of the day, would operate on loads so light as to make an inefficient system if all were left in circuit. A solenoid switch placed in the circuit of each of the transformers enables the operator at the station to throw out as many as the load conditions warrant. These switches may be arranged also to operate automatically as the load rises or falls.

One or more of these switches may be used in central stations as synchronizers, as they will work simultaneously from the switchboard, regardless of the location of the switches.

Fig. 2 represents an alternating-current system of distribution for both power and lighting, where some of the applications are worked out. By reference to the diagram it will be seen that in this particular case all of the solenoids connected with the control of the apparatus work on the low-potential side of the transformers.

New Electric Light Plant at Cook County Court House, Chicago.

The electric light plant installation at the Cook County Court House, Chicago, Ill., is an example of an isolated plant in the centre of a large city, and is especially interesting on this account; and all the more so since it replaces a former plant which had become obsolete. With the experience the engineers had had with the former plant, they were in a good position to judge of the conditions of generating their own current than would be the case if it had been an entirely new project. The fact that boilers are required for heating such a large building is undoubtedly a strong argument in favor of combining an electric light plant with this work, since the additional cost of the attendance required is not very great.

The building is lighted by sixteen arc lights and 2,300 incandescent lamps. The voltage at the switchboard is 125. The generating machinery consists of one 100-kilowatt and one 150-kilowatt, direct-current, engine-type, six-pole generators, built by the National Electric Company, Milwaukee, direct-connected to engines of the four-valve, single-cylinder type, the former running at 225 revolutions per minute and the latter at 200 revolutions per minute. The engines are single cylinder with double slide admission valves and Corliss exhaust valves. The pressure of supply steam is 125 pounds per square inch.

The new plant is a great improvement on the former belt-driven installation, there being now no appreciable noise or vibration, which is an important requirement of a plant installed in a public building of this nature.

On several occasions the generators have had to carry a steady overload of twenty per cent, which they have done very satisfactorily, without any sparking or the necessity of changing the position of the brush-holder yoke.

Madison Square Garden Electrical Show.

There is to be held at Madison Square Garden, New York city, from December 12 to 23, 1905, an electrical trade show, wherein is to be shown the many applications and developments of electrical engineering. On the main floor will be placed the heavy exhibits, while the gallery will contain the smaller appliances and accessories.

There has not been an electrical exhibition in New York city since 1899, and on account of the many developments that have taken place, both in the construction and development of electrical appliances, the promoters feel that this show will provide an excellent opportunity for demonstrating to the trade, as well as to the general public, the advances in the different lines of applied electricity.

Direct current at 115 volts and alternating current two-phase sixty cycles at 104 volts will be available. Gas can be secured. Steam will be available to a limited extent. Information concerning any matter pertaining to the exhibition may be obtained from G. F. Sever, director of exhibits, at 26 Cortlandt street, New York city.

An Industrial Beneficial Association.

The shop employés of the Crocker-Wheeler Company, Ampere, N. J., have organized a beneficial association which has a number of novel features.

Every employé who pays ten cents a week to the association will be entitled to ten dollars a week for twenty weeks during incapacity through illness. If he dies his family will receive $100. The payment of twenty cents, thirty cents or forty cents a week entitles him to $15, $20 or $25, respectively, with death benefits of $150, $200 or $250. This plan went into effect on April 3.

The Crocker-Wheeler Company has offered to contribute an amount equal to the dues paid to the association. Thus, if $6,000 is paid yearly in dues, the income of the association will be $12,000. The company does not require representation in the association, and the society will be run by the employés. The president of the association, James Moore, has charge of one of the large planers in the main bay of the shops. The other officers are Charles H. Brittain, vice-president; George T. Owen, financial secretary; Frederick Mains, recording secretary, and William Lennox, treasurer.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TEN-MILLION-DOLLAR TELEPHONE COMPANY—The Colorado Telephone Company, Denver, Col., has filed papers of incorporation with a capitalization of $10,000,000. The company will also have headquarters in New Mexico, at Albuquerque, with J. E. Elder as the New Mexico agent.

MEXICAN HYDROELECTRIC POWER SCHEME—The San Ildefonso Hydroelectric Power Company, of Mexico City, Mexico, expects to complete within three months a dam of 6,000,000 cubic metres, and will then proceed to erect two hydroelectric power plants on the Monte Alba river. This will increase the power furnished to electric light plants and factories from 3,200 to 7,200 horse-power.

A SUBWAY FOR BALTIMORE—At the request of Mr. B. N. Baker, president of the Baltimore Trust and Guarantee Company, Subway Engineer Phelps has prepared tentative plans and an estimate of cost for the construction of a system of subways for the street cars in the business section of Baltimore, Md. The subway will have a total length of 21,400 feet. It will cost $2,000,000, and is expected to take about two years in construction.

MADISON RIVER POWER COMPANY INCORPORATED—The Madison River Power Company, Helena, Mont., has been incorporated. The purpose of the company is to erect a power plant along the Madison river, for the development of electric power. The capital stock is $600,000, of which $551,000 has been subscribed. The directors are P. E. Bishland, New York; A. J. Nichols, New York; W. S. Brayton, East Orange, N. J.; C. R. Ganter, New York, and A. S. Hidley, New York.

TRAMWAY SYSTEM OF PARA, BRAZIL, PURCHASED BY ENGLISH SYNDICATE—The animal traction tramway system of Para, Brazil, has been sold to an English syndicate. The syndicate purposes to change the motive power to electricity, and will install the most modern electric traction system within a few months. The United States consul at Para states that the greater part of the material for electrification of the railway is to be purchased in the United States.

ELECTRIC LIGHTING PLANT IN WEST AFRICA—It is proposed to establish an electric installation at Dakar, Senegal, French Colony, West Africa, for the purpose of lighting the town and furnishing the necessary power for the various civil and military services and for an electric tramway. The government has already been approacned by two firms, one offering to undertake the electric lighting, and the other offering to furnish the power for the tramway system. Before coming to a decision, however, the government is determined to fix the necessary requirements and conditions, and with this object in view has nominated a commission to thoroughly study the question and draw up a list of requirements to be fulfilled.

WESTERN TELEPHONE SYSTEM EXTENDING ITS OPERATIONS—The Western Electric Telephone System, with headquarters in Des Moines, Iowa, has filed articles of incorporation with a capital stock of $1,000,000. The officers are: president, Thomas A. Way, of Britt; vice-president, S. X. Way, Mason City; secretary, B. C. Way, Mason City; treasurer, E. P. Healey, Britt. The board of directors consists of C. E. Yost, Omaha, Neb.; Thomas A. Way, Britt; T. A. Potter, Mason City; E. B. Smith, Des Moines, and N. T. Guernsey, Des Moines. Thomas A. Way and S. X. Way already control a number of telephone systems in the northern part of the state. These systems all use the Bell apparatus. The purpose of the company is purely to extend its field of operation.

POWER PLANTS AT SHOSHONE FALLS—Plans are under way for the incorporation of the Shoshone Power Company, of Boise, Ida. The incorporation will be with a capital of $5,000,000, divided into 5,000,000 shares. The scheme is said to be one of the largest ever attempted in the West, and contemplates the installation of an electric generating plant under the Shoshone falls, on the Snake river, in Idaho. At this point the falls have a vertical drop of 210 feet. The incorporators have acquired water sufficient to generate 45,000 horse-power, and the purpose is to transmit electrical energy to Salt Lake City and intermediate points. This means the construction of a transmission line 201 miles in length to Salt Lake City. It also contemplates branch lines to the smaller towns in southeastern Idaho, such as Albion, Oakley, Malad, and in Utah at Cache Junction, Collinston, Brigham and other towns.

FREIGHT TUNNEL PLANNED FOR BOSTON—The Boston Transportation Company, Boston, Mass., has applied to the legislature for the right to build freight tunnels under the city of Boston. It is contemplated to establish an up-to-date tunnel system larger than anything heretofore conceived. The plans outlined involve the building of more than ten miles of tunnel in the downtown districts, for the general transportation of freight. Large tunnels would connect the North and South stations, the Hoosac tunnel docks, the domestic and foreign steamers, and the principal wholesale sections of the city. Under the provisions of the charter the company must complete this ten miles of tunnel within three years, or forfeit $200,000. It is estimated that the tunnels will cost about $1,000,000 per mile. It is proposed to make the Boston tunnel at least eight feet wide for single-track, and proportionately high, and about thirteen feet six inches wide for double-track tunnels. At the side and between the tracks will be space for the laying of electric conduits of various kinds.

ELECTRICAL EQUIPMENT THIS SUMMER—The Long Island Railroad Company anticipates having its electrical equipment on the Far Rockaway branch and the line across Jamaica bay trestle fully installed some time in June. The company has placed an order for 122 steel motor cars for this service, and it is understood that a score or more are ready for delivery. As soon as the company receives the cars it will install the electrical equipment in its own yards. In length, seating capacity and general appearance these cars resemble the subway steel cars. In addition to the motor cars, nearly sixty cars used on the present trains are being remodeled to be used as trailers. Nearly forty-five miles of road are being equipped for electric power. The lines will extend eventually to Hewletts, Valley Stream and Queens. Similar equipment is to be installed on the North Shore branch and on the Manhattan Beach line. The Pennsylvania Railroad and the New York Connecting Railroad are to spend $50,000,000, and the Long Island Railroad is to spend $40,000,000 more in these interconnecting traffic improvements.

NEW PUBLICATIONS.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS—The ninth annual report of the International Association of Municipal Electricians has been printed. The work covers the proceedings of the ninth annual convention, including the papers presented and the discussion. A list of officers is given, and the text is supplemented by portraits of the officers and committeemen.

ANNUAL REPORT OF THE BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS OF THE COMMONWEALTH OF MASSACHUSETTS—The twentieth annual report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts for the year 1904 has been issued. It gives a list of the gas and electric lighting companies which have been chartered under the general law during the past year, with the amount of capital and location of each, and the reports of 144 companies, and the gas and electric light plants of eighteen towns and three cities. It also contains a number of valuable tables relating to the cost of operation of various plants in the state.

Digitized by Google

TELEPHONE AND TELEGRAPH.

DENISON, TEX.—Work has been commenced on an independent telephone plant in South McAlester.

HUNTINGTON, IND.—The United Telephone Company is arranging for a second exchange at Huntington.

PORTLAND, ORE.—The Pacific States Telephone and Telegraph Company is preparing to place underground its wires in all parts of the city of Portland.

RAPID CITY, S. D.—The building of a telephone line from Hermosa to Rapid City is under consideration. A company is being formed, and money is being subscribed for the project.

LOGANSPORT, IND.—The Home Telephone Company has contracted for the installation of a new section to the present board, which will increase the capacity of the exchange 420 telephones. This will make the capacity 2,380.

BATH, N. Y.—Directors of the fifteen rural telephone lines covering the western half of Steuben County have entered into an agreement with the Century Telephone Company, whereby the rural lines will be centered in the Bath Century office, establishing connection with the toll and village lines, as well as affording communication from one rural line to another.

HAMILTON, OHIO—The stockholders of the Hamilton Home Telephone Company, at a meeting held recently, voted to increase the capital stock from $200,000 to $300,000. Manager Thompson reported 1,710 telephones in service in Hamilton, and 2,150 in the county. The proceeds of the sale of stock will be used in the building of lines and their extension over the entire county.

ALTON, ILL.—At the annual meeting of the directors of the Fosterburg & Upper Alton Main Line Telephone and Telegraph Company J. T. King, D. M. Kittinger and Albert Penning, directors of the company whose terms of office had expired, were reelected for a term of three years. The directors changed the name of the company to the Star Telephone and Telegraph Company.

HOLLAND, PA.—A telephone company has been organized by citizens of Holland and Milford to run a line from Milford to Riegelsville, where it will connect with the long-distance telephone system. It is to go by way of Spring Mills to Holland. The following are the officers: president, Alton C. Rapp; vice-president, Mahlon Angell; secretary, William H. Farrand; treasurer, Elmer E. Culver.

AUGUSTA, S. C.—The Independent Telephone Company, which has been operating the Strowger automatic system for a number of years, has sold at public outcry by the receiver under mortgage foreclosure proceedings for $15,000. The plant cost over $100,000. The property was bought in by a representative of the bondholders, who has stated to the public that the service will be discontinued and the plant dismantled.

SAN FRANCISCO, CAL.—J. S. Torrence and Thomas W. Phillips, directors of the Los Angeles Home Telephone and Telegraph Company, have been investigating the possibilities of extending the Los Angeles telephone system to San Francisco. The company proposes to install an automatic system which is at present in use in a number of towns on the Pacific coast. It is stated that the new plant will cost about $4,000,000.

NORTH BRANCH, N. J.—The annual meeting of the Hillsborough & Montgomery Telephone Company was held at Belle Mead recently, when officers were chosen for the ensuing year as follows: president, Peter A. Garretson; vice-president, Hueston Labaw; secretary, Louis E. Opie; treasurer, Clarence R. Covert; board of directors, besides the foregoing, Nelson Y. Dungan, C. A. Hoagland, Abram A. Cortelyou, William M. Funkhouser.

CINCINNATI, OHIO—The directors of the Bell Telephone Company have decided to issue $650,000 of new stock, as authorized at the annual meeting of last month, when an issue of $1,000,000 of additional stock was voted. The stock will be offered the present stockholders in the proportion of one share for every six they hold. Some of the money realized will go toward buying a few small independent exchanges, but the greater portion will be spent in improving the company's present system.

CHEYENNE, WYO.—An agreement has been entered into between the Rocky Mountain Bell Telephone Company and the Pacific States Telephone Company, whereby the two companies will connect their lines and make possible telephonic communication between Wyoming and Colorado points and Pacific coast cities. The local company will build west from Ogden to the Nevada state line, and the Pacific States company will build east from Reno, Nev., to the junction point. It is understood that the work will be done as rapidly as possible.

CHICAGO, ILL.—The Postal Telegraph-Cable Company will move into its new quarters in the Rialto Building on May 1, which hereafter will be known as the Postal Telegraph building. The leases were signed in July, 1902, running from May 1, 1905, for twenty-five years. Two entire floors will be occupied, and additional space has been leased in the basement. The total annual rental on the space to be occupied will exceed $30,000. The telegraph company will expend over $250,000 in improvements and fitting up the building to meet its requirements.

IOWA FALLS, IOWA—The annual meeting of the stockholders of the Central Iowa Telephone Company, which operates exchanges at Hampton, Eagle Grove and Iowa Falls and intermediate toll lines, was held March 10. The following board of directors was elected: F. E. Wettstein, of Cleveland, Ohio; N. W. Beebe, of Hampton; Joseph Huseman, W. D. Wagoner, W. P. Mayse and J. R. Skinner, of La Porte City; George Wright, of Eagle Grove, and W. V. Shipley and J. H. Funk, of Iowa Falls. The following officers were elected: president, F. E. Wettstein; vice-president, J. H. Funk; secretary and treasurer, W. V. Shipley.

LAS VEGAS, N. M.—E. M. Burgess, general superintendent of the Colorado Telephone Company, with offices in Denver; T. J. Mathews, manager for the company at Socorro, and J. E. Elder, local manager, have completed arrangements for the establishment of a long-distance telephone line, which will connect the cities of Las Vegas, Santa Fe, Albuquerque and Socorro, and all intermediate points, covering a distance of over 200 miles. The Colorado Telephone Company already has telephone systems in each of these cities. The Socorro system taps the mining camps of Magdalena, Holly and Carthage, and San Marcial and San Antonio.

FREMONT, NEB.—The annual meeting of the shareholders of the Farmers' Telephone Company was held recently. The report of the secretary showed that there were 365 telephones in use, being an increase of nine over the previous year. The receipts exceeded the disbursements for the year by $386.99. It was decided to improve the service at North Bend, and to abandon the switchboards at Pleasant Valley and Webster. The work on these lines will be cared for at Scribner. A new line will be extended from the bluffs near North Bend, several miles north. The board of directors chosen for the year consists of W. D. Holbrook, Herman Rexin and Charles Woodruff.

KEARNEY, NEB.—The organization of the Kearney Telephone Company has been completed, and the officers of the company selected. They are T. E. Parmelee, president; Warren Pratt, vice-president; W. S. Clapp, secretary and treasurer; W. J. Stadelman, general manager. These, with F. H. Gilcrest, constitute the board of directors. The new corporation has acquired the plant and business of the Home Telephone Company, the Kearney & Northwestern Telephone Company and the Overton Telephone Company, all three of which systems will be operated under one management. The toll lines east and west are to be equipped with copper wire, and other improvements are to be made.

NEW ULM, MINN.—Citizens and farmers of the neighboring towns have organized the New Ulm Rural Telephone Company to establish telephones in fourteen towns adjoining New Ulm, in the counties of Brown, Nicollet and Blue Earth. Articles of incorporation were adopted, and the capital stock will be $50,000, divided into 2,000 shares. A large portion of the stock has already been subscribed. Officers were elected as follows: president, Philip Liesch, New Ulm; vice-president, Alex. Russell, West Newton; secretary, A. J. Vogel, New Ulm; treasurer, Otto Schell, New Ulm. A director for each of the fourteen towns was also elected. New Ulm will be the central point from which the rural lines will radiate. Steps have been taken to begin construction, and it is expected to have the line completed next summer.

Digitized by Google

ELECTRIC RAILWAYS.

MARSHFIELD, ORE.—It is announced that an electric line will be built between Marshfield and North Bend.

OROVILLE, CAL.—A franchise to build an electric road, from Durham to the Glenn County line, has been sold to A. E. Boynton.

ALTON, ILL.—The Edwardsville, Alton & St. Louis Traction Company has awarded the contract for building a line from Edwardsville to Mitchell, a distance of eight miles.

SAN ANGELO, TEX.—A. J. Morgan has taken the necessary preliminary steps looking to the construction and operation of an electric street railway system in San Angelo.

HAMILTON, IND.—The De Kalb county commissioners have granted a franchise to the Seagrave syndicate for an electric line through the county, to the line north from Waterloo.

YOUNGSTOWN, OHIO—A franchise has been granted the Shenango Traction Company, of Greenville, to operate through Wheatland. Right of way through Pymatuning township has also been given.

MAUCH CHUNK, PA.—The Carbon Street Railway Company directors held a meeting recently, when a $75,000 bond issue was agreed upon. The amount will be raised at once to rehabilitate the road, provide for rolling stock, etc.

McKEESPORT, PA.—Work has been commenced on the extension of the Pittsburg, McKeesport & Greensburg trolley line, about five miles long, from Irwin to Trafford City. When ready for traffic the extension will have cost $250,000.

MADISON, WIS.—The Madison Traction Company has been sold to T. Warren Montgomery, of New York. The purchase price is said to be $500,000. T. Warren Montgomery, Jr., son of the purchaser, will be manager of the system.

MEDFORD, ORE.—The proposed Medford & Crater Lake Park line is assuming definite shape, and it is believed the road, now surveyed, and for which right of way is being secured from Medford to the Upper Rogue, will be built shortly.

LANCASTER, PA.—The Lancaster, Oxford & Southern Railroad is to be converted into a trolley system. A mortgage for $200,000, covering the road from Oxford to Peach Bottom, and the extensions from Fairmount to Quarryville, has been filed.

INDIANAPOLIS, IND.—Work has been started on the electric line between Findlay and Lima, Ohio. This line, thirty-two miles long, will be the connecting link of a system of trolleys joining Indianapolis, Cleveland, Toledo, Detroit and Dunkirk, N. Y.

SANTA ROSA, CAL.—The Petaluma & Santa Rosa Railroad is to extend its line from Green Valley to Forestville. The work is to be started immediately and pushed rapidly. Another important extension now contemplated is from Santa Rosa to Healdsburg.

HARTFORD, CT.—It is stated that the New York, New Haven & Hartford Railroad Company is planning an extension of the Hartford Street Railway Company to Middletown, on the west side of the Connecticut river, and to Portland from South Glastonbury on the east side.

CHESTER, PA.—The Interurban Railway Company will, it is understood, take over the business of the Delaware Suburban Company, which is preparing to build a trolley line from Wilmington to Elkton, Md., *via* Marshallton and Newark. There will be fourteen miles of road.

POTTSTOWN, PA.—The Schuylkill Valley Traction Company will extend its line from Saratoga, through Pottstown, to Boyertown, where connection will be made through to Reading. The Pottstown & Reading Company will build a line to Reading, *via* Royersford and Valley Forge.

SCRANTON, PA.—The Northern Electric Street Railway Company has been granted a street car franchise by Scranton councils. Officers and a board of directors were elected as follows: A. J. Connell, president; Ezra H. Ripple, secretary and treasurer. These, with W. L. Connell, H. C. Reynolds and Thomas J. Foster, constitute the board of directors.

SANTA FE, N. M.—The El Paso Water Users' Association has made application at El Paso for a franchise to run an electric railroad from Anthony, N. M., to El Paso, a distance of eighteen miles. The same company also asked for a franchise to build a long-distance telephone line to follow along the railroad, and to have frequent branch lines in each direction.

HOUSTON, TEX.—It is stated officially that the Trinity & Brazos Valley road is to be extended from Mexia to Houston as rapidly as the work can be done, and that as soon as this is accomplished another line will be run to Beaumont from some point on the Houston line. The road will have the most direct route between Fort Worth and Houston and Beaumont

PORTLAND, ORE.—A trolley line, to handle both freight and passengers between Portland, Tacoma, Olympia, Seattle, Everett and other Puget sound points, is to be built. The road is to follow the abandoned line of the Union Pacific railroad, and work is to start at once. A. Bettes, of Spokane; W. L. Benham, of Seattle, and R. R. Streets, of Olympia, are behind the project.

TRENTON, N. J.—James Smith, Jr., receiver of the Atlantic Coast Electric Railway Company, has filed his third annual report in the United States Circuit Court. It shows the net earnings of the road to have been $112,672.99, against $93,881.93 for the previous year. The operating expenses were $118,883.65, against $113,278.23, and the gross earnings $231,566.64, a gain of $24,394.48 over the preceding year.

NASHVILLE, TENN.—The Nashville Railway and Light Company has decided to build a $150,000 car shed and machine shops on the West Nashville line. The shop building to be erected is to be fireproof, and supplied with modern equipments for the work to be carried on. The company purposes to build and do all of the repair work here, and, in addition, it will be in a position to build many of the cars it uses.

BLOOMINGTON, ILL.—A company, known as the Bloomington, Clinton & Decatur Interurban Traction, has filed articles of incorporation in the counties of McLean, De Witt and Macon for the construction of a chain of interurban railways throughout central Illinois. The capital stock at the outset is $250,000. The incorporators are Jerome J. Danforth, Charles P. Ogden, William Smith, R. S. Buchanan and A. Stewart Hayes.

MARION, IND.—The board of county commissioners has granted a franchise to the Marion & Eastern Traction Company to construct an interurban electric line from Marion to Warren. The company filed a bond to have the road completed and in operation within one year. The company composing the Marion & Eastern Traction Company is of the men that constructed and now own the Northern Traction line, recently built between Marion and Wabash.

OMAHA, NEB.—The Omaha & Council Bluffs Street Railway Company has commenced the preliminary work on the proposed extension of the Walnut Hill line to Bellevue and Fort Crook, by placing a corps of engineers in the field to survey the most practicable as well as profitable route. With the extension the Walnut Hill & Fort Crook line will be from eighteen to twenty miles in length. Hourly service, it is expected, will be given to start with.

FREEPORT, N. Y.—The Long Beach Transportation Company has purchased a private right of way from Atlantic avenue to the foot of Woodcleft canal, at Freeport, running through to Little Swift creek, upon which it has already begun the construction of a short trolley line from Atlantic avenue to the dock, to connect with its line of steamers running to Point Lookout. This line will connect with the New York & Long Island Traction Company's cars.

PROVIDENCE, R. I.—The Providence & Danielson Street Railway is negotiating for the construction of a trolley freight and passenger line from Warwick Neck, nine miles from Providence, to the city of Putnam, Ct., where connection will be made with the Consolidated Railway for Worcester. It is proposed to handle coal and general freight almost exclusively at first. The freight cars will eventually be run at night, and passenger cars in the daytime.

SALINA, CAL.—M. V. Quigg, president of the Monterey County Gas and Electric Company, has contracted to build, equip and

Digitized by Google

put in operation an electric road for passengers and freight traffic between Monterey and Salina, which will ultimately be extended to Hollister, and later into the San Joaquin valley and Fresno. Work on the road, which is to cost $300,000, will be commenced within four months. It is planned to have the road in operation by January, 1906.

NORFOLK, VA.—The Seaboard Traction Company has applied to the council of Portsmouth, Va., for rights of way for an electric railroad, which will run from Smithfield to Portsmouth and Suffolk, and thence on through Petersburg to Manchester, opposite Richmond, Va. Work is to begin within six months, and to be completed within two years. L. R. Britt, of Norfolk, is president of the company, and W. H. Robinson, formerly of Pittsburg, Pa., is general manager.

FORT WAYNE, IND.—Directors of the Fort Wayne, Van Wert & Lima Traction Company have perfected arrangements for the extension of the line to Fort Wayne. Cars are in regular operation between Lima and Van Wert, and the grading, bridges and other preliminary work on the route to Fort Wayne are practically completed. All that remains to be done is the laying of the rails and the construction of the overhead lines, and it is expected this work will be commenced shortly.

MANISTIQUE, MICH.—The construction of an electric railroad, thirty-five miles long, extending from Manistique, through Thompson and Garden, to Fayette, Delta County, following the shores of lake Michigan, is projected. Manistique men and farmers in the Garden district are principally interested. It is likely that the enterprise will be undertaken, in which event the power will be furnished by the Manistique Light and Power Company, whose new plant is now nearing completion.

MARION, IND.—Work has been resumed on the Kokomo, Marion & Western Traction Company's line, which is being constructed between Marion and Kokomo. The line was constructed from Kokomo to Swayzee, ten miles west of Marion, last fall, and the work is now being done between Marion and Swayzee. Officials of the company say cars will be run between Marion and Kokomo in two months. Cars are now running beween Kokomo and Greentown, which is about half the distance from Kokomo to Marion.

PHILADELPHIA, PA.—The annual meeting of the Easton Consolidated Electric Company was held on March 15. The following officers and board of directors were elected: president, W. Hinckle Smith; vice-president, J. S. Rodenbough; secretary and treasurer, S. H. Sargent; directors, J. S. Rodenbough, George W. Norris, W. M. Davis, W. Hinckle Smith, Edward B. Smith, George H. Colket, W. A. Stern, John S. Bioren, S. H. Hackett. The only change in the board was the election of Mr. Hackett in place of J. V. Bull, both of Easton.

PHILADELPHIA, PA.—Officers have been elected for the companies operating the electric road between Camden, N. J., and Jersey City as follows: For the Trenton & New Brunswick Railroad, I. H. Silverman, president; A. S. Chandler, vice-president; W. E. Harrington, general manager; W. A. Stern, treasurer, and A. W. From, secretary. For the Camden & Trenton road: W. A. Stern, president; I. H. Silverman, treasurer; W. E. Harrington, general manager; A. W. From, secretary. The New York-Philadelphia company elected W. A. Stern, president; A. N. Chandler, vice-president; W. E. Harrington, vice-president, and J. Dixon Andrews, secretary.

SPRINGFIELD, ILL.—Articles of incorporation have been filed of the Interstate Traction Company. The principal office is to be at Hoopeston. Capital stock, $100,000. The company purposes to construct an electric railroad from a point in Edgar County, Ill., on the state line between Illinois and Indiana, through the counties of Edgar, Vermilion, Iroquois, Kankakee, Will and Cook, to Chicago, and from a point in Ross township, Vermilion County, to Potomac, in the same county; thence to Paxton, Ford County; and from a point in Grant township, Vermilion County, through the counties of Champaign and McLean, to Bloomington; and from a point in Grant township, east to the Indiana-Illinois state line. The incorporators are James H. Dyer, James A. Cunningham, Alfred H. Trego, Charles C. Williams and Jacob S. McFerran, all of Hoopeston, Ill.

ELECTRIC LIGHTING.

FLORENCE, S. C.—The Florence Electric Light and Power Company is arranging to light Timmonsville.

SALEM, ORE.—An electric light and power plant, to cost $25,000, is to be established. T. B. Wilcox and other Portland capitalists are behind the scheme.

JACKSONVILLE, FLA.—The committee on electric light plant has been advertising for bids for a new 350-horse-power water-tube boiler, for the municipal plant.

LACONIA, N. H.—The Laconia Electric Lighting Company has been purchased by William L. Maurau, of Providence, R. I. The price paid is understood to be $58,000.

OAKLAND, CAL.—The Sebastopol Lighting Company has been sold to the Vacaville Light and Power Company. The new owners will improve the property and re-wire the town.

NEW BEDFORD, MASS.—The Nantucket Gas and Electric Company, together with franchise, bills, etc., has been sold at receivers' sale, in Boston, to Leslie K. Storrs, for $26,000.

SEBRING, IOWA—A franchise has been granted to the Light and Power Company of Sebring. The franchise is for twenty years and gives the exclusive right to furnish light for the village of Sebring.

BRISTOL, VA.—The Tennessee city council has granted a franchise to J. Edward Durham, of Philadelphia, and William B. Cutter, of Buffalo, to own and operate an electric light and power plant in that town.

TOLEDO, OHIO—The city council of Toledo has appointed a committee to investigate the municipal lighting plants in other cities, and to report on cost of installation and operation of a 2,000 arc-light plant in Toledo.

HARTFORD, CT.—The Baker Electric Company has organized and elected the following officers: president, George W. Christoph; vice-president, Robert H. Lewis; treasurer, Burton E. Baker; secretary, Foster E. Harvey.

ESCANABA, MICH.—The common council has voted to submit to the voters of the city the proposition to sell the city gas and electric plant. The plant is antiquated, and has been run at a loss. It cost originally $80,000.

WASHINGTON, PA.—The Burgettstown Water, Light and Heat Company has been organized, with J. P. Linn, president; J. P. Leech and E. M. McGregor, vice-presidents; R. P. Stevenson, secretary, and R. C. Cassidy, treasurer.

AMITE CITY, LA.—An electric light and power plant to furnish light for Roseland and Independence, La., is being erected at Amite City. The promoters of the enterprise are H. C. Hull, of Amite City; Hyman C. Reed, of New Orleans, and others.

PERTH AMBOY, N. J.—The stockholders of the Citizens' Electric Light, Heat and Power Company have elected permanent officers, as follows: president, George F. Reynolds; vice-president, Max Goldberger; secretary and treasurer, Clancy Boynton.

WILBUR, WASH.—The Wilbur Electrical Company has elected for the ensuing year as follows: president, W. D. Roe; vice-president, C. H. Holmes; secretary-treasurer and manager, Charles Kolb; directors, Charles Kolb, W. D. Roe and T. W. Maxwell.

WOODBURY, CT.—The Woodbury Electric Company has completed its electric lighting plant. Two dams have been erected, and a storage reservoir, covering thirty-two acres and having a capacity of 55,000,000 gallons of water, has been built. The fall from the distributing reservoir to the power-house is 192 feet. The new board of directors consists of Floyd F. Hitchcock, S. C. Tomlinson, W. L. Judson, Arthur D. Warner and E. S. Boyd. The officers are: F. F. Hitchcock, president; S. C. Tomlinson, vice-president, and E. S. Boyd, secretary and treasurer.

SPENCER, N. C.—At a meeting of the board of aldermen of Spencer a contract was closed with the Salisbury & Spencer Street Railway Company for a system of electric lights, the same to be put into operation by May 15 of this year. In addition to maintaining arc lights on the principal streets of the town, the company is also to furnish incandescent lights and power for busi-

Digitized by Google

ness and domestic purposes. A franchise was also granted the above-named company, as successor to the Salisbury Heat and Power Company for the purpose of operating a street railway between Spencer and Salisbury, and also, if desired, to maintain and operate a telephone system.

PERSONAL MENTION.

MR. THOMAS B. PECK, JR., has accepted the position of manager of the Metropolitan district of the Electro-Dynamic Company, with offices at 11 Pine street, New York city.

CAPTAIN LEONARD D. WILDMAN, of the Signal Corps, United States army, has been ordered from Nome, Alaska, to Fort Gibbon, on official business pertaining to wireless telegraph work.

MR. WILLIAM S. FANSHAWE, New York city, has become a member of the firm of Harvey Fisk & Sons, bankers. This company is well known throughout the engineering field, handling as it does large lots of electrical and street railway securities.

MR. J. W. KRUEGER, who is well known throughout the electrical industries of the Middle West in view of his previous connection with the Wesco Supply Company, of St. Louis, has recently joined the sales organization of the Electrical Material Company, of Baltimore, Md.

MR. FREDERICK A. HUNTRESS, general manager of the Worcester Consolidated Street Railway Company, Worcester, Mass., has resigned and will go to Brazil as general manager for the Rio Janeiro Light and Power Company. This is a new corporation being organized by New York and Canadian capitalists.

MR. LaRUE VREDENBURGH, who presented an able and interesting paper on the subject of advertising at the Boston convention of the National Electric Light Association, will make a report on "The Commercial Side of Sign and Decorative Lighting" at the Denver-Colorado Springs convention, to be held June 6 to June 11.

MR. H. D. CRITCHFIELD, general counsel and sales manager for the Automatic Electric Company, Chicago, Ill., returned to his desk on March 28, after a long and serious siege of illness. Mr. Critchfield was attacked by appendicitis in January, and was operated on at the Chicago Hospital February 1. While convalescing he was seized with pneumonia, from which he has just recovered.

MR. FRANCIS B. BADT, of F. B. Badt & Company, Chicago, has recently returned from a visit to the factory of the Ward Leonard Electric Company. The intention of this visit was to inspect carefully the many new features of this company's apparatus. Mr. Badt has represented the Ward Leonard Electric Company in the West for many years. He expresses himself as being greatly pleased with the recent advance in the art as shown in his company's new apparatus.

MR. H. L. VOUTE has been appointed general manager of the Southern Telephone and Telegraph Company, at Hot Springs, Ark. Mr. Voute became identified with the telephone business in 1900. His first position was that of a pole-shaver. From this position he was promoted to the draughting bench, and was soon assigned to general telephone work. This was with the Home Telephone Company, at Los Angeles, Cal., and at one time Mr. Voute acted in the capacity of assistant general manager of the plant.

MR. FRANK W. FRUEAUFF, Denver, Col., who was a visitor to New York last week, is credited with saying that the railroad people had been making an extensive canvass of possible delegates for the Denver-Colorado Springs convention of the National Electric Light Association. It is their belief that there will be a record attendance. The figure given is at least 3,500. This is possibly optimistic. Mr. Frueauff states, however, that there is no question that the meeting will break all previous records in point of attendance and general attractiveness.

MR. A. C. BUNKER AND MR. W. C. APPLETON, alternating-current engineers, have become associated with the Crocker-Wheeler Company, Ampere, N. J., in the engineering and contract departments, respectively. The increasing activity of the Crocker-Wheeler Company in the alternating-current field has necessitated a corresponding development in the engineering force. Mr. Bunker has been connected with the Stanley Electric Manufacturing Company on the Pacific coast. Mr. Appleton has acted as engineering salesman for the General Electric Company in the Atlanta territory.

MR. WILLIAM J. CLARK has been elected president of the Perforated Music Roll Company, New York city. Mr. Clark, who is the well-known manager of the General Electric Company's foreign department, has had a most remarkable career. He was born in Derby, Ct., in 1855. From 1879 to 1887 he was postmaster at Birmingham, Ct. During his term as postmaster at Birmingham, his exceptional ability was so recognized that he was frequently called upon by the post-office department to act as post-office inspector. In this capacity he made many important investigations, among them the Star Route frauds, frauds in the Brooklyn post office, the famous mail robbery of the Chicago & St. Louis post-office route in 1886, the Jersey City post-office burglary, and a number of other cases of a similar character. An evidence of his energy and cleverness in this service is shown by the fact that in running down over one hundred criminals, only three failed of conviction. In 1886 Mr. Clark began his street railway career by securing a charter to build a street railway, connecting Ansonia, Derby and Birmingham, Ct. The following year he contracted with the Vandepoele Electric Company for the equipment of this line, the first of its kind in New England. This enterprise suggested the reorganization of the Vandepoele company, and negotiations were conducted, culminating in the sale of the Vandepoele patents to the Thomson-Houston Company. Mr. Clark became connected with this concern in 1888 as general agent of the railway department. He remained in this position until the General Electric Company was formed by the consolidation of the Thomson-Houston and Edison General Electric companies in 1892, subsequently becoming general manager of the railway department. In the early nineties he effected a reorganization of the British Thomson-Houston Company. He held the title of managing director of this corporation until the completion of his work, when he returned to the United States. Mr. Clark's connection with the Perforated Music Roll Company will not alter in any way his present relations with the General Electric Company.

MR. JAMES FARLEY is the subject of an article entitled "Strike-Breaking as a Profession," by William Brown Meloney, in the issue of *Public Opinion* for March 25. The author states that about fifteen years ago Mr. Farley was keeping a hotel in Plattsburg, N. Y. He sold his hotel and drifted to Long Island when the Brooklyn strike of 1895 occurred. At that time he was penniless and seeking employment. Being taken on by the management of the Brooklyn Rapid Transit Company he was made a forehand of the squad of non-union employés. He then conceived the organization of the powerful force he controls to-day. When the strike was broken he took the names and addresses of the men over whom he had been working, and asked them if they wanted to break another strike. At this time the Philadelphia strike was brewing. A few weeks later each of these men received a telegram from Mr. Farley, directing them to report to him in Philadelphia. This was the real beginning of Mr. Farley's business as a professional strike-breaker. The author states that since this time there has not been a labor disturbance affecting street railway companies in which Mr. Farley has not played a prominent part. He has been assaulted numberless times, and been shot at and wounded twice. Mr. Farley claims that he has a most remarkable organization. He has his staff of personal representatives, and in some corner of the country one of his clients is always employing his services. These clients are the railroad companies, the street car companies. This he considers his specialty, and would rather not do anything else. His first aim in taking hold of a strike situation is to keep the public riding. The public, he believes, if given cars enough will ride on them to where they want to go. The author states that for two months preceding the actual strike on the Interborough system Mr. Farley received $1,000 a day. Before that, when strikes seemed imminent, he was retained on two occasions with a fee of $10,000. For his work in the Chicago strike he received $50,000. It is estimated that he is worth from $1,000,000 to $1,500,000, the result of his strike-breaking practice during the past ten years.

Digitized by Google

OBITUARY NOTICES.

MR. GEORGE MOORE JOHNSON, an electrical contractor, died on Thursday, March 23, at his residence, 89 Miller avenue, Brooklyn, N. Y. He contracted a spinal disease from a fall in August last, while he was endeavoring to board a moving car. He was born on October 25, 1860, and was a member of the Star of Cuba Lodge, F. and A. M. The burial was made in Cypress Hills Cemetery, Brooklyn, on the afternoon of Monday, March 27.

MR. ARTHUR BREESE DAVIS, general manager of the Viaduct Manufacturing Company's works, Baltimore, Md., died on the evening of Monday, March 27. Mr. Davis was a native of Waterford, N. Y., and was born in 1831. He was a merchant for some time at Sandy Hill, and went to Baltimore about twenty years ago. He had been connected with the Viaduct Manufacturing Company since that time. He was a great, great grandson of Colonel Livingston, first lord of the Livingston Manor on the Hudson river, and grandson of Arthur Breese and Catherine Livingston. He was a son of Henry H. and Mary Breese Davis.

MR. WILLIAM FREDERICK POTTER, president of the Long Island Railroad Company, died on Sunday afternoon, April 2. Mr. Potter had been ill since March 3. He became president of the road on January 13, when he was elected to succeed William H. Baldwin, Jr., who died on January 3. Mr. Potter was fifty years of age. He was born on October 26, 1855, at Utica, N. Y., and was educated at Highland Military Academy, Worcester, Mass. On October 1, 1875, Mr. Potter entered the employ of the Flint & Pere Marquette Railroad as a clerk in the auditor's office. From October 31, 1876, to September, 1877, he was a clerk in the treasurer's office. From September, 1877, to November 1, 1879, he was a conductor on a passenger train. He was then promoted to station master at East Saginaw, Mich., which post he held to June, 1881. From that time on to July 5, 1884, he was superintendent of the eastern division of the road. He was then promoted to be assistant general superintendent, which place he held until August 10, 1891, when he became general superintendent. On January 1, 1897, Mr. Potter became general superintendent of the Long Island Railroad. He was soon promoted to be vice-president, and, at the death of Mr. Baldwin, became president of the road.

MR. WILLIAM OFFUTT MUNDY died at the East End Hospital, Pittsburg, Pa., Wednesday, March 29. Death was due to blood poisoning, developed from an affliction of the ear which first caused him annoyance about two months ago. Mr. Mundy was a graduate of the Rose Polytechnic Institute, of Terre Haute, Ind., and was still a young man, not yet having reached thirty. Until a year ago he was master mechanic of the St. Louis Traction Company, St. Louis, Mo., and his work there attracted the special attention of railway operators. The new shops of that company, embodying many of the best labor-saving devices, were built under his direction. He was marked for his keen observation, especially in the lines of his profession which, coupled with his inventive genius, enabled him to improve shop conditions by the substitution of many labor-saving appliances. The inventions of Mr. Mundy were not confined, however, to the equipment of the railway shops, for he did much toward the improvement of systems of electric train control. He was also the inventor of an air-brake appliance of much merit. Quite recently he invented a street car window, the construction of which permitted the removal of window sashes to facilitate the repairing and cleaning of the windows. He was a leader in his profession, and his ideas have contributed much of value to electric railway practices, and particularly to the equipment of shops and to the construction of railway motors and controllers. In April, 1904, Mr. Mundy resigned his position with the St. Louis Traction Company to become a commercial engineer of the Westinghouse Electric and Manufacturing Company, at East Pittsburg, Pa. He was a man of great energy, and one who was enthusiastic in everything he undertook. He possessed a genial disposition which won for him a host of friends everywhere he went. He was a prominent member of the American Street Railway Association, and was third vice-president of the mechanical division last year. Mr. Mundy was married January 4 of this year to Miss Kathleen Eddy, of Detroit, Mich. His parents reside at Louisville, Ky., where he received his early education.

ELECTRICAL SECURITIES.

A continuation of the irregular price movement and further contraction in speculative animation is the apparent outlook in the stock market. A review of the price values of a number of prominent industrials will show slight declines, although this is hardly indicative of the full extent of the realization which has been going on for the past two weeks. The long upward swing of prices, with the consequent inflation in many quarters, brought about a condition which made possible heavy liquidation in almost every line. At the same time there is extant a general feeling of confidence that the retrogression is merely a slipping back for a firmer hold. It would not be surprising, therefore, if the late spring showed even a more vigorous boom than has characterized the early year operations. An interesting feature of the present time is the building boom which is going on in the western states. It appears that there is greater activity this spring than has been noticed for a number of years. This will occasion large expenditures of money, the most of which will go to a class which is not likely to do much hoarding. The stimulation thus produced will hardly fail to have a very beneficial effect upon prosperity in general.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 1.

New York:	*Closing.*
Brooklyn Rapid Transit	67¾
Consolidated Gas	205½
General Electric	185⅜
Interborough Rapid Transit	207
Kings County Electric	200
Manhattan Elevated	167
Metropolitan Street Railway	122⅝
New York & New Jersey Telephone	170
Westinghouse Manufacturing Company	189½

New York & New Jersey Telephone directors have declared the regular quarterly dividend of 1½ per cent, payable April 15 to stockholders of record April 5.

The annual meeting of the stockholders of the General Electric Company will be held at the company's office in Schenectady, N. Y., at twelve o'clock noon, on Tuesday, May 9, 1905, for the election of directors for the ensuing year, and for the transaction of any other business which may properly come before the meeting. The stock transfer books will be closed at the close of business hours on Wednesday, April 12, and will remain closed until Wednesday, May 10, 1905.

Boston:	*Closing.*
American Telephone and Telegraph	144
Edison Electric Illuminating	255
Massachusetts Electric	69¼
New England Telephone	137
Western Telephone and Telegraph preferred	100½

At the annual meeting of the American Telephone and Telegraph Company there were no changes in the directorate, and the following were elected: Charles W. Amory, George F. Baker, Francis Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, T. Jefferson Coolidge, Jr., W. Murray Crane, Frederick P. Fish, Henry S. Howe, Charles Eustis Hubbard, Charles E Perkins, William Lowell Putnam, Thomas Sanders, Nathaniel Thayer, Theodore N. Vail, John I. Waterbury, Moses Williams. Resolutions were passed authorizing the transfer of certain lines in the state of Georgia to the company actually operating them for $350,000, and in the state of Alabama for $148,000, This is merely a formal transfer designed to meet the legal requirements of these two states. The by-laws of the company were amended in accordance with suggestions of President Fish, made in order to facilitate the company's business.

Philadelphia:	*Closing.*
Electric Company of America	12
Electric Storage Battery common	88½
Electric Storage Battery preferred	88½
Philadelphia Electric	11½
Philadelphia Rapid Transit	31
United Gas Improvement	116½

Chicago:	*Closing.*
Chicago Telephone	138
Chicago Edison Light	169
Metropolitan Elevated preferred	63
National Carbon common	42½
National Carbon preferred	112
Union Traction common	10
Union Traction preferred	40

Digitized by Google

INDUSTRIAL ITEMS.

THAYER & COMPANY, INCORPORATED, announce their removal on April 1 to 42 Broadway, New York city. Orders for Cahall boiler repair parts should, to secure prompt attention, be forwarded to the new address.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., manufacturer of the Christensen air-brake and electrical machinery, is now occupying additional offices in the Old Colony Building, Chicago, Ill., and has moved the general sales office of the electrical department from Milwaukee to Chicago.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, St. Paul, Minn., has entered the field of electrical supply jobbers, and will carry a very complete line of electrical supplies. The firm is already established and known among the trade, as it has been doing a large business in machines and lamps for the last six years.

THE SIMPLEX COMPANY, 60 Nassau street, Newark, N. J., is a new company which has been organized to manufacture electrical measuring instruments. The president of the company is Mr. M. C. Rypinski, until recently in charge of the business of the Empire Electrical Instrument Company, New York city, and previous to that with the General Electric Company.

MACHADO & ROLLER, 203 Broadway, New York city, are calling attention to the misunderstanding which seems to exist in the matter of the direct-current Whitney instruments. The Whitney direct-current instruments are of the permanent magnet fixed coil type, containing no delicate moving coil and current-carrying springs, eliminating the liability to burn out. At the same time the apparatus is stated to be sensitive enough for work on shunts.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., has published a net price list of electrical repairs and repair parts for service undertaken by its winding and repair department. This book makes a convenient reference work for various forms of motor repairs. The Doubleday-Hill Electric Company is the manufacturer of armature coils, armature punchings, commutators, field coils, wire connectors, transformers, tablet boards and switchboards. The company also makes a specialty of experimental work.

QUEEN & COMPANY, Philadelphia, Pa., are distributing a new circular, No. 1204, descriptive of condensers and self-induction apparatus. This circular shows a wide variety of condensers, from the most elaborate standards down to the small tin-case condensers used extensively in telephone work. Standards of self-induction, both fixed and variable types, are illustrated and described. Curves are given, showing the absorption and leakage in standard condensers. Copies of this circular will be sent to interested parties upon request.

THE ROBBINS & MYERS COMPANY, Springfield, Ohio, is distributing a publication of sixty pages, entitled "The Standard Autograph and Picture Book." This book illustrates and refers briefly to some of the models of fans and motors which the company is supplying to the trade. These books have been circulated to a considerable extent already, and the general character of the publication has elicited many flattering comments. A motor edition of the same book, which omits the fan motor section, has also been distributed. As long as the edition lasts these books will be sent upon request.

THE ELECTRICAL TESTING LABORATORIES, Eightieth street and East End avenue, New York city, is distributing, in pamphlet form, a description of the equipment and facilities of its excellent laboratories. An interesting pamphlet devoted to the subject of electric incandescent lamps used as standards of candle-power has also been issued. This publication covers methods of preparations and the proper use of standard lamps, a description of the special type of lamp constructed for photometric work, and a description of a portable high-accuracy potentiometer which may be used in connection with seasoned and standardized incandescent lamps for the accurate checking of direct-current ammeters. Copies of these papers will be sent upon application.

THE CENTRAL ELECTRIC COMPANY, 207-211 East Jackson Boulevard, Chicago, Ill., is calling attention to its portable universal desk lamp. The distinctive feature of this portable is that the adjustable arm is "self-maintaining," remaining in any position in which it is placed. There are no screws, bolts nor nuts to loosen or tighten. The base of the portable weighs five and one-half pounds, is finished in either polished brass or oxidized copper to match the arm, and the bottom is felt-covered to prevent marring or injuring a polished desk. The apparatus is also made up as a universal bracket, so that the light may be thrown at any desired angle. It is adjustable either up or down, and swings either to the right or left.

THE AMERICAN DIESEL ENGINE COMPANY, 11 Broadway, New York city, is making constant progress in the development of the American Diesel engine. The following contracts give evidence of the demand for this type of machine, and are also an indication of the sizes in which this apparatus is now manufactured: Baldwin Locomotive Works, Philadelphia, Pa., 450 horse-power; Gorham Manufacturing Company, Auburn, R. I., 450 horse-power; William Knabe & Company, Baltimore, Md., 225 horse-power; Citizens' Electric Light and Ice Company, Lebanon, Ind., 345 horse-power; city of Menasha pumping plant, Menasha, Wis., 150 horse-power; Baxter Springs Electric Company, Baxter Springs, Kan., seventy-five horse-power; Effingham Light and Power Company, Effingham, Ill., 240 horse-power.

THE CONSOLIDATED GAS, ELECTRIC LIGHT AND POWER COMPANY, Baltimore, Md., announces its removal from its temporary office, 30 South Eutaw street, to a commodious suite of rooms in the Continental Trust Building. The company's main offices include engineers' department, executive department, bookkeepers', auditors' and solicitors' departments, occupying the entire mezzanine floor. On the ground floor, with an entrance on Calvert street and on the main corridors of the building, the company has located its showroom, in which will be exhibited the latest developments in matters relating to the commercial uses of electricity, such as lamps of various types, motors of various types and for various uses, the electrical cooking and heating devices. To this exhibit will be added various types of meters. These meters will be in operation, and will be for the instruction of the public in their operation and reading.

THE WELLMAN-SEAVER-MORGAN COMPANY, with main office and works at Cleveland, Ohio, announces that Mr. George B. Damon, who has been manager of its New York office, has been transferred to an important position in connection with the engineering and sales department, at Cleveland, Ohio, and that Mr. W. A. Stadelman, for the past ten years manager of the eastern office of the Brown Hoisting Machinery Company, has become manager of the general eastern office of the Wellman-Seaver-Morgan Company, with offices at 42 Broadway, New York city. Mr. Stadelman is well and widely known from his connection with the Sprague Electric and Railway Motor Company; as chief engineer of the Equitable Electric Railway Construction Company; general manager of the Bristol Belt Line Railway Company and latterly in his connection with the Brown company. All enquiries and matters requiring attention convenient to the New York office of the Wellman-Seaver-Morgan Company will have Mr. Stadelman's personal attention.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., is issuing a new catalogue covering Ward Leonard enameled field rheostats. This announcement should not be confused with the recent announcement that the company has issued a new catalogue covering a new motor field rheostat. The motor field rheostats are made up on enameled resistance tubes, and are designed with a four to one, six to one and eight to one taper in ampere capacity. The new catalogue covers generator field rheostats of the standard enameled type, with a two to one taper in ampere capacity. This catalogue will show a marked reduction in price. The Ward Leonard Electric Company announces in this catalogue that, since the inventions contained in the Ward Leonard rheostats have been placed upon the market, the reduction in the price of field rheostats during the past ten years has been greater than in any article of electrical manufacture patented or unpatented, including generators, motors, incandescent lamps, sockets, switches, etc. This new catalogue should be secured by any one interested in this line of manufacture. Copies will be sent free upon request.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 15. NEW YORK, SATURDAY, APRIL 15, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Electrolysis of Platinum . . . 607
A Pertinacious Current . . . 607
Electricity in Mines . . . 608
Where a Consulting Engineer Is Needed . . . 609
Giving a Dog a Bad Name . . . 609
Telephone Engineering—XV, by J. C. Kelsey . . . 610
The Application of the Cymometer to the Measurement of the Co-Efficiencies of Coupling of Oscillation Transformers . . . 611
Direct-Reading Resistance Thermometers . . . 612
Electricity in the Anthracite Coal Mines II, by Robert Thurston Kent . . . 613
Seventh General Meeting of the American Electrochemical Society . . . 619
The Manufacture of Concrete Blocks and Their Use in Building Construction . . . 619
A Field for the Illuminating Engineer, by L. B. Marks . . . 620
Wireless Telegraphy in China . . . 620
Driving Two Alternators in Parallel, by R. E. Spencer Geare . . . 621
Commercial Electrical Engineering . . . 621
Platinum Resources of the United States . . . 622
BOOK REVIEWS . . . 622
ELECTRICAL PATENTS . . . 623
Mechanical Construction of Steam Turbines and Turbo-Generators, by W. J. A. London . . . 624
First Electric Railway in Manila . . . 627
Official Catalogue of the Exhibition of the German Empire at the World's Fair . . . 627
Directors' Nominees for Officers for 1905-'06 of the American Institute of Electrical Engineers . . . 627
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 628
INDUSTRIAL SECTION:
Extensive Power Plant Equipments . . . 630
Electricity in Industrial Applications . . . 630
The Weiny-Phillips Repeaters . . . 630
Steel-Armored Cable Fittings . . . 630
The "Metaphone" . . . 631
The "Innovate" Adjustable Hangers . . . 631
Starting Compensators for Alternating-Current Motors . . . 632
The Manufacture of Armington & Sims Engines . . . 632
New Form of Hydraulic Governor . . . 633
Queen Stand-Pipe Rheostats . . . 634
A Simple Wire Shade-Holder . . . 634
"Wire Grip" Moulding . . . 634
A "Wireless" Electric Battery . . . 634
Rock Drills on the Panama Canal . . . 634
CURRENT ELECTRICAL NEWS . . . 635

ELECTROLYSIS OF PLATINUM.

Platinum is generally considered to be an ideal electrode for electrolytic processes in which the electrodes play no part. It is a good conductor, it does not oxidize, and is generally thought to be unaffected by electrolysis. This is true so long as the current flowing from the electrode does not vary, but, if it vary, electrolysis may take place, although ordinarily there would be no reaction between the conducting solution and the metal. This phenomenon has been investigated recently by Messrs. A. Brochet and J. Tiet, the electrolyte in this case being sulphuric acid. The action took place whether an alternating current or a varying direct current was used. No explanation of this peculiar action is offered. It has been known for some time that metals could be dissolved electrolytically by means of an alternating current, the explanation offered being that, while the greater part of the metal dissolved during one-half of the wave was redeposited during the next half-wave, some managed to get out of reach of the electrode, as it were, and remained in solution; but the action of platinum is not similar to this, for platinum itself is not dissolved by a direct current, but dissolves only when the current varies.

It is interesting to note, while speaking of platinum, that the United States Geological Survey purposes undertaking an investigation of the different sources of this metal in this country. We produce but a small fraction of the platinum which we consume yearly, and the discovery of important deposits of this valuable metal would be welcomed. For many purposes it is indispensable, and were it not so expensive, it would be more widely used. The records of the United States Geological Survey show that during the year 1903—the latest year for which complete figures are available—this country produced only 110 ounces of platinum, valued at $2,080. The quantity of platinum imported into the country was valued at $2,055,933—about one thousand times as much as we produced.

A PERTINACIOUS CURRENT.

While laboring to develop a practical method of dispersing fog, Sir Oliver Lodge has carried out some interesting physical investigations and arrived at some conceptions of what is taking place during certain phenomena, which he puts forward to explain actions not previously understood. It will be remembered that Sir Oliver has endeavored to apply, on a large scale, the effects of a high-voltage brush discharge of electricity on fogs. It has been known for a long time that the action of such discharges on mists was to cause the minute particles of water to coalesce into drops when they were precipitated, leaving the air clear. The work was at first carried on in the laboratory on a small scale, but he has made some tests out of doors, with what was reported to be fair success. The latter tests were conducted at Birmingham University, and it was reported that a considerable space around the discharging wire was cleared of the fog.

The difficulties of applying such a system to everyday purposes are great. One of these is, of course, the cost of an equipment of this kind, which would be in use but a short time. Another has been the devising of means of obtaining a satisfactory supply of electricity. What is needed is a direct current of exceedingly high potential. This can be obtained from the well-known physical static machine, but such generators have only a small output. An induction coil gives the high pressure desired, but its discharge is not continuous. What has been done by Sir Oliver is to adapt the induction coil to his purpose. This has been done by causing the coil to charge condensers, which themselves supply the continuous discharge. To employ condensers in this way, it is necessary to place between them and the induction coil an interrupter or valve of some

Digitized by Google

kind, which would allow current to flow into the condensers from the coil, but would not allow it to flow back through the secondary coil, and thus discharge the condensers.

This arrangement was described by Sir Oliver at a recent meeting of the Royal Institution, of London, and an explanation given of his selection of the term "pertinacious" to describe the current obtained. The idea was to obtain a designation which would distinguish this flow from that given by the induction coil itself, and which would at the same time indicate somewhat the character of the current. As this current has an exceedingly high potential, it will flow through high resistances, or even across breaks in the circuit, hence the term "pertinacious."

Sir Oliver has not been satisfied with hunting for a suitable form of current, but has endeavored to derive some conception of the action of the rectifier which would picture to him what is actually going on. His idea is this: as is well known, one of the striking features of a Crookes tube, when subjected to a discharge, is the dark space surrounding the cathode, outside of which there is a blue glow reaching to the anode. As the vacuum is made higher, this dark space grows out, pushing before it the glow, until the whole tube becomes dark. Sir Oliver's idea is that this dark space is due to a discharge of negatively charged corpuscles from the cathode, which traveling at enormous speeds and in great numbers stop the positively charged particles which are flying from the anode. The higher the vacuum, the further do the negatively charged particles travel, and the longer is the dark space. When the dark space has completely filled the tube, the flow through it in the opposite direction stops, because the positively charged particles can not leave the anode, but are beaten back into it by the others.

These negatively charged particles do not necessarily travel toward the anode, but fly off in straight lines from the cathode; hence, if a tube be arranged so that they will not fall upon the anode, the flow of current will not be interrupted by them. If, then, a tube be arranged so that the discharge from one electrode is directed upon the other, but the discharge from the second does not fall upon the first, the tube becomes a rectifier, allowing the current to pass through it in one direction only. For this action to be continuous, it is necessary that there should be a continuous supply of ions. This is accomplished by making one of the electrodes of mercury, which maintains a definite vapor pressure in the tube, and thus keeps up the supply of carriers. The particular rectifier used by Sir Oliver Lodge is a Cooper Hewitt mercury-vapor lamp of the old form. This is placed vertically. It has an iron anode at the top, and a mercury cathode at the bottom. The outside of the bulb containing the mercury is wrapped with tinfoil and connected electrically to the anode. This forms a condenser, and the cathode rays of the mercury are drawn to the walls of the tube, leaving a free path for the positive carriers down the centre of the tube. Current can not pass through the tube in the opposite direction, because the discharge in that case from the cathode would be directed upon the anode below it.

ELECTRICITY IN MINES.

That electricity offers the best method of conducting the general work of a mine is pretty well demonstrated by the progress which has been made in the substitution of this power for others in the anthracite coal mines in the neighborhood of Scranton, Pa. The second article dealing with these equipments appears in this issue of the ELECTRICAL REVIEW, the first article appearing in the issue of April 8. From this description it will be seen that, after trying the electric motor, the superiority of electricity was evident, and the system is being extended as rapidly as possible to other mines in the vicinity. The situation is such that it has been possible to supply a number of mines with power from a single station, thus gaining considerably in the efficiency of station operation.

Both direct-current and alternating-current systems are in use. The latter has the advantage when transmission over some distance must be made. When it is used, however, and when electric locomotives are installed, it becomes necessary to convert a portion of the alternating current into direct current for the locomotive. This double transformation, while undesirable, is not a great drawback. We have become accustomed to it in railway operation. When direct currents are used it is unnecessary, but then the transmission problem is more troublesome. In these mines there is not much danger of explosion being caused by sparking.

The headway which electrical operation is making in this region is very encouraging to advocates of that system, particularly as it has been preceded by trials of mules, steam and compressed air. As compared with mule traction, there is a great saving in labor, as with the latter system each animal requires a driver, while a single locomotive can handle a long train of cars. As compared with compressed air, there is much saving in time and gain in efficiency. The compressed-air locomotive is being charged for about one-third of the time it is in operation. In addition to this, it is necessary to carry the air pipes through the mines—a work much more difficult and expensive than that of carrying in electrical conductors. While it might seem that the compressed-air locomotive had a greater flexibility of movement in that it was not tied down to an overhead conductor, the custom of attaching to each electric locomotive a long cable, which it unwinds and winds up as it moves, enables it to proceed some distance from the trolley wire, thus permitting it to move about as freely as the compressed-air locomotive. But more important than this is the fact that it can be kept at work constantly.

Another advantage of the electric system is the greatly improved lighting in the mines which it makes possible. It is becoming the custom to light the mines pretty thoroughly, since this greatly facilitates the work of the miners and of hauling. If the supply for the working motors and for the lights be drawn from the same station, so much the better; but there is so much gained by the use of electric lights that even were it not thought advisable to introduce the motor in place of the mule, there is little doubt that electric lighting would spread rapidly. However, a great part of the work in some of the mines, at least, is now being done by electric motors.

Digitized by Google

WHERE A CONSULTING ENGINEER IS NEEDED.

There is a certain class of people which looks upon the engineer as a great scientific expert—a man who has devoted years of study and hard work to learning thoroughly his profession, and whose services are indispensable when important work is to be done. But, to them, the engineer is a man of such importance that he will not stoop to small work. He perhaps would be out of his element if he did, and when a small job is to be done, there is little to be gained by employing expert advice.

Upon the other hand, there is another class of people—men who probably call themselves practical—who have done a good deal of work, who have learned what they know in the hard school of experience, and who think that they know all that is necessary for carrying out a small undertaking, and therefore do not need the services of a consulting engineer. There are many men in this class who have done a lot of work. Some of them have almost grown up with the electrical profession. For carrying out certain kinds of work, better men can not be found, but, in the broader sense of the word, they are not engineers. But few of them are capable of grasping the larger features even of a small undertaking, and for this reason they do not build wisely, although they build well. As a rule, they install a plant which will be reliable, but it is apt not to be efficient.

Of course, both of these classes are in the wrong. There are many engineers who are not only competent, but who would gladly do the consulting work for small plants, and whose advice and instructions would save, many times over, the fee charged. It must be a small job indeed, and a very unimportant one, which is not worth doing right. If it is to be done right, it must be done by a man who knows how to do it. A dynamo tender does not necessarily become a good designer, nor even a good operating engineer. There are very few linemen, if any, who know how to design a transmission line. The man who has learned his trade merely by doing what others have told him to do is very apt to follow precedent although conditions may call for something entirely new. If he has learned to raise poles by means of pikes, he will probably go on putting in poles in the same way until some one makes him do it in a different way. Until he has been shown that there are better ways than the one which he practises, he naturally thinks he knows the best way, and that he knows all there is to be known about raising poles. Only recently we were shown a letter received by an electrical engineer, which said that a certain electrical plant had no need of his abilities, because the writer, who was also the engineer of the plant, had done all the work himself, from the designing and laying out of the plans to installing the motors, putting in the poles, and hanging the wire. To strengthen his contention that the work was done as well as it could be, he told, somewhat in detail, how he had strung wire, planted poles and run dynamos in various parts of the world. He had been in the business for many years, and during that time had visited many countries. We are sorry to say that, with all his experience, his grammar seems to have stuck where it was when he left the primary school, leading one to infer that his engineering abilities had not been much developed. No doubt the plant erected by this man was thoroughly reliable. Probably it is giving satisfactory service; possibly it is paying well. But is it not more probable that a better plant could have been laid out by securing the services of a competent consulting engineer in the first case, or that much improvement might be effected both in the operation of the plant and in the service by calling in an expert to-day? We have no doubt that there are many plants throughout the country where practically the same condition obtains. The owners of the plant may be satisfied because it pays dividends. The engineer may be satisfied because he built the plant. The consumers may be satisfied because they know no better. Yet, if a competent man were brought in to overhaul the plant and put it in first-class condition, eyes would be opened on all sides.

GIVING A DOG A BAD NAME.

A few years ago it was the fashion for the daily papers, when discussing electric railway matters, to refer to this system as the deadly trolley. This designation was unjust, and possibly harmful. Electric railway currents are capable of giving severe shocks to persons who come in contact with the two sides of the circuit, but they seldom, if ever, cause death directly. By far the greater number of accidents occurring on electric railways are not due to the method of propulsion, but to the speed at which the vehicles move. This danger is common to all rapid transit systems, and it seems unfair to damn one system by constantly associating with it a derogatory adjective.

The tendency to see the sensational side of things or to take a fling at a system which, for some reason, has gained the disapproval of the reporter, still persists. On account of an accident to an elevated train a short time ago, it became necessary for the passengers to descend to the elevated structure and walk back to the station. A reporter on one of the large papers, in describing this, sought to add to his narrative by dwelling upon the perils of this short journey in such close proximity to the "deadly third rail." It is all very well to inspire a feeling of respect for electrical conductors, but it does irritate to read about the imaginary dangers, as described by this uninformed reporter. One could imagine that sparks were flying in all directions, arcs were hissing, and that the passengers owed their escape to successful dodging of artificial thunderbolts. A railway current will kill a man if he is laid across the conductors long enough. The same result might be brought about more quickly if he were careless in his movements in the neighborhood of the business end of a mule. When properly erected and protected, as railway systems are in general, there is very little danger from electric shocks. It is probable that there have been more deaths from accidents to steam locomotives since the beginning of the year than from shocks obtained from railway circuits.

Digitized by Google

TELEPHONE ENGINEERING—XV.

BY J. C. KELSEY.

THE CENTURY THREE-STRAND TWENTY-FOUR-VOLT SYSTEM.

In closing the discussion of commercial common battery telephone systems, I call attention to the only telephone system developed in the eastern part of our country prior to 1904. This was in Cleveland, Ohio, and was developed by Mr. Kidney. The system uses a bridged primary for operator's purposes, cuts off both sides of the line, has a natural busy test, and is balanced at all stages of the connection. Instead of the customary 100-ohm impedances, common to a twenty-four-volt system, but forty-ohm windings are used, which may at times add a noticeable amount of current to the subscriber's transmitter. As in cut-off relay systems, the subscriber is aware of the entrance of the operator's plug, and receives a click in the receiver. Every detail has been carefully considered, and a close inspection will find this system the equal of any other in excellence of operation.

When the subscriber removes the receiver, the relay LB is actuated, and closes contact *c*. This lights lamp LL, which is in series with a pilot relay, twenty ohms, which causes the relay PR to close contacts *f*, and light pilot lamp PL. If the line is parallel to a trolley line, or is sensitive on account of great electrical disturbance, the line will not be noisy, as is usually true of common battery systems, as the relay LR is balanced, and offers equal retardation to whatever charges that attempt to escape to ground through other lines. This system is not grounded, which is well for smaller exchanges; but when the subscriber list is large, the resistance of the system gets so low that it is the same as grounded. And a ground at the battery will protect the weaker lines from the escaping charges on the disturbed lines.

The operator, seeing LL lighted, inserts answering plug AP, which allows battery to flow through relay ASR, which controls the answering supervisory lamp, and the cut-off relay COR. The energization of COR cuts off battery connections from the line at *d* and *e*, LR becomes deenergized, and LL darkened. The pilot relay and lamp are also put out of service.

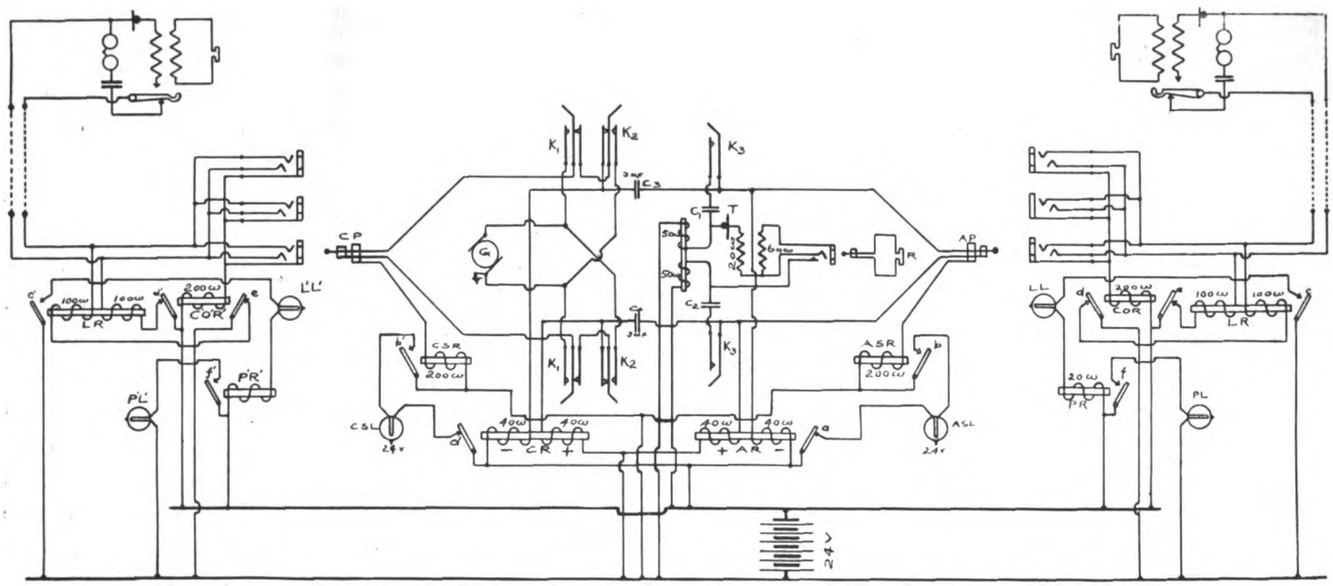


FIG. 26.—THREE-STRAND CUT-OFF RELAY SYSTEM.

When the operator plugged in, relay ASR closed contact at *b*, and ASL would have lighted, but contact *a* is open, because the relay AR is energized, it taking the place of the line relay LR.

With K_3 the operator bridges her primary winding and transmitter across the line, and ascertains the desired number. The operator's set is a very ingenious arrangement, and differs from all other systems. Battery is furnished the primary circuit through a fifty-ohm tandem winding. Two condensers, C_1 and C_2, complete the bridge without causing the least interference to the cord circuit. The receiver circuit is simply closed with secondary winding resembling the usual independent method of connecting subscriber sets.

Ascertaining the number, the operator tests by touching the tip of the plug to the desired jack-sleeve. If the line is busy, a positive potential exists on a normally negative condition. The positive current from the jack-sleeve passes back over the tip side of the circuit through the minus winding of CR, and thence to negative side of battery. Energy is stored up in the core of CR. When the tip is removed the magnetic energy quickly dies to zero value, thereby generating a current in CR which shows itself in the operator's receiver in the form of a click and also to the calling subscriber.

If the line is not busy the negative tip touched to a negative jack-sleeve will produce no click, hence the operator inserts calling plug CP. This energizes relay CSR, closing contact *b'* and lighting lamp CSL. It also energizes cut-off relay C'O'R', so that the removal of the called subscriber's receiver will not affect the line signals and give a false signal.

The operator has two keys at her disposal for ringing. If one party is to be rung—on a two-party line without disturbing the other—the bells are connected to ground on the respective sides of the line. If key K_1 was used the party whose bell was connected to the tip-side of the line would be called. If the operator used K_2 the party on the ring-side would be called. When the party answered relay CR would be energized and open contact *a'*, causing lamp CSL to be extinguished. The controlling relays or supervisory relays are AR and CR. When the parties hang up receivers these relays close contacts *a* and *a'*, lighting supervisory lamps ASL and CSL, whereupon the operator pulls down the connection.

The condensers C_3 and C_4 perform

Digitized by Google

the usual service of making complete the talking connection between the subscribers of the impedance system. In every sense this system is complete. It gives a clear ringing circuit which those systems with permanently bridged relays or impedances very clearly lack. There is no doubt that the bridged impedance or relay cuts down ringing very seriously and gives a general relay chattering. The click of the receiver is felt, which may be said to be the only fault.

The question of battery is immaterial. A ten-volt battery system would give just as good transmission as a twenty, forty, or forty-eight-volt system. The results would be better, too. With low-voltage there is less strain on insulation and less chance for leakage. The only advantage of high-voltage work is that relays can be made more cheaply.

It is the alternating-current values that count. It is alternating current that passes through condensers, repeating coils, induction coils and receivers. The alternating current produced by a transmitter on a forty-volt system is no greater than that produced by a ten-volt system. The alternating-current values of the Bell long-distance forty-eight-volt circuits are not as high as those produced by the normal twenty-four-volt system, yet they use forty-eight volts. There is as yet several and many unsettled points about communication.

One man says a transmitter with great range is the thing. He also says that alternating pressure does not count. But what else does a transmitter with great range do than to raise the pressure above that attained by a feebler transmitter. It is a well-known fact that local battery transmission is better than common battery transmission. It is also said that a common battery transmitter is superior to a local in points of construction. It is not the fault of the common battery transmitter then. It is the fault of the apparatus which projects the alternating currents out on the line. And a measurement of local battery talking alternating pressure reveals that its electromotive force is twice what the best common battery transmission can produce.

If this is the case, then it can not be that higher pressure is a detriment. One might say that the higher the pressure the greater the absorption by the capacity of the line. Yet, the higher the pressure the greater will be the current on the line and the lesser effect will absorption due to capacity have.

The currents flowing, due to local battery service, are much greater than common battery. The inference is that common battery systems have not the power of impressing energy upon the external lines that the local battery transmission possesses.

It has been done time and time again, but a common battery transmission has failed and the substitution of a local battery set in good order has succeeded. Surely, the fault is in the system. Whether repeating coil or retardation, there is no difference in the alternating pressure obtained. The same subscriber's instrument will give the same pressure out on the toll line with either system. It is alternating current in each case and the advantage is with neither. Neither one will come within half way of the alternating values of local battery.

There has been talk concerning relative advantages of two and three-strand systems. Some claim that the two-strand system is objectionable on account of bridged impedances and that its missing third sleeve-strand will not allow of special work, such as metering, etc. The bridged impedances in the two-strand systems are actually an aid in transmission and not a detriment. About the work done with the third strand, there is not one thing which can be done with a three-strand system which can not be done with the two. One thing is objectionable, a two-strand system has difficulty in ringing out on both sides of the line. However, the Kellogg four-party harmonic ring makes it unnecessary to ring out on both sides of the line.

Out of all the commercial systems there seems to be but three original systems. The Bell repeating-coil system being in the field first naturally covered a great deal of ground and made the path of the inventor along new lines a hard one. A great many names are concerned with the repeating-coil system, each contributing some distinct feature and making the system a success in every way. The names of Stone, Hayes, Scribner, Carty, McBerty and Conner have a lasting place. McBerty has contributed a great feature to the system and that lies in the present repeating coil. Without the No. 13 repeating coil the Bell telephone system would have very disagreeable work to perform, if putting all the lines on metallic basis can be called disagreeable. However, from a scientific standpoint, the No. 13 repeating coil has merit enough to stand alone. In these days of earth currents from the very numerous electric lines, the trunking of connections between exchanges would be a difficult matter were it not for Conner's contribution of the high-resistance disconnect trunk relay.

The original two-strand work has among its vital contributors Dean, Dunbar, Miller, Webster and Libby. The system that these men worked out stands without priority. It has numerous imitators and its excellence has not a doubter. This group of engineers in the Kellogg Switchboard and Supply Company gave to the independent telephone field a great share of its impetus.

Another distinctive system is that worked out by Fowler, of the Sterling Electric Company, in which he permanently bridges the relay across the circuit in series with the only or common battery. It is this system that gives the clean, quiet operation, which advantage is partially offset by the weakened ringing, due to the low impedance of the bridged coils when traversed by low-frequency ringing currents.

Switching, both by manual and automatic means, has nearly reached its maximum utility. There is a tendency now to improve the transmission and it is safe to say that a few years will find the present method of speech transmission considerably altered.

The Application of the Cymometer to the Measurement of Coefficiencies of Coupling of Oscillation Transformers.

A paper "On the Application of the Cymometer to the Measurement of Co-Efficiencies of Coupling of Oscillation Transformers," was read by Dr. J. A. Fleming at a recent meeting of the Physical Society, of London. This paper deals with the latest pattern of instrument called by the author a cymometer, designed for the measurement of the frequency of electric oscillations, and also the length of long electric waves. It consists of a sliding tubular condenser, consisting of two brass tubes, separated by a thin ebonite tube, the outer tube being capable of sliding off the inner tube. Parallel with this sliding condenser is placed an inductance coil or helix, of bare copper wire, wound on an ebonite tube. The outer brass of the sliding condenser carries a collar, which in turn carries a rod with a crutch at the end resting upon the inductance coil. The circuit of the instrument is completed by a copper bar which joins one end of the inductance coil with the inner surface of the sliding condenser. When the outer tube of the condenser is moved by an insulating handle, the same motion reduces equally the capacity of the condenser and the

Digitized by Google

portion of the inductance coil included in the closed circuit. The circuit therefore consists of a variable capacity and inductance in series. The author calls the square root of the product of the capacity and inductance in any position, the oscillation constant of the instrument. A scale is provided parallel with the inductance coil, on which is engraved the oscillation constant and the corresponding frequencies connected therewith by the formula $n = 1/2\pi\sqrt{CL}$. In addition to this, the instrument is provided with a vacuum tube, preferably a Neon vacuum, which is connected between the inner and outer surfaces of the condenser. The instrument is used in the following manner: the copper bar is placed parallel and near to a circuit in which oscillations are taking place, and the handle of the instrument is moved, thus varying the oscillation constant, until the vacuum tube glows most brightly. Under these circumstances it is known that the circuit of the cymometer is in resonance with that of the circuit being tested, and their oscillation constants are therefore the same, hence the scale reading gives the product of the capacity and inductance of the circuit being tested. The instrument is also provided with a rectangular wire circuit, the inductance of which is known. If this circuit is joined up with any unknown capacity and oscillations set up in it, the cymometer can be used as above, to determine the product of capacity and inductance in the circuit being tested, and the inductance being known, the capacity is, therefore, known also. Again, if we have any oscillation transformer, we can join up the primary and secondary circuits, so as to inductively oppose or aid one another. If we call L and N the inductance of the primary and secondary circuit respectively and M their mutual inductance, the effective inductances L_1 and L_2 of the two circuits joined in the two ways are respectively given by $L_1 = L + 2M + N$; $L_2 = L - 2M + N$. Hence we have $M = L_1 - L_2/4$ and $L + N = L_1 - L_2/2$. If, then, either L or N is separately measured, and if the resultant inductance of the compound circuit is measured, we can find the coefficient of coupling $M/\sqrt{LN}$ of the oscillation transformer. The inductance of any circuit can be ascertained for the high-frequency currents by the cymometer in the following manner: the circuit to be tested is joined up in series with a known capacity, and the rectangular circuit is provided with the instrument. Two measurements are then made: (1) when the inductance to be tested is included in the circuit, and (2) when excluded from it. If the observed oscillation constants under the two conditions are called O_1O_2, then we have the following expression for the unknown inductance: $L' = O_1^2 - O_2^2/C$. The instrument can also be used for measuring the oscillation constant or the frequency in an open oscillating circuit, such as that of a wireless telegraph aerial, and by means of it the wave-length which is being sent out from the aerial can be measured, and also the wave-length of waves being received on any aerial. The instrument can also be employed to analyze a compound oscillation taking place in a circuit and determine the component frequencies. It thus acts as an electrical equivalent of a spectroscope.

Direct-Reading Resistance Thermometers.

At the meeting of the Physical Society, of London, held March 10, Dr. R. T. Glazebrook, past-president, in the chair, a paper "On Direct-Reading Resistance Thermometers, with a Note on Composite Thermocouples," was read by Mr. A. Campbell. The paper describes two methods by which the reading of a resistance box in connection with a platinum resistance thermometer gives directly the actual temperature without the use of any formula or table. In the first method the variable resistance in the measuring arm of the Wheatstone bridge is shunted by a suitable resistance. When this shunt has the proper value, the change of resistance in the measuring arm necessary to give a balance is proportional to the change of temperature of the platinum to a good degree of accuracy up to 1,000 degrees centigrade. A more exact method (that of the "rectifying loop") is somewhat similar. In it the measuring arm consists of a closed loop of resistance, one end of the arm being a fixed point on the loop, while the other end is a slide which can be moved along the loop. The total resistance of the arm is connected by a simple parabolic law with the excess X of the slider reading over a zero reading. Thus $R = A + BX + CX^2$. The author shows how the resistance of the loop and the zero reading may be calculated so as to make this parabolic formula identical with that giving the temperature resistance variation of any specimen of platinum. When the resistances have these values, the reading X will be proportional to the temperature (centigrade) of the platinum.

In an appendix the author points out that for measuring small temperature difference up to 100 degrees or 150 degrees, the most useful thermocouples are iron-nickel or iron-constantan. The voltages given by these are nearly, but not quite, proportional to the differences of temperature. In order to make the proportionality more exact, he proposes to use a "composite" (triple) junction by putting in parallel with one of the usual wires a wire of a third metal (*e. g.*, copper); by adjusting the relative resistance of the branches of this parallel circuit, the temperature voltage curve of the combination can be practically rectified.

Mr. W. Duddell said that by putting a constant resistance in series with the rectifying loop, it would be possible to simplify the mathematical processes involved in the method.

Professor Callendar thought the rectifying loop method of reducing the direct readings to the gas scale would be useful in practical work, especially at high temperatures, but for the most accurate scientific work at moderate temperatures the corrections would be too complicated, and trouble would be saved by adopting the ordinary method. It was most important in practice to secure accurate compensation of the leads which could be ensured in a satisfactory manner only by making the leads and the ratio arms equal. Neither the loop method, nor the three-lead arrangement subsequently proposed by the author, could be used with a bridge-wire, as both involved plug or sliding contacts of negligible resistance. The three-lead arrangement also precluded the possibility of making an insulation test of the leads at any time. With regard to composite thermocouples, he did not think the arrangement would be useful except for very moderate ranges of temperature.

The chairman pointed out that for the most accurate work it was advisable to work with the simplest possible form of apparatus and to apply the necessary corrections at the end. The constantan wires referred to by Mr. Campbell had been tested over a large range of temperature, and it had been found that a constantan-iron couple gave a linear formula.

Mr. Campbell, in reply, said it would be possible to arrange the rectifying loop with plug contacts instead of sliders; with twenty-five ohms in the measuring arm, sliders could not cause serious error. He had indicated clearly in the paper that when once the ratio of the resistances of the zero reading and the total loop (or the shunt) was found the absolute values of these resistances might be altered in any ratio desired. The bridge could thus have equal or unequal arms at will.

Digitized by Google

Electricity in the Anthracite Coal Mines—II.

The Application of Modern Methods in the Development of a Long-Established Industry.

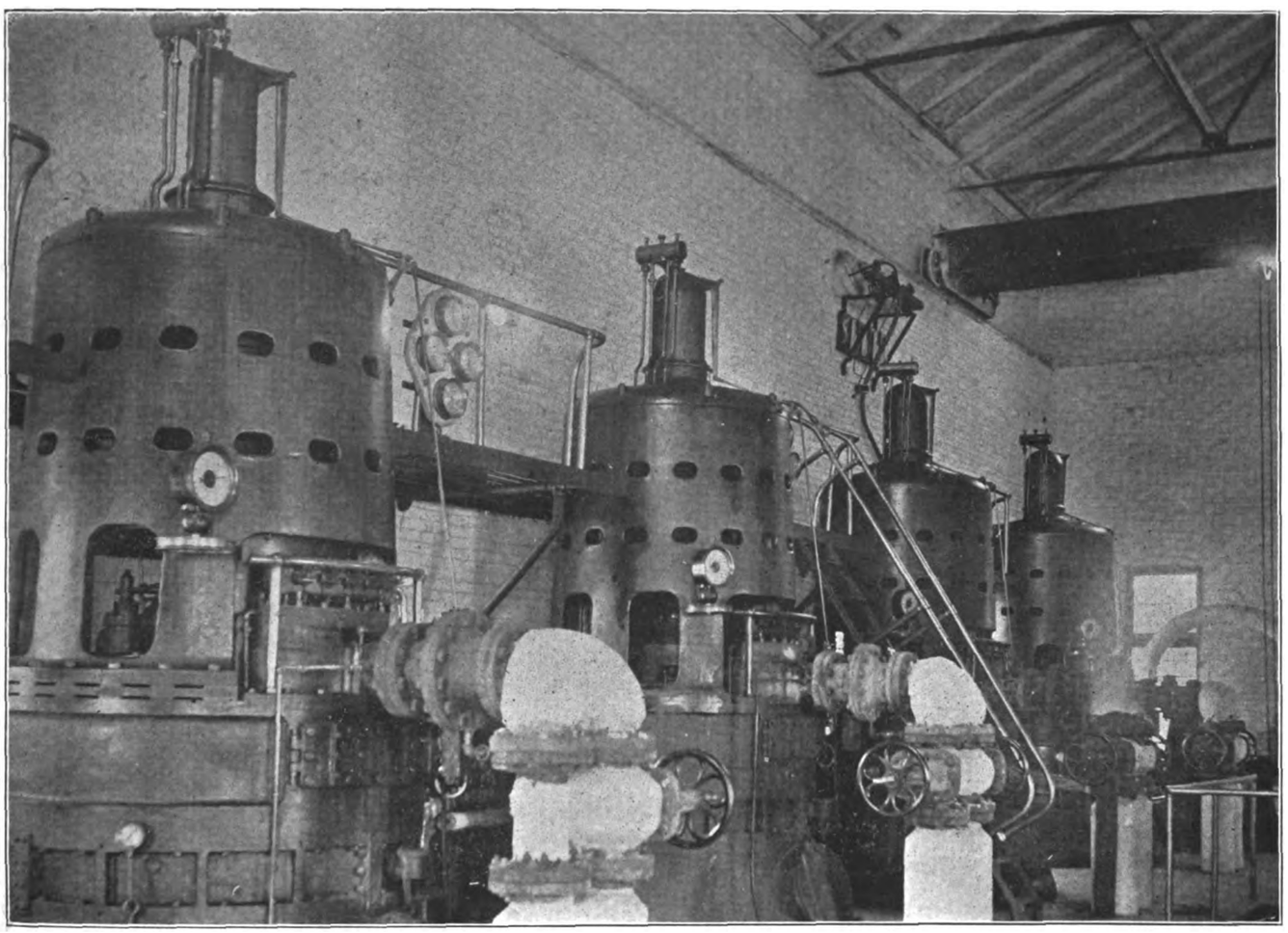
By Robert Thurston Kent.

THE Hampton central power station, which has been erected about two years, generates current for transmission to eight different collieries in the vicinity of Scranton. These are the Bellevue and Dodge, the Brisbin, the Cayuga, the Hyde Park, the Pyne, the Sloan, the Diamond and the Archbald. Of these, the line to the Cayuga colliery is not yet in operation. The voltage on this line is to be higher than on the others, and the transformers to raise the voltage are not yet installed.

The station is located near the Sloan colliery, and consists of two buildings—boiler house and turbine station. The turbine station is built of brick, with a peaked slate roof, and has one main floor and a basement. On the main floor are installed the generating sets, the exciters and the switchboard. In the basement are placed the air pumps for the condensers, the oil pumps for maintaining pressure beneath the step bearings of the turbines and an oil switch for a heavy-current line. The transformers for the Cayuga line will eventually be placed in the basement also.

The generating units are four 500-horse-power Curtis turbines, each direct-connected to an alternating-current generator. The turbines run at 1,800 revolutions per minute with steam at a pressure of 150 pounds per square inch, superheated 200 degrees Fahrenheit. The generators are three-phase, sixty-cycle, 126-ampere machines generating current at 2,300 volts. This is the voltage used on all the transmission lines except the Cayuga, no transformers being interposed between the generator and the line. These machines are placed in a row along one wall of the building.

The field current is supplied by two fifty-kilowatt, 125-volt direct-current generators which are each direct-connected to a McEwen engine running at 280 revolutions per minute. The exciters are placed at one end of the building, one on each side. They run with saturated steam at 150 pounds per square inch pressure. Each exciter furnishes field current for two alternators.



CURTIS TURBINES IN HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

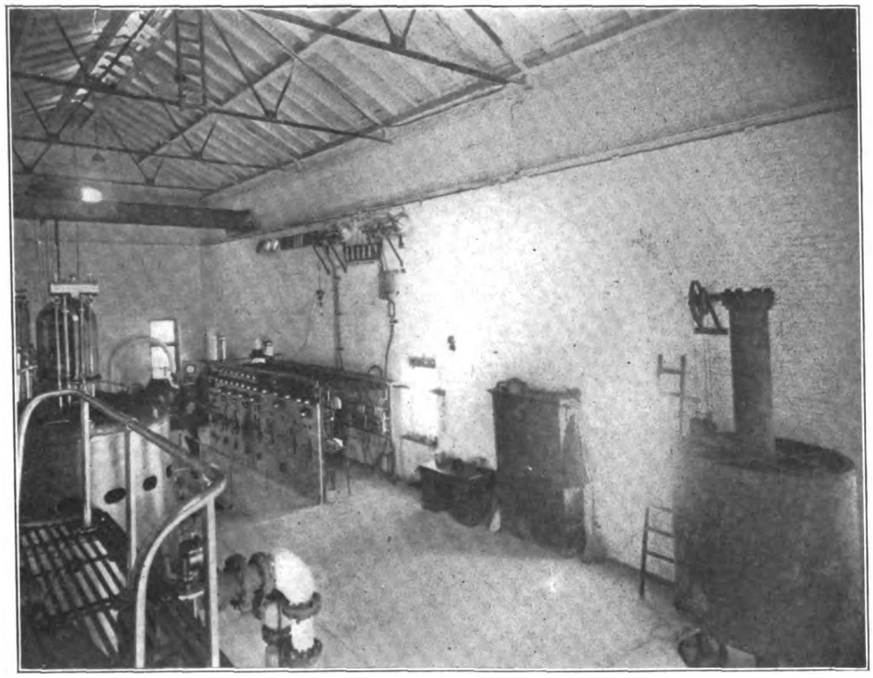
Outside the building and directly behind the turbines are four Worthington barometric condensers, one connected to each turbine. The turbines exhaust to these through a tee. The exhaust steam enters at the side, and the condensing water at the top of the tee. The condensed steam and the water fall through the condenser tube to the basement, where they are removed by an air pump. There are two of these air pumps, each taking care of two condensers. The pumps are

Digitized by Google

Worthington make, and the cylinders are ten by eighteen by eighteen inches. A vacuum of about twenty-eight inches is maintained.

The condensing water is at present supplied by a steam pump which lifts the water from a stream a few hundred feet distant and pumps it to the station. This arrangement, however, is only temporary, and will be replaced by a gravity supply when the water hoist now building is completed. This water hoist will be described later.

Each turbine is supplied with a gray marble gauge board, on which are mounted four gauges. These gauges show, respectively, steam pressure, first stage of vacuum, full vacuum and the pressure underneath the step bearing. The boards are mounted beside each turbine on the railing of a gallery which runs along the top of the machines.



INTERIOR OF HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

Steam is brought into the building from the boiler house by two lines. One of these lines takes saturated steam from the steam drums of the boilers. The other receives it from the superheaters. Branches run from each of the two lines to each of the turbines, being united at the nozzle. Stop valves are placed in each branch, so that they may be cut out in case of accident, and the turbine run on saturated or superheated steam, as the case may be.

The steam lines enter the station through the basement, and were originally supported on brick piers. Owing to the settling of these piers and to vibrations in the lines, there was danger of the pipes being ruptured. The piers were accordingly cut down, and heavy helical springs carrying a chair were placed between the top of the pier and the pipe, the pipe being supported in the chair. This method of support has proved eminently satisfactory, and no trouble whatever has been encountered with the lines or supports.

A pressure of 300 pounds per square inch is maintained underneath the step bearing by means of an oil accumulator and two oil pumps. The pumps are Worthington duplex outside-packed plunger pumps, with cylinders six by two by six inches. The accumulator is a plunger working within a cylinder. The plunger extends from the basement through the floor to the turbine room, and on its upper end is a large cylindrical weight. Whenever the oil pressure falls, the weight and plunger descend, tending to raise the pressure. The throttle valves of the pumps are connected to the accumulator and plunger by means of chains with weights on the ends. The chains are wrapped around pulleys on the valve stem, and open the valves whenever the plunger descends, thus starting the pumps and raising the pressure. As the pressure is restored, the plunger rises, closing the throttle valves, and either slowing down or stopping the pumps. Should the pumps become disabled, the accumulator will keep the pressure at 300 pounds per square inch for five minutes with all four turbines in operation, and for twenty minutes if only one turbine is running.

The steam-driven oil pumps have replaced pumps which were driven by electric motors. These were installed when the station was first put in operation. The motors were of the direct-current type, and current was furnished for them by the exciter units. The exciter engines, being run with saturated steam, would slow down whenever the steam pressure dropped, and the voltage was thus lowered. The pump motors would slow down, and the oil pressure would fall, so that the turbines suffered in consequence. Since the installation of the steam-driven pumps no trouble from this cause has been experienced.

The oil coming from the turbines is run first through a filter to remove impurities, and then through a separator, which frees it from water. The filter and separator were built by the Hendricks Manufacturing Company, of Carbondale, Pa.

The switchboard is installed on the opposite side of the station from the turbines, and faces them. It consists of seven panels of gray marble. One panel is for the exciter units, and carries an 800-ampere Thomson astatic ammeter for each machine and one 175-volt Thomson astatic voltmeter. A plug switch allows throwing the voltmeter on either unit. There are also placed on the panel two three-pole, single-throw switches for connecting the exciters to the alternators' field bus-bars, and three single-throw, double-pole switches for the station lights, which are run from the exciters. The rheostats for the exciters are placed on the back of the panel, and their hand wheels project through to the front.

There are four alternating-current generator panels, one for each machine. Each panel carries two 600-watt Thomson indicating wattmeters and two Thomson astatic ammeters registering, respectively, to 100 and 250 amperes. There are also on each panel a 175-volt Thomson voltmeter, which is used with a multiplier of twenty, and a single-throw, double-pole switch for the field current. An oil switch is mounted on the back of the panel for the generator current, and a relay on the front of the panel will throw the switch in case of a short-circuit or heavy overload. The field rheostats for the alternators are located in the basement. They are worked by means of a hand wheel on the panel, which is joined to the rheostat by a chain and sprocket wheels.

Three output panels take care of the

Digitized by Google

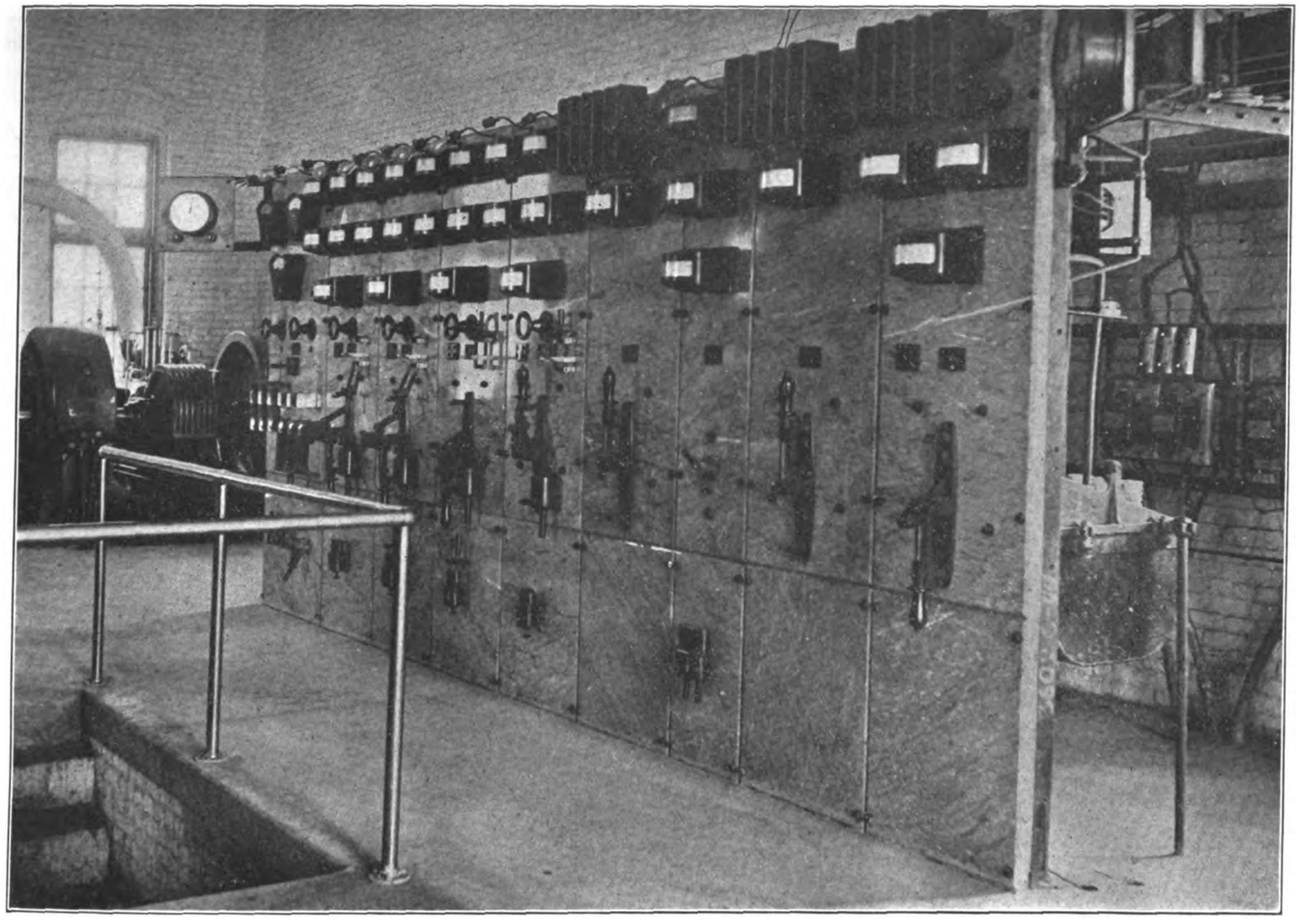
current going to the substations. These panels each carry a 250-ampere Thomson ammeter and an oil switch on the back. There is also a relay on each panel for throwing the switches in case of overload.

There is also one panel for the current going to the water hoist heretofore mentioned. As about 1,500 kilowatts at eighty-five per cent power-factor and 2,300 volts are to be transmitted, the current will be very heavy, and it was considered best to place the oil switch in the basement, and break each line in a separate compartment. Accordingly, an electrically operated switch was placed in the basement, with each line in separate compartments, with a slate floor and a four-inch brick wall between. The switch is thrown from the switchboard. The leads are encased in lead cables, and run up the sides of the building to the roof, where they are taken out.

In addition to the other instruments, each output panel carries an integrating wattmeter on the back. A synchronizer and ground detector complete the switchboard equipment. The transformers for the various measuring and indicating instruments are placed on the wall directly behind the various panels on which the instruments are carried.

A twelve-ton traveling hand crane completes the station equipment.

The leads are taken from the building through sewer pipes set in the wall directly under the eaves, and pointing downward to the outside at an angle of about thirty degrees. In the bell end of the pipe a heavy circular glass plate is inserted, and the wire is carried through a hole in the centre of this plate. Considerable trouble, however, has been experienced by the glass plate working loose, and falling out, and it is probable that the method used at the Bellevue substation will hereafter be adopted.



SWITCHBOARD AT HAMPTON CENTRAL POWER STATION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The boiler house is located about twenty-five feet distant from the turbine station, and is a brick and frame building. The boiler equipment consists of fifteen 300-horse-power Babcock & Wilcox boilers operating at 125 pounds pressure. The boilers are fitted with McClave stokers, which are driven by a slide-valve engine which is geared to a countershaft running the length of the building. The stoker shafts are connected to the countershaft by means of chain belting.

Feed water is passed to the boilers by two Epping-Carpenter compound duplex feed pumps with steam cylinders ten and twenty inches diameter by eighteen inches stroke, and with water cylinders ten by eighteen inches. Before entering the boiler the water passes through a Green economizer. Each boiler is fitted with a Babcock & Wilcox superheater which will superheat the steam 200 to 235 degrees Fahrenheit. Steam is taken from the drum of each boiler through an eight-inch nozzle to a header which runs the length of the boilers. This header branches into a number of lines, one line going to the turbine station, and the others to various collieries in the vicinity. Some of these lines are nearly 2,000 feet long. Another line from the superheaters carries steam to the turbines only.

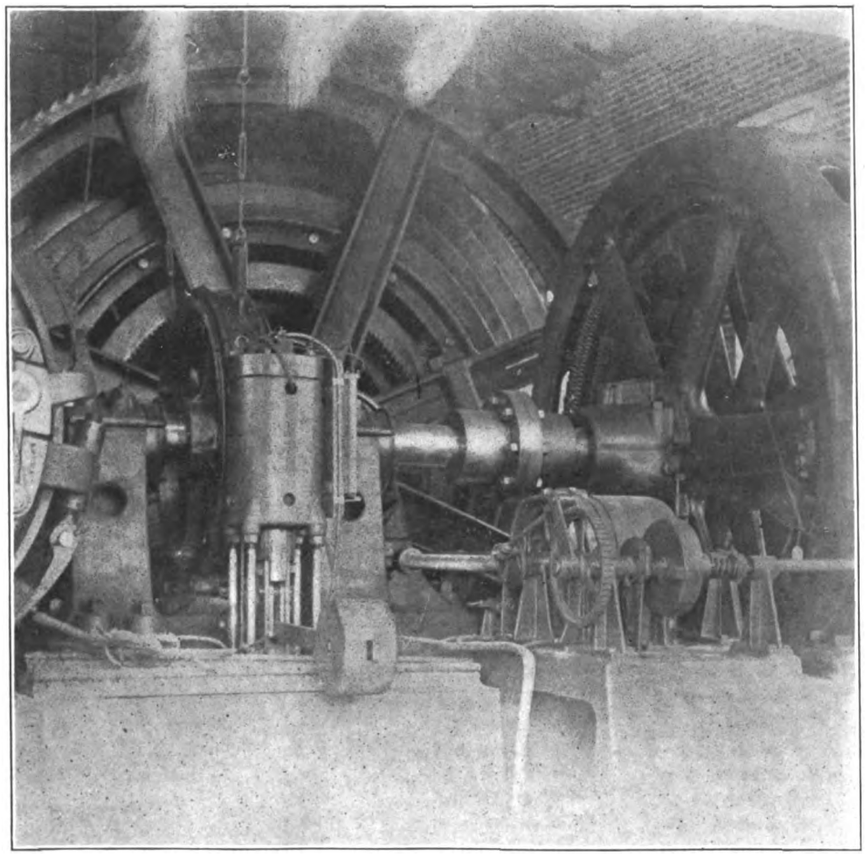
A combination system of forced and induced draught is used. Two sets of fans, driven by steam engines, are installed, one delivering air into the ash-pit of the boilers, and the other into the stack just beyond the economizer. The pressure of the air delivered into the ash-

Digitized by Google

pit furnishes just sufficient draught to force the air through the fire, and to carry the gases of combustion through the economizer, and any regulating of the draught is generally done by means of the fans delivering air into the stack.

Coal is brought to the boiler house in railroad cars which are run on a trestle in the boiler room. The coal is dumped into an overhead storage bin below the trestle, and is spouted from this bin directly to the stoker hoppers.

The ashes are removed by flushing them from the ash-pits with water, and the mixture is forced through a bore hole into the mine. The ashes are then used for filling up the abandoned workings.



Motor and Winding Drums for Water Hoist, Hampton Central Power Station, Delaware, Lackawanna & Western Railroad.

The water hoist heretofore mentioned is located about 500 feet from the power station. A shaft about 460 feet deep has been driven and all the mines in the vicinity will drain to it. Water will be hoisted from this shaft by means of two buckets suspended from a hoist tower over the shaft. Around the base of the tower has been built a concrete basin, into which the buckets will be dumped. The water will be piped from this basin to the boiler and turbine station, where such of it as is needed for condensing and other purposes will be utilized. The remainder will be carried on down the hill, and discharged into the Lackawanna river.

The hoist tower is ninety-three feet from the base to the centre of the sheave at the top. It is built of structural steel, roughly in the shape of an A. From the tower are suspended two buckets six feet in diameter and nineteen feet six inches deep. The capacity of each bucket is seventeen tons of water. In the bottom of the bucket are located two lift gates with an area practically equal to the cross-section of the bucket. These gates are lifted automatically when the bucket reaches the top, and the water is discharged through the bottom into a spout fitted below the bucket, and which deflects it to either side of the shaft. Each bucket makes a complete round-trip in one minute and fifty-five seconds, the total lift being 555 feet.

The buckets are raised and lowered by means of an 800-horse-power induction motor running at a constant speed of 400 revolutions per minute, driving a pair of drums on which the cables from the buckets are wound. These drums are conical, in order to obtain a slow starting speed. The two diameters of the drum are sixteen feet and ten feet. The motor is set at right angles to the drums, and motion is transmitted to the latter through a friction clutch and bevel gearing. Band brakes are placed at a number of different points, in order to make a quick stop if necessary.

The substation located at Bellevue colliery is not typical of those installed at the other collieries, in that it has an engine and generator. A typical substation is that at the Sloan mine, a short distance from the Hampton station. This station is built of brick, one story high, and is about fifteen feet square. It immediately adjoins the engine house containing the engines used for operating the cages in the mine shaft.

The equipment of the station consists of a 200-kilowatt rotary converter running at 900 revolutions per minute, by means of which alternating current at sixty cycles and 104 volts is converted to direct current at 275 volts. The current is stepped down to 104 volts from 2,200-line voltage by means of three seventy-five-kilowatt, type H, oil-cooled transformers built by the General Electric Company.

The switchboard in the substation has two panels, one for the alternating-current end, the other for the direct-current end of the rotary. The alternating-current panel carries three blow-out fuses, a power-factor indicator, a Thomson ammeter and an oil switch. The direct-current panel carries an overload circuit-breaker, a 1,500-ampere ammeter, a rheostat, a single-pole, single-throw switch, and a 600-volt voltmeter. The wires are carried into the station in the same manner as they are led out of the central power station.

All rotary converters of 300 kilowatts capacity and over are used with six-phase current. This is done in order to obtain a smaller unit for the same horse-power, and the phase is changed from three to six in all cases by means of transformers.

The Nanticoke Power Plant—The new Nanticoke power station is located between Nanticoke and Wilkesbarre, and is about three miles distant from the latter place. It is on the bank of the Susquehanna river, on the Wilkesbarre side. This station will represent the latest and best practice in the application of electric power to coal mining. It will also be the first use of induction motors in the mine and breaker. Power will be transmitted to four collieries, which are from two to four miles distant.

The power station consists of two buildings immediately adjoining one another. One of these is the boiler plant, and the other the tur-

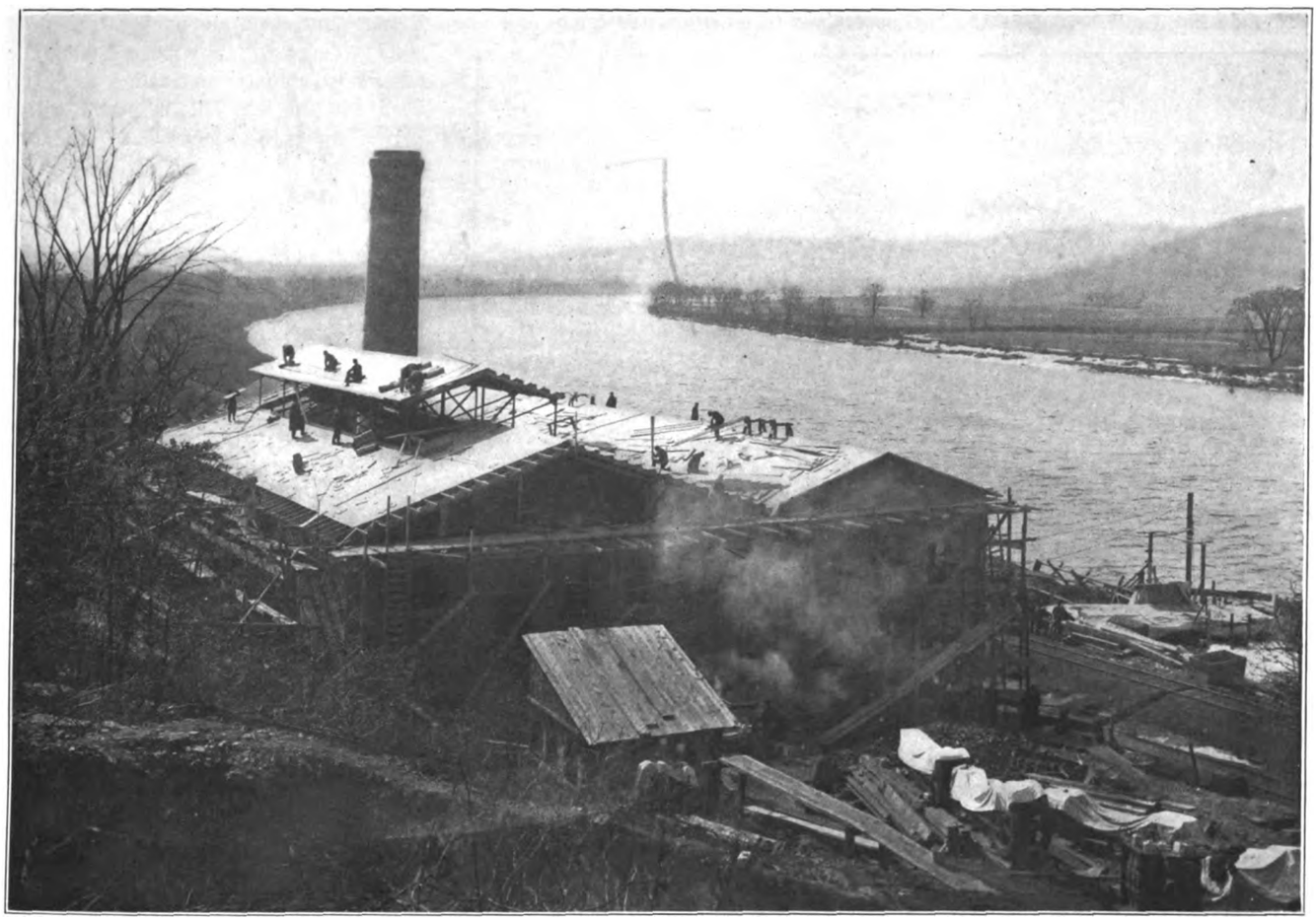
Digitized by Google

bine house. The floor of the boiler house is about five feet above that of the turbine station, while that of the turbine station is about twenty-two feet above low water in the river. The turbine station is located on the side nearest the river. The present equipment will be three 500-kilowatt Curtis turbines, which will operate with steam under a pressure of 150 pounds per square inch and a superheat of 200 degrees. Each turbine is to be direct-connected to a revolving-field, three-phase, sixty-cycle, 4,150-volt alternator, connected on the four-wire system. to the various collieries without transformers at a voltage of 4,150.

The boiler equipment consists of three 303-horse-power Babcock & Wilcox boilers, each boiler fitted with a Babcock & Wilcox superheater. The boilers are to be hand-fired and will have Parsons stationary pin-hole grate bars. The furnaces are designed to burn refuse from the mine of a size not larger than barley.

The station has a Custodis brick stack seven feet in diameter by seven feet high. This will not be depended upon room. It will be brought in to the boiler room by a scraper conveyer, which makes a right-angled turn near the track and delivers the coal on the boiler-room floor.

The ashes are to be removed by means of a small crane. This crane runs on an I-beam suspended along the front of the boilers. It is equipped with a small Sprague direct-current motor, which causes it to travel along the I-beam in the boiler room and along a track built outside, and which is carried to any point at which it may be desired to dump the ashes. Another small motor is used for



NANTICOKE POWER STATION UNDER CONSTRUCTION, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

Although but three of the turbines are to be installed at present, the station has been designed for an ultimate equipment of five.

The auxiliary apparatus installed in the turbine station will consist of a steam pump for oil circulation for the step bearings of the turbines, and two exciter units. The exciters are seventy-five-kilowatt, 125-volt, direct-current machines. One exciter is to be driven by a seventy-five-kilowatt Curtis turbine, and the other by a seventy-five-kilowatt, 440-volt induction motor. Current will be transmitted for draught however, the draught being furnished on the Parsons system. The station has been designed to allow five boilers to be eventually installed.

Feed water will be furnished by two Knowles duplex horizontal pumps, each one of which is large enough to supply all the boilers. Water is passed through a Cochrane feed-water heater before entering the boilers.

Coal will be brought to the station from the mines by a branch of the Lackawanna Railroad, and dumped at the back some 200 feet away from the boiler raising and lowering the bucket in which the ashes are carried. When it is desired to remove ashes the bucket is lowered to the floor and placed immediately under the fire-doors. The ashes are then drawn into the bucket from the furnace with a hoe, and the bucket is then raised by means of the motor. By throwing a switch the travel motor carries the bucket outside, where it is automatically dumped by a trip. As soon as the ashes are emptied from the bucket the travel motor is automatically reversed, and the carriage is returned to

Digitized by Google

a point just outside the boiler room, where it stops.

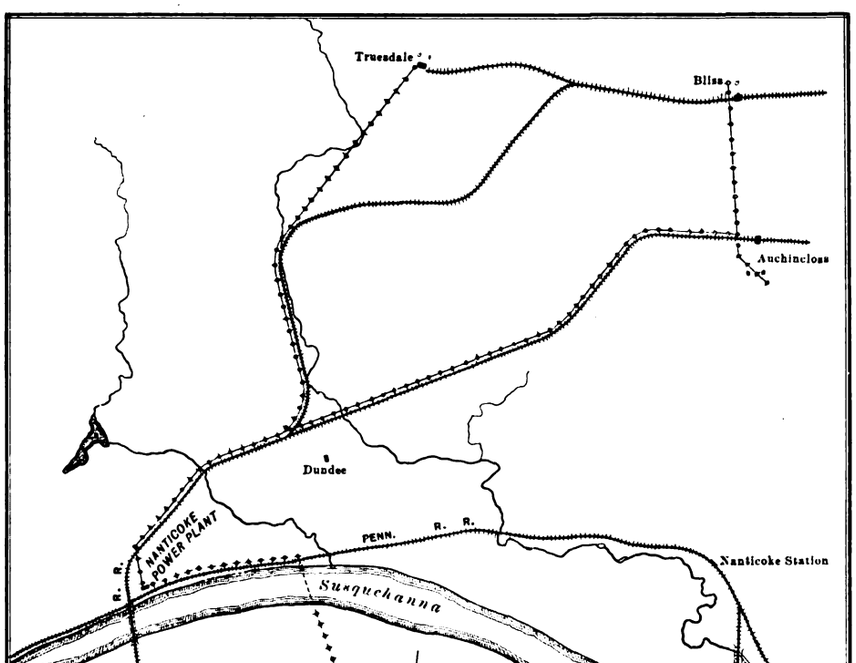
The condensers are to be Worthington surface condensers, one for each turbine. The condensed water is pumped by motor-driven centrifugal pumps into the heater, and thence into the boiler.

The condensing water will be obtained from the river by means of a tunnel which is driven from the river about ten feet below low water mark to a shaft in the station. There is a partition in this tunnel, the cold water going on one side, and the hot water on the other. At the river end of the tunnel walls are built to deflect the hot water away from the entering water, so as not to raise the temperature of the latter. The water will be elevated to the condensers by three vertical-shaft Worthington centrifugal pumps. The pumps are to be driven, respectively, by thirty, sixty and ninety-horse-power General Electric induction motors. Eventually the full output of the pumps will be 10,000 gallons per minute. In addition to condensing water, make-up water for the boilers will be taken from the tunnel.

In the vertical shaft driven down to the tunnel there is a vertical steam pump built by the Scranton Steam Pump Company, which is to be used for feeding the boilers whenever the condensers are stopped.

The power generated at this station is to be transmitted to the following collieries: the Auchincloss, the Bliss, the Truesdale and the Avondale. At the Auchincloss colliery the shaft is seventeen hundred feet deep. The high-tension wires will run directly down the main shaft to the motors. In this mine the veins are at an angle of about forty-five degrees, and the loaded cars will be hauled up this incline by means of hoists, driven by induction motors. The hoists are close together in this mine, and one bank of transformers will be used for all the motors. There will be three 200-kilowatt transformers, stepping down the line voltage to 240 volts for the motors. In addition to the hoists, induction motors will also be used in the mine to drive a drainage pump. This will be a two-stage centrifugal pump with a capacity of 700 gallons per minute, against a 190-foot lift. It will be driven by a fifty-horse-power, 440-volt induction motor.

In the breaker there will be installed a fifty-horse-power, 500-volt, direct-current motor operating a car hoist, and thirteen other motors operating at 275 volts, and used for various purposes. Current is supplied to these by a rotary converter, and three 110-kilowatt transformers.



MAP SHOWING LOCATION OF THE NANTICOKE CENTRAL STATION AND COLLIERIES SUPPLIED, DELAWARE, LACKAWANNA & WESTERN RAILROAD.

The Bliss colliery will have installed a 300-kilowatt rotary converter furnishing direct current on the two-wire system of 550 volts. This converter is to be used in connection with two direct-current generators which are already installed. This direct current will be used to operate two hoists in the mine, as well as six locomotives at present installed and some additional ones which are to be purchased.

Inside the mine there will be a hoist driven by a 200-horse-power General Electric induction motor operating at 440 volts. There will also be a 1,000-gallon centrifugal pump operating against a head of 100 feet. This pump will be driven by a forty-horse-power induction motor, and will be used to pump a mixture of water and culm to the culm bank. The voltage will be stepped down for this motor by means of three fifteen-kilowatt transformers installed in the mine.

The breaker at the Truesdale colliery is new. There will be a substation there containing a 200-kilowatt rotary converter furnishing direct current at 275 volts. The line current will be stepped down by means of three seventy-five-kilowatt oil-cooled transformers. There will also be three 250-kilowatt transformers, stepping down to 440 volts for operating the induction motors in the breaker. When the breaker is fully equipped there will be over fifty induction motors installed. Inside the mine there will be a six-stage, 700-gallon centrifugal drainage pump working against a head of 600 feet. This pump will be driven by a 150-horse-power induction motor. Three fifty-kilowatt transformers will be installed in the mine for this motor.

At the Avondale colliery a substation is proposed. At this colliery there is at present a 200-kilowatt, 275-volt generator. The substation will contain a 300-kilowatt, 550-volt rotary converter running on the three-wire system. There is to be installed a 500-volt, 100-horse-power motor, driving a vertical-shaft centrifugal pump with a capacity of 2,500 gallons per minute against a ninety-foot lift.

The transmission lines will be carried from the power plant to the various collieries on pole-lines following the routes shown on the accompanying map. The lines to the Truesdale, Bliss and Auchincloss collieries will be ordinary pole-lines. That to the Avondale colliery will be a pole-line up to the point where it crosses the river. From the river to the colliery the line will be carried on three or four tall steel towers.

At the Bliss colliery the generators are installed on the three-wire system, the

Digitized by Google

outside wire being grounded. The three-wire system is made necessary by the fact that the motors in the mine are operated at one voltage, and the locomotives at another.

The unusual feature in the collieries operated from the Nanticoke station is the use of induction motors in the mine. The use of these was decided upon on account of the economy of copper. The shafts in some cases are 1,700 feet deep, and the motors are often located 3,000 to 4,000 feet away from the base of the shaft. By carrying the high-tension lines down the shaft and into the mine, and installing transformers at the motor, the wires are much smaller than would be the case if the alternating current was converted on the surface and direct current carried to the motors in the mine. Another feature of the use of the induction motor in the mine is the absence of sparking. This will permit its use in a gaseous portion of the mine where the use of a direct-current motor with a sparking commutator might be dangerous. This is a minor feature, however, as the engineers of the company state that the high-tension wires might easily be broken by the falling of the roof of the mine, thus causing a spark which would ignite any gases present.

It will be noted that the voltage at which current is transmitted from the Nanticoke station is about twice that at which it is transmitted from the Hampton station. All the transformers have been so wound that, at any time, they can be used at the higher voltage, so that eventually current can be obtained from either station, or the equipment made uniform in the generating stations if desired.

The extent to which the Delaware, Lackawanna & Western Railroad Company has adopted electricity in its collieries is shown by the following summary of electrical machinery installed: at eighteen stations and collieries there are installed a total of twenty-two generators, with a combined capacity of 4,498 kilowatts. There are five rotary converters with a combined capacity of 850 kilowatts. The company operates or has ordered fifty-six electric locomotives of various horse-power, the total horse-power being 3,950. In the different mines there are installed twenty-one electrically operated hoists, operated by twenty-eight motors with a total capacity of 1,915 horse-power. There are twenty-three motor-driven pumps, the motors having a capacity of 1,571 horse-power. In addition to this machinery there are installed twenty-four other motors for miscellaneous uses, having a total capacity of 318 horse-power.

The use of electricity in this industry has proved so successful that its further extension will probably be rapid. This is shown by the improvements which the Lackawanna company is making, and also by the installation of electricity in the mines of companies which heretofore have used other motive power, such as compressed air, steam, or animal power.

Seventh General Meeting of the American Electrochemical Society.

The seventh general meeting of the American Electrochemical Society will be held at Boston and Cambridge, Mass., Tuesday, Wednesday and Thursday, April 25, 26 and 27, 1905. The programme announced is as follows:

Tuesday, 9.30 A. M., session of the society in Room 6, Lowell Building, Massachusetts Institute of Technology; 1 P. M., reception by President Pritchett at the Technology Club, followed by lunch tendered by the Institute of Technology; 2 P. M., excursion to the General Electric Company's plant at Lynn; 8 P. M., presidential address at the Lowell Building, followed by a smoker at the Hotel Lenox.

Wednesday, 9.30 A. M., session of the society at Harvard University, Pierce Hall; 1 P. M., reception, followed by lunch tendered by Harvard University; 2 P. M., a visit to Harvard buildings or excursion to the New England Gas and Coke Company, at Everett; 7.30 P. M., banquet for members and ladies at Hotel Lenox.

Thursday, 9.30 A. M., session of the society at the Lowell Building; 1 P. M., lunch at the Technology Club; 2 P. M., afternoon session of the society at the Lowell Building, or inspection of the Institute Technology buildings.

The following titles of papers are announced:

"On the Heat of Solution of Aluminum Bromide in Ethyl Bromide," Professor H. E. Patten.

"The Interdependence of Atomic Weights and Electrochemical Equivalents," Professor A. Reuterdahl.

"An Optical Method of Observing a Diffusion in an Electrolyte," C. Hambuechen.

"The Microstructure of Silicon and Silicon Alloys," A. B. Albro.

"Specific Inductive Capacities," Dr. L. Kahlenberg.

"The Rotating Diaphragm," Dr. W. D. Bancroft.

"Notes on Economic Temperatures of Copper Refining Solutions," Professor C. F. Burgess.

"Electrolytic Precipitation of Chromium," Professor H. R. Carveth.

"Conduction in Electrolytes," Dr. J. W. Richards.

"Adherence of Nickel to Nickel," R. C. Snowdon.

"Electrodeposition of Silver," R. C. Snowdon.

"Treating Low Grade Ore and Tailings by Electrolysis," Ernest Fahrig.

"Some Experiments with the Reduction of Titaniferous Ores into Steel and Titanate of Iron," A. Lodyguine.

"Experiments with the Reduction of Different Oxides of Lead by Electric Current," A. Lodyguine.

"Some Results of Experiments with the Electrodeposition of Metals on Aluminum," A. Lodyguine.

"Billitzer's Method of Determining Absolute Potentials," Dr. H. M. Goodwin.

"On the Utilization of Blast Furnace Gases in Connection with Electric Smelting," A. J. Rossi.

"A Low Voltage Standard Cell," Professor G. A. Hulett.

"A Diaphragm Cell for Electrolysis of Brine," C. P. Townsend.

"Colloids," Dr. W. R. Whitney.

"Electric Arcs," Dr. W. R. Whitney.

"Mercury Arc," Dr. E. Winetraub.

"Reversible and Irreversible Polarization," Professor W. S. Franklin.

"An Electric Switch," William Smith Horry.

"Electrostatic Method for Separating and Concentrating Ores," Professor Lucien Ira Blake.

"The Aluminum Electrolytic Condenser," C. J. Zimmerman.

"Metallic Thorium," Professor Charles Baskerville and Fritz Zerban.

The headquarters will be at the Hotel Lenox, Boylston and Exeter streets, Boston.

The Manufacture of Concrete Blocks and Their Use in Building Construction.

The Engineering News Publishing Company, 220 Broadway, New York city, announces the offer of $350 in prizes for the best papers on "The Manufacture of Concrete Blocks and Their Use in Building Construction." The author whose paper is judged to be the best will receive a prize of $250. The author whose paper is second in rank will receive a prize of $100. From the whole number of manuscripts offered, the five best will be selected for submission to a jury consisting of Messrs. Robert W. Leslie, past-president of the American Cement Manufacturers' Association; Richard L. Humphrey, president of the Cement Users' Association, and Professor Edgar L. Marburg, secretary of the American Society of Testing Materials.

Digitized by Google

A FIELD FOR THE ILLUMINATING ENGINEER.

BY L. B. MARKS.

Although much progress has been made in recent years in the development of various types of electric lamps, the art of electric lighting in so far as this art applies to the proper amount and distribution of light for the illumination of interiors has not kept pace with the development of the lamps themselves.

The electrical engineer may be skilled in designing electric light plants, but when it comes to laying out the detailed lighting scheme of a house, he is apt to fall short for the reason that his training does not, as a rule, qualify him to obtain the best results in this particular field. As a matter of fact it is often the architect, rather than the electrical engineer, who decides the lighting problem and prescribes the location of outlets for lamps. Sometimes the decorator may be called upon to arrange the lighting scheme, and even the fixture manufacturer often has a hand in the matter. Lastly, the owner himself may suggest certain arrangements which though ridiculously extravagant are carried out because no one in particular has direct charge of the whole question of illumination.

This condition of affairs accounts for the glaring defects in lighting which are noticeable in most residences at the present time. In some cases the outlets for the lamps are improperly placed; in others where the outlets are correctly located, the number of lamps on the individual outlets is either too large or too small. In still others, where both of the above conditions are properly complied with, the intrinsic illumination of the lamps themselves may be entirely too great. This last defect is the most common of all. Unshaded or inadequately shaded lamps, hung low in the rooms, are the rule rather than the exception. Lights so hung are exceedingly trying on the eyes and are directly responsible for many a case of nervous headache arising from irritation of the eyes.

On the other hand, one often sees just the other extreme, that is to say, lamps so densely shaded that only a very small percentage of the light is useful. Sometimes this shading is done for æsthetic reasons, but in many cases it is done at the cost of both art and illumination.

The amount and character of the illumination must naturally depend upon the use to which the light is to be put. In a parlor, for instance, a moderate degree of light, well diffused, is usually the desideratum. In a library a stronger light is needed for reading purposes; a reading lamp with reflector is generally the most economical means of securing this strong light, but other illumination should always be superimposed in the room in such a case. In a dining room the illumination of the table is, of course, paramount, but here, as in the last case, the light should not be concentrated on the table to the exclusion of the rest of the room; the whole room should be moderately well lighted. The same general rule holds for the billiard room also. If the billiard table alone be brilliantly illuminated by localized light, as is often the case, the eye tires much quicker than if there be also a good general illumination throughout the room.

The value of diffused light is frequently overlooked or underestimated in planning the lighting scheme of a house. Even in cases where economy of lighting is an object, the laws of diffusion and reflection are often entirely ignored with the result that a great many more lamps than would otherwise be necessary are required in order to produce the needed illumination.

On the other hand, there are many cases in which the number of lamps installed is far greater than is required to give the necessary light. The electrical engineer or the architect, or whoever may be responsible for the lighting arrangements, often provides a large excess of lamps so as to be sure there will be enough. In so doing he takes no cognizance of the fact that when current is supplied by the lighting company, the average charge per lamp for lighting may be smaller or larger depending upon the number of lamps installed. It is not until the bill for current is received that the user realizes that his lighting arrangements are extravagant. He then learns that the charge for lighting per kilowatt-hour is based upon the number (or equivalent number) of hours his total lamp equipment is in use, and that the more current he uses within certain limits, the lower will be the charge per kilowatt-hour. As a matter of fact, however, he finds later that he seldom, if ever, gets the benefit of any reduction in charge, for the reason that in normal lamp service he does not use the equivalent of his total lamp equipment for a sufficient number of hours to obtain any reduction. Obviously, had the original lamp equipment been limited to what was necessary for the proper lighting of the establishment, the cost of lighting would be considerably reduced, to say nothing of the saving in the cost of installation.

It is not at all uncommon to find the total lamp equipment in residences to be at least fifty per cent larger than is actually necessary to give the requisite results so far as satisfactory illumination is concerned. And this statement is true not only of dwellings in which artistic and æsthetic considerations in lighting rather than economy of current are paramount, but also of those in which the decorative feature of the illumination is subordinate and subservient to economy.

In public buildings, art galleries, theatres, churches and large stores, the importance of careful design in the lighting arrangements is even greater than in the dwelling house. Although more attention is now being paid than heretofore in these cases, to the details of electric lighting, one still finds at every hand flagrant violations of some of the elementary principles of scientific illumination.

The question of electric illumination has grown too broad to be properly handled by the electrical engineer as such, or by the architect. The problems that present themselves for solution are numerous, and more or less complex and demand the attention of the specialist in illumination—the illuminating engineer, for whom the field is growing year by year.

Wireless Telegraphy in Canada.

At a recent meeting of the Marconi Wireless Telegraph Company, in London, it was stated that in view of the commercial demand between England and America a new station with the latest improvements had been nearly completed in Canada. With a reduced rate to sixpence (twelve cents) the directors thought two wireless stations would be fully employed during the year. Four stations had been equipped on the St. Lawrence, and a new contract had been entered into with the Canadian company, representing the extension of the organization of the wireless telegraph stations already established to the order of the Canadian government. Five stations also had been equipped at fishing centres along the Labrador coast. When other stations contemplated in Canada had been erected there would be a chain of stations, and they will afford the Newfoundland government direct wireless communication between the Labrador coast and Canada.

Digitized by Google

DRIVING TWO ALTERNATORS IN PARALLEL.

BY R. E. SPENCER GEARE.

Not long ago it was desired to run two alternators in parallel. They were seventy-five and 100-kilowatt machines of 3,300 alternations, and were wired up in such a manner that one was usually overloaded, while the other was running below normal load, and it was desired to synchronize them and thereby make one machine help to take part of the overload of the other; *i. e.*, to make the two act as one unit.

The alternators were belted to a jack-shaft which was driven from a 200-horse-power Corliss engine. The 100-kilowatt machine was driven by a twenty-four-inch belt, whereas the seventy-five-kilowatt machine was driven by a sixteen-inch belt. This would naturally bring in different "slips" to be figured upon.

It had been found impossible to parallel the machines satisfactorily, and upon investigation the synchronizing lamps showed that there was a difference of one and two-thirds revolutions in 550 revolutions per minute between the two. This tended to make one machine take more load than its share, whereas the seventy-five kilowatts should have taken three-sevenths of the load and the 100 kilowatts the remaining four-sevenths.

Right at this point it might be well to call attention to the fact that synchronizing lamps are the only possible means of determining exactly the difference in speed between two alternators. The revolution counter and tachometer are liable to variations from one to two revolutions, and too much dependence can not be placed upon their performance.

It was stated by an electrical inspector that if machines ran within one to one and one-half per cent of the same speeds they would act as gears, figuratively, when thrown in parallel, and the faster machine would tend to pull the slower with it, just as gears would do when meshed. He evidently disregarded the fact that in such a case a "wattless" or "cross-buck" current would be generated by the slower machine, which would make it impossible for the slower machine to take its share of the load, and therefore throw the greater part of the load upon the faster machine. This was the exact state of affairs when the machines were thrown in parallel.

It was desired to get the speeds of the machines exact, a state of affairs shown to be true when the synchronizing lamps remained lighted at the same brilliancy or remained out entirely, or when the synchroscope hand remained stationary. The circumference of the pulley was measured on the jack-shaft which drove the 100-kilowatt generator and the circumference of the pulley on the generator itself. The ratio between these was adopted as a constant. The circumference of the pulley on the jack-shaft which drove the seventy-five-kilowatt generator was measured. From the standard ratio adopted the proper circumference of the pulley on the seventy-five kilowatts was figured. Incidentally the circumference of the pulley in use on the seventy-five-kilowatt machine differed from the correct value by nearly two inches, of course precluding any figuring for slip. A new pulley for the seventy-five-kilowatt generator was ordered, the diameter called for being to the third decimal place. The rim of the pulley was made extra thick. The pulley was furnished as ordered and placed upon the generator.

On comparing the speeds of the machines it was found that there was a difference of one-third of a revolution in 550. This difference represented the loss of speed due to slip in the belts.

It was then a comparatively easy matter to take off a small cut from the thick rim of the new pulley and bring the machines to exactly the same speed. After this they operated in parallel very nicely, each taking its share of the load.

It is a dangerous experiment to figure on the slips beforehand in such a case. There are too many circumstances which enter the question. For instance, the question of belt-dressing, stiffness of belt, and tightness of the belt are things the influence of which can only be guessed at and therefore calculations involving these guesses are only approximate. It is far better to disregard the question of slip at first, where such exact speed regulation is required, and upon afterward determining it, make use of it, as was done in the case of reducing the size of the pulley on the smaller generator.

Commercial Electrical Engineering.

Mr. Charles F. Scott, chief electrician of the Westinghouse Electric and Manufacturing Company, contributed the following interesting editorial to the April number of the *Electric Club Journal*, upon the subject of "Commercial Electrical Engineering":

"'He must understand more about the customer's business than the customer himself, and he must know more as to what the apparatus will do than the designer himself.' Such was the reply of a man who was for a long time connected with the sales department of the electric company, when asked the principal qualifications essential in a commercial engineer. The man himself had handled many negotiations in which the engineering features were of great importance and he had, moreover, been in a position to observe the work of others.

"The engineering work of a large electric company may be divided under two general heads; the first is the design of apparatus and the issuing of specifications and data describing what it will do, the second is the selection and application of the apparatus to specific cases.

"The latter, which may be termed commercial engineering, is sometimes quite a simple matter; in other cases it is of the greatest difficulty and calls for the highest grade of engineering ability. It is not so much a knowledge of the theoretical elements involved in the design of the apparatus, a motor for example, which is needed, as a good practical knowledge of what the motor can do. This practical knowledge needs to be based upon a definite knowledge of what the motor can do on shop test, and upon good judgment—based upon experience—in the selection of a definite motor to meet the requirements under particular conditions which may be uncertain and indefinite and varying in character, an estimate which is very hard to express in amperes or horse-power.

"But why should an electrical engineer or an electrical salesman know the customer's business, too?

"Electrical work is seldom purely electrical. Electricity is simply an agent. It enters into other things as a means of accomplishing results. Hence, it enters into them vitally and intimately. Every department of a railway or a factory which adopts electricity may in one way or another be modified by it. Electrical engineering is related to all other kinds of engineering, steam, hydraulic, pneumatic, mechanical, civil, chemical. In order that the commercial engineer may effectively apply his apparatus and show that it can produce results, he must be thoroughly familiar with the business of which his electrical machinery is to form a part and which perchance it is to modify or revolutionize; hence, the need of a fundamental all-around common-sense knowledge of all kinds of engineering and all kinds of operation. Hence, the education of the engineer should not be a mere collection of facts but a development of engineering faculties. The education of the electrical engineer in college and in the apprenticeship course should lay a foundation in the fundamental principles of different branches of engineering in a training which will enable these general principles and general knowledge to be correctly applied in particular cases. In no branch of engineering is a broad general knowledge and the ability to apply and use such knowledge for specific purposes more necessary than in electrical engineering."

Digitized by Google

Platinum Resources of the United States.

On account of the increased demand for platinum the United States Geological Survey will make an examination of the platinum resources of the United States. It proposes to collect the heavy sands from all placer mines in the United States, where evidence of platinum has been found by preliminary tests. The samples thus obtained will be used in determining the best methods of extracting the various minerals which have economic value. In many places the separation and sale of these useful minerals, such as magnetite, chromite, garnet, monazite, rutile, topaz, zircon, gold, platinum, iridosmine, etc., may become a permanent and profitable industry.

As a preliminary step in this investigation owners of placer deposits are invited to mail to the office of the United States Geological Survey, Washington, D. C., not more than four pounds of material most likely to contain platinum in their placer deposit. This material will be carefully examined and the owners duly notified of the results. It is suggested that the gravel be concentrated as well as possible before mailing, care being taken not to lose any heavy material. There should be noted on the package, or in a letter accompanying it, or both, the total quantity of original gravel which the concentrate represents, in order that a general idea may be obtained of the value of the gravel for the purposes under investigation.

After an examination of these preliminary samples, experts will be sent to all localities where preliminary tests give promise of platinum in profitable quantity. The expert will report on the size of the deposit and superintend the collection of representative samples for concentration. Concentration experiments will probably be carried out in connection with the exhibits of mining machinery at the Lewis and Clark Centennial at Portland, Ore., between June 1 and October 15 of this year.

Each package of sand should be accompanied by exact information as to the name and post-office address of the sender, the name of the mine or claim from which it came, and the state, county, city, village, or district in which the deposit is located. On request, postal franks will be sent to owners of deposits in order that sand may be shipped without expense.

Great care should be used to pack the sand securely for transmission through the mails. It is preferable to sew up the sand tightly in a canvas bag, and tie the tag, which requires no postage, carefully to the package. No specimens will be examined unless the above information is given in regard to the exact locality from which the samples have been obtained.

The director of the Geological Survey will appreciate all information which can be given as to the efforts previously made to separate platinum from the sands in neighborhoods, and as to the quantity of platinum produced in the district.

Platinum has been discovered in California, Oregon, Idaho, Montana, New York, North Carolina, Georgia, Pennsylvania, Wyoming and Alaska, in the United States, and in Canada, Mexico, Central America, the West Indies and South America.

BOOK REVIEWS.

"Experimental Researches on the Flow of Steam through Nozzles and Orifices," to which is added a note on the flow of hot water. A. Rateau, engineer of the mining corps, professeur à l'Ecole Supérieure des Mines de Paris. Authorized translation by H. Boyd Brydon. New York. D. Van Nostrand Company. Cloth. 74 pages. 5¼ by 7½ inches. 3 figures and 4 plates. Supplied by the ELECTRICAL REVIEW at $1.50.

In 1892 Professor Rateau published in the *Annales des Mines* the results of his experiments on the flow of steam through nozzles and orifices. Previous to that time other investigators of this important subject, both in Europe and America, had employed practically the same method of research. It consisted of condensing the steam after passing through the nozzle under test in a surface condenser, and then weighing the water obtained during a certain lapse of time. This method, however, presents many inconveniences and sources of error. Rateau described an indirect method he used in which all readings were completed in a very short interval of time. This enabled the experiments to be made rapidly and precisely. Rateau employed the greatest care in his experiments and the total accidental error in the calculated results could not exceed one per cent; the mean error was probably not more than a few thousandths of one per cent. The result of Professor Rateau's experiments showed that with very careful work the same coefficient of discharge is obtained as Grashof gave in his formula which was derived from pure thermodynamic calculations. The translation of this article into English gives to a great many English reading engineers an important book on a subject found in but few books in the English language. It will be especially of value to those interested in steam turbine design, for Rateau undertook these experiments when he was beginning his study of the steam turbine.

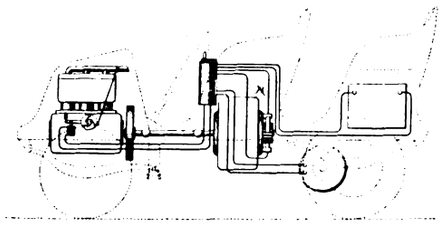
"The Insulation of Electric Machines." Harry Winthrop Turner and Henry Metcalf Hobart. New York. The Macmillan Company. Cloth. 298 pages. 6 by 9 inches. 162 illustrations. Supplied by the ELECTRICAL REVIEW at $4.50.

This is the first book to be published on this most important subject. Usually, texts on dynamo electric machinery dismiss the subject of insulation with a page or two, or more frequently hardly mention it at all. As a matter of fact, the subject is one of vast importance to both the designer and the operator of electrical apparatus, as nine-tenths of the ultimate breakdowns in electrical machinery are due to the breakdown of the insulation, no matter what the primary cause of the trouble. The work of Turner and Hobart is therefore very timely, and makes a valuable contribution to the subject. This work is more an exhaustive compilation of information bearing on the subject from papers, trade publications, etc., than a text laying down the fundamental principles of design. Existing materials and methods of using them are well described, but the application of materials to particular work, such as, for instance, transformer design, is not taken up to any extent. In this respect the book will be rather disappointing to the designing engineer. On account of the nature of the subject, it has, of course, been necessary to make considerable use of trade names of materials and to describe these at some length, and in this connection the trade publications of the companies furnishing such materials have been frequently quoted for directions and information concerning the materials described. Very little attention has been given to the question of the testing of insulating materials and apparatus for making such tests. The curve work in the book is of the roughest character, amounting to little more than free-hand sketches, and this detracts much from the appearance of the book as a whole. The metric system has been used throughout in connection with all distances, which will be somewhat awkward to the average American engineer, as he will have to translate to the units with which he is familiar. This work is, however, a most valuable contribution to the subject, giving, as it does, the first logical and comprehensive outline of the general subject. Although the book is of English origin, American writers on the subject have been freely quoted, and in all cases of quoted material full credit has been given. The bibliography in one of the final chapters will be found of especial value to those who wish to study the subject further.

Digitized by Google

Electrical Patents.

Lars G. Nilson, of New York, N. Y., has assigned to the Fischer Motor Vehicle Company, of New Jersey, a patent recently granted to him on an electrogasoline vehicle (786,376, April 4, 1905). The invention has special reference to such vehicles as are driven by electricity, and the objects are to provide improved controlling and operating mechanism, and in vehicles of the type which employ an engine driving a dynamo, a motor or motors and a storage battery so arranged as to permit the dynamo to supply both the motor and the storage battery and to permit the battery to supply the motor as an auxiliary to the dynamo, to provide means whereby the charging of the batteries and the output of current from the dynamo may be automatically regulated according to the demand for current, and means whereby the motors may be readily controlled to operate as motors, as braking means, or as battery-charging means. Mr. Nilson prefers to provide

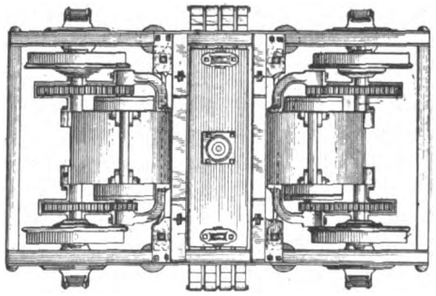


ELECTROGASOLINE VEHICLE.

a main and an auxiliary controller, the main controller regulating the ordinary running speeds of the motor and an auxiliary controller regulating the operation of the motor, as a braking, or as a charging means, and to prevent accidents provide means whereby the auxiliary controller will be inoperative except when the main controller is in certain positions.

Mr. Henry H. Cutler, of Milwaukee, Wis., has secured fifteen patents on electrical apparatus, the majority of which have been assigned to the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., the remainder having been assigned to Arnold Magnetic Clutch Company, also of Milwaukee, Wis. The various structures covered relate to systems for controlling electric motors, power-transmission mechanism, speed-varying means, and magnetic clutches.

One of these patents relates to a system for operating electric vehicles (786,419, April 4, 1905). The invention relates to improvement in alternating-current motors and means for connecting the same with a driven mechanism, the object being to provide an alternating-current motor for operating electric vehicles, electric railway trains, interurban railway trains, electrically driven boats, and any devices which are adapted to be driven by electric motors, and to provide means for connecting the same

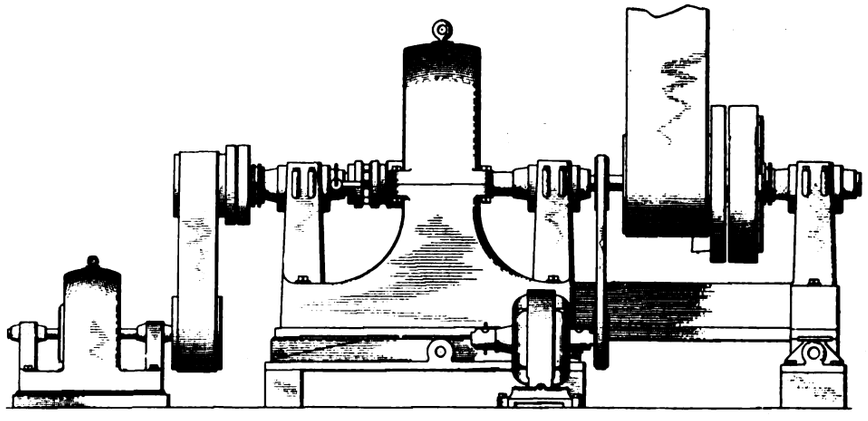


SYSTEM FOR OPERATING ELECTRIC VEHICLES.

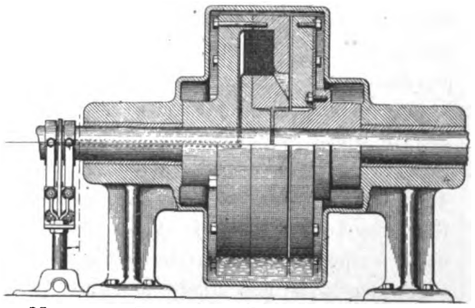
with the driven mechanism thereof, whereby the motor may operate independently of the driven machinery and be connected therewith without undue strain upon the motor or the parts driven thereby. In carrying out the invention, the driving-wheel of an electric vehicle is provided, also an alternating-current motor for operating the same and capable of running independently thereof. A controlling circuit has electromagnetic windings connected therewith, which windings are adapted to respond to variations in voltage. Suitable instrumentalities are adapted to be operated by the windings to control the operation of the motor. A clutch is employed for connecting means with the motor to drive the wheel at one speed, and a second clutch connects means with the motor to drive the wheel at a relatively higher speed. Suitable means are provided for supplying a direct current to the controlling circuit and the clutches, also means for varying at will the voltage impressed upon the controlling circuit.

Another patent has particular reference to a synchronous motor and clutch mechanism associated therewith (786,417, April 4, 1905). The invention relates to alternating-current power-transmitting apparatus, and the object is to provide means whereby a synchronous alternating-current motor may be employed to efficiently and economically start and drive its load without strain upon the power-transmission system and also to provide means whereby the part driven by the motor may be caused to rotate at any desired speed at will. In the embodiment of the invention, the rotor of a synchronous alternating-current motor and the load thereof is provided, and a magnetic clutch is arranged to introduce inductive and frictional slip between the rotor and its load. The slip is controlled by suitable means so that the load may be brought to full speed without undue disturbance of the electrical supply circuits.

A third patent covers a magnetic clutch or speed accelerator (786,411, April 4, 1905). The object of the invention is to provide an electromagnet element whereby a driven part may be rotated at any desired speed equal to or less than that of the driving part. A primary winding is provided having suitable energizing windings. A secondary member is adapted to be inductively influenced thereby to create torque producing currents in the secondary member, whereby relative movement between the primary and secondary members results, these members being axially movable relatively.



SYNCHRONOUS MOTOR WITH CLUTCH.



MAGNETIC CLUTCH OR SPEED ACCELERATOR.

Digitized by Google

MECHANICAL CONSTRUCTION OF STEAM TURBINES AND TURBO-GENERATORS.[1]

BY W. J. A. LONDON.

The bedplates of large turbo-generators should be of some moderately inelastic body, such as concrete, or brick and cement, and should extend the whole length of the turbine bedplate. Steel or iron constructions in foundations are not to be recommended as they invite trouble, due to vibration.

In the Parsons and Westinghouse turbines expansion takes place in the revolving blades as well as in the stationary blades. This calls for final radial clearances. With a drum type of spindle the loss by radial clearance space is somewhat larger than is the case with a disc type of machine, but skin friction is reduced to a minimum, there being no big areas revolving in media of different densities.

Owing to the difference of pressure between the two sides of the rotating vanes in a Parsons turbine, the whole annulus must be filled with steam so that small diameters and low velocities have to be resorted to where its density is very high, in order that the percentage of clearance to blade height will not be excessive. As the steam expands, its volume increases, and as the number of rows or blades varies with the square of the velocity, it is advantageous to step up in the diameter of the spindle as soon as possible. Various designs have been tried for these spindles, one type being shown in Fig. 1A, which consists of a plain forged steel drum having ends pressed into it of high carbon, or nickel steel. The steps are taken care of by a series of cast-steel rings. This type of spindle has the advantage that the forged steel body in itself is more homogeneous than the casting, and consequently is less likely to cause balancing troubles. The cast-steel rings can each be separately balanced and shrunk on. The disadvantage to this type is the number of parts necessary to make the whole, and the amount of machining and fitting necessary, which makes this construction somewhat expensive. Messrs. Parsons now use the type of spindle shown in Fig. 1B for all their designs, using cast steel for the drum. With spindles of this design balancing troubles are often very serious, it being impossible to guarantee absolutely homogeneous material, and on account of the weakest section falling midway between the bearings whipping is likely to occur, due to unbalanced mass.

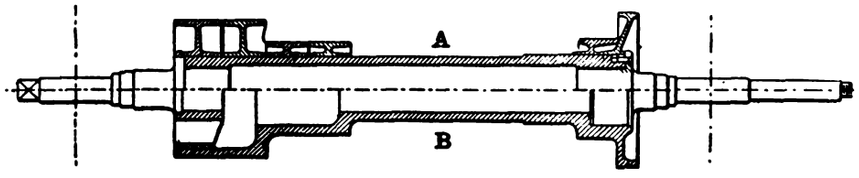


FIG. 1.—CONSTRUCTION OF TURBINE SHAFTS.

The design of the stationary part of a Parsons turbine is a very important item, especially with large machines. As the diameters increase the greater is the tendency for distortion. Further, the cylinder can not readily be supported between the bearings, owing to the fact that the centre part of the cylinder is at a higher temperature than the two ends, and the consequence would be that the cylinder would lift in the centre; this is exactly what must not take place. Further, any support or irregularity cast on to the part of the cylinder that must remain concentric at once causes distortion, and makes the cylinder elliptical or otherwise out of truth. It is, therefore, clear then that no rigid supports can be placed in the cylinder between the bearings. If ribs are necessary for stiffening on the under half they should be duplicated on the top half.

The British Westinghouse Company, between two and three years ago, when entering the field of turbine manufacture, arrived at the conclusion that the most successful turbine should combine the principles of action and reaction. The objections to building turbines on the straight Parsons principles lay in the great overall length, mechanical difficulties in the construction of the spindle, and the adoption of dummy packing rings to eliminate end thrust. By making the turbine double flow—that is, by admitting steam in the centre and passing same through equal rows of blades on each side—end thrust and dummies were eliminated, although the overall length of the machine becomes much greater than that of a straight Parsons turbine; further, the initial blade height would only be half the length of a single flow. This limiting blade height again would necessitate the stepping of the spindle.

In expanding steam from 160 pounds absolute to twenty-seven inches of vacuum, the available work in heat units is 325 per pound, in expanding from 160 pounds down to sixty pounds absolute, the available work is 78.9 British thermal units, or about twenty-four per cent of the total work in the whole expansion. In view of this it was considered that a slight decrease in efficiency might be allowed in the high-pressure end of the turbine if considerable mechanical improvements could be effected thereby. By adopting a combined impulse wheel for the expansion from boiler pressure to about sixty pounds absolute, it was found that the velocity necessary for the wheel fixed such a diameter that Parsons blading could be successfully used on the one diameter already determined by the velocity of the impulse wheels. The specific volume of the steam at sixty pounds pressure was so much increased from boiler pressure that the initial blade height on a large diameter was not prohibitive. The result of this combination is that a machine can be built which is very much shorter than the Parsons machine for given conditions, at the same time maintaining the high degree of efficiency. With this type of machine skin friction of the discs of the ordinary impulse type of machine is eliminated. The efficiency of the compound impulse section is comparatively high, but perhaps not so great as the remainder of the machine; this again is probably balanced by the losses due to skin friction in the long high-pressure end of the Parsons machine.

A longitudinal section of a British Westinghouse turbine is shown in Fig. 2 and the design allows of forged steel being used throughout in the construction of the rotating members. A centre shaft of high-carbon steel extends from one bearing to the other, on which is shrunk the disc supporting the blade-carrying drum. The centre disc is of forged steel and the outer drum is of weldless rolled steel. This outer drum carries the impulse blades in steel rings which are shrunk on. The Parsons blading is carried directly in grooves in the main drum. Stiffening discs of thin steel are also fitted into the ends of the drum. A spindle of this construction is extremely stiff, and having a thorough-going shaft there are no joints in the spindle likely to give way and cause trouble. The stresses due to centrifugal force in a reasonably thin drum can be reduced

[1] Abstract of a paper read before the Manchester, England, local section of the Institution of Electrical Engineers on February 28.

Digitized by Google

mathematically to the following simple equation: $C=MV^2$, where C=centrifugal force, M=mass of material, V=mean velocity in feet per second.

A further simplification of this formula, which, when considering steel or other material of similar density, is near enough for rough calculations only, is $C_1 = V^2/10$, C_1 in this case being the stress per square inch. The radius has no effect on the centrifugal stresses (other than loading by the blading), and the peripheral velocity is, therefore, the limiting feature.

Special construction of the generator is necessary to cope with the speeds demanded by this class of prime mover. The majority of continuous-current generators to-day are constructed with semi-enclosed slots, a keypiece being driven in on top of conductors. This construction is satisfactory for the core of the armature, but the end windings require some other method of support. Fig. 3A shows one method of end winding with binding wire. This construction, as will be seen, is so designed that where the heaviest load comes on the conductors the thickness of binding wire is greatest. The alternative to the above construction, now generally used, is shown in Fig. 3B, the end winding being kept in position by bronze end bells. This construction has the advantage that repairs can be readily attended to. The greatest difficulty so far that has been experienced with this class of end bell is the procuring of suitable material. With cast bronze it is difficult to ensure the material being homogeneous; and, further, the physical properties are never so sure in this class of material as in the case of binding wire or forged material; so that, in a construction of this kind for the end bells, it is advisable, where possible, to use rolled material.

The method of building up the commutator now adopted in nearly all continuous-current turbo-generators is as follows: the segments are built up with intervening layers of mica and clamped together. The mica is then tied round the outside at the place where the shrink rings are to be fitted, the steel rings then shrunk on and the whole machined inside and out. The commutator is then supported on cones at each end, which fit tightly on to the shaft. Owing to the wear that is bound to take place on such commutators, allowance must be made so that when the commutator is worn down to a certain extent, the segments do not become too weak to support themselves between the rings, and, in consequence, bulge out, causing high bars. To eliminate this a good scheme is to design the bars so that at, say, half the original depth, they are stiff enough to carry themselves rigidly, and have sufficient cross-section to carry the current without undue heating. In order that it may become apparent when it is time to stop truing up the commutator, a series of notches or grooves can be placed along the commutator segments indicating the limits for truing up. All overhanging mica, etc., should be turned off, as this has often been found to give trouble by collecting dirt. Everything throughout should be so designed that when running there is as little unbalanced mass as possible, and where keyways are cut in the shaft, two should be provided diametrically opposite, in order to keep the shaft itself as uniform as possible. Provision should be made in all armatures for the speedy application of balance weights.

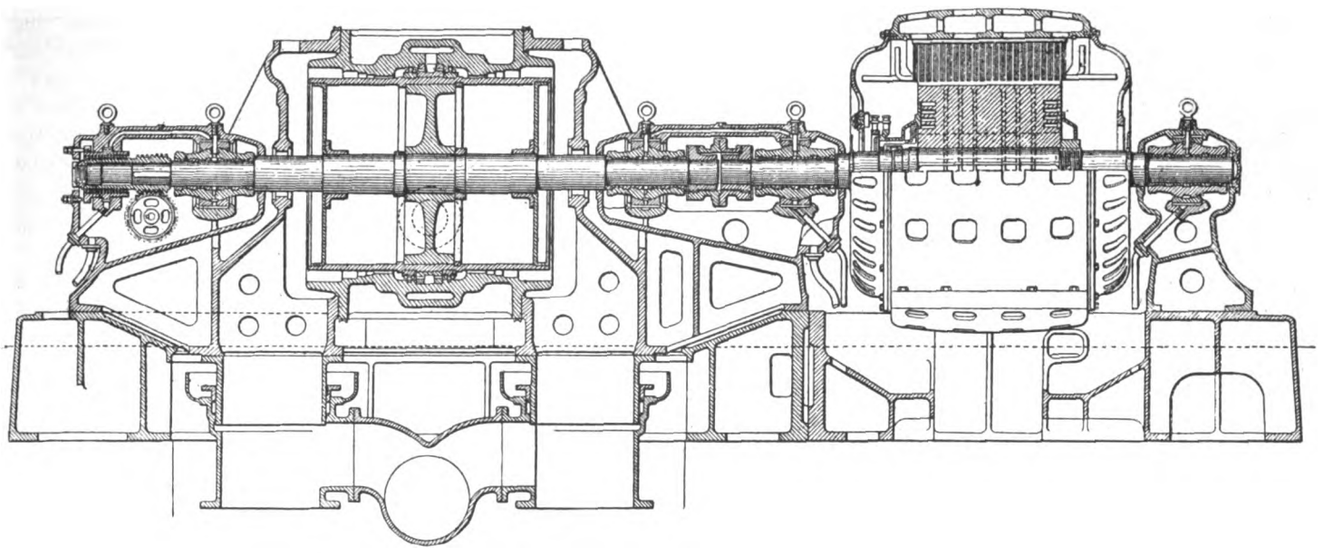


FIG. 2.—LONGITUDINAL SECTION THROUGH A BRITISH WESTINGHOUSE TURBO-GENERATOR.

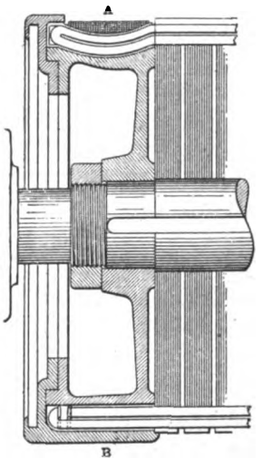


FIG. 3.—METHODS OF SECURING THE END-CONNECTIONS OF ARMATURE WINDINGS.

It has been found that it is almost impossible to use carbon brushes on turbo-generators, owing to the fact that the armature floats when running, thus causing the brushes to dance. Metal brushes must, therefore, always be used, and, in consequence, unless commutating poles or compensating windings are adopted, the position of the brushes must be altered to suit small variations of the load. In all modern turbo-generators commutating poles or compensating windings are adopted, thus ensuring fixed lead.

During the last few years the demand for large turbo-alternators for high voltages has necessitated the adoption of the rotating field type of alternator. The rotating field may be built up of (1) laminated plates; (2) slabs of forged steel, say, about two inches or three inches thick; (3) solid core with poles bolted on; (4) one solid piece.

All the above constructions are now adopted by different makers. In large machines the peripheral velocity amounts

Digitized by Google

to something like 300 feet per second. The British Westinghouse Company, in its design for the 5,500-kilowatt turbo-alternators for the London Underground Railway Company, adopted the solid construction. These rotors run at 1,000 revolutions per minute. The outside diameter is sixty-seven and five-eighths inches, and the peripheral velocity of the pole-faces 294 feet per second. The field itself is a solid forging of Whitworth fluid-compressed steel, the centre being bored out to admit the high carbon steel shaft. The sides of the poles are milled out to admit the windings, ventilating ducts being also milled out. The solid pole construction materially stiffens the shaft, and, as the whole length of the poles themselves can be taken as being absolutely rigid, the only deflection that takes place is between the ends of the poles and the bearings. To reduce as low as possible the loss by windage smooth cores should be adopted where possible. In order to obtain ample ventilation two totally different methods may be adopted: (1) as much exposed surface and free air way as possible; (2) machine entirely enclosed with forced ventilation.

Both these systems are now extensively used, and it is hard to decide which is preferable. The first has the advantage of being more efficient, but has the objection of being noisy. The noise is almost entirely eliminated in the enclosed machine, but tests have shown that, with this type, to obtain sufficient ventilation, a considerable amount of power is absorbed by the blowers, resulting in a somewhat less efficient machine.

In turbine bearings we are confronted with the following conflicting conditions: on the one hand, the shaft should be sufficiently strong and rigid, necessitating large diameter journals, and the bearings must be sufficiently long to keep the pressure per square inch low, to allow of the oil being constantly renewed round the journal. On the other hand, the circumferential speed of the journal must be kept as low as possible to reduce friction. In order to make the whole length of the bearing effective, this length must not be excessive. For small turbines and generators with high speeds down to about 2,000 revolutions per minute the bearing almost universally used consists of a series of concentric tubes fitting loosely over one another, the intervening cylindrical spaces being filled with oil. For large machines, however, with speeds below that mentioned, the rotating elements can be sufficiently well balanced to run smoothly in solid bearings. The small bearings referred to above are invariably of bronze, but with solid bearings, cast iron, white-metal lined, have shown themselves to give excellent results. Even with large bearings for the comparatively slower speeds the bearings must be allowed a certain amount of give; this can be done either by easing off the brushes toward the end or fitting the whole bearing into a spherical seat. With white-metal bearings the danger, of course, lies in their running out should the oil supply at any time fail. With bronze bearings the effect would be very severe seizing of the shaft, doing possibly a considerable amount of damage to the whole spindle. With good white-metal bearings the writer has seen the oil supply fail, the only result being a slight wearing of the bush, causing no damage whatever to the shaft. As regards the metal for the journal itself, the experiments of Herr O. Lasche, of Berlin, go to prove that the metal employed, whether of nickel steel, Siemens-Martin steel or mild steel, has little influence on the degree of friction. With regard to the degree of smoothness and to the facility for taking a highly polished surface, Herr Lasche points out that microscopic examinations of the outside faces, even with magnifications of 100 times, did not reveal any great difference in their structure. The coefficient of friction for mild steel was found to lie between those of the harder materials, Siemens-Martin and nickel steel. The experiments clearly show that there is no great gain by using nickel steel. Further, the nickel steel, after a somewhat prolonged service, showed larger pores than a mild steel journal of equal service. The effect of clearance has a marked influence on the efficient working of turbine bearings. It also has a large influence on the amount of total friction and also on the running and safe working conditions. In bearings with small clearances a relatively great amount of power is required to overcome the friction, even if the shaft is not very heavily loaded. Friction between the shaft and the oil, between the oil and the bushes, and between the oil particles themselves has to be overcome. In consequence it is better to ease the bearings considerably on the upper half; this materially decreases the friction and allows much smoother running. If the shaft is well balanced the upper half of the bearing can be entirely dispensed with, and this is practically done in many instances, a clearance of one-sixteenth inch being allowed on the top half of the bearings. However, should the shaft have any tendency to whip, an uncovered bearing of this kind leads to trouble, as it offers no resistance to the shaft moving laterally. For this reason instead of cutting the whole of the top of the bearing away it is safer to allow a strip of the bearing to remain along the top, thus holding the whole shaft.

The peripheral velocity in turbine bearings is necessarily very considerably higher than in ordinary steam engine practice, velocities of fifty feet per second being regular practice. The load per square inch, however, must be kept very low. In steam turbine practice to-day it is usual to allow a constant of 2,500 for the peripheral velocity in feet per second multiplied by the pressure per square inch on the bearings. This in some cases is raised as high as 3,000. Experimental bearings have been run, however, with a peripheral velocity of seventy feet per second and a pressure of seventy pounds per square inch, thus giving a figure of 4,900. The crux of the whole question is the facility for dissipating the heat, and for this reason as much of the bearings as possible should be in contact with the outer walls, provided, of course, that the outer walls themselves are also free to dissipate heat. Water-cooled bearings are very often resorted to in very large machines, the principal advantage of these being that in a turbine of the Parsons type the heat from the high-pressure end of the turbine is transmitted to the bearing, the water-cooled bearing, therefore, isolates this heat from the bearing proper. In machines where there is no close contact with steam-heated surfaces, the bearings working within the limits mentioned —*viz.*, from 2,500 to 3,000 for potential voltage can run satisfactorily without water cooling. An ample oil supply, however, should be given; in fact, the supply of oil in turbine bearings should not be restricted. In steam turbines the oil leaves the bearings uncontaminated by water or other matter, and can be returned to the cistern and reused, so that there is little loss by providing an ample oil supply. The usual European practice in turbine work is to allow about 0.05 gallon per square inch of bearing surface per minute. Ball bearings at moderate speeds give excellent results, but they do not stand the test of high speeds; they are noisy even with small balls. This is very pronounced when the peripheral velocity of the revolving body is about thirty feet per second, so that on the whole they are not suitable for high speed work, nor are they as safe as the plain bearing.

To reduce the troubles arising from im-

Digitized by Google

perfect balancing to a minimum, the following points must be taken into consideration in the design of the machine: (1) the materials adopted should be as homogeneous as possible. (2) The design should be absolutely symmetrical. (3) Where possible all parts should be machined inside and out with the greatest accuracy. (4) The shaft must be sufficiently stiff to resist undue whipping. (5) Special care must be taken with the windings and insulations to ensure rigidity when running. (6) Where possible the normal running speed should be below the "critical speed." If this is not possible the normal speed should be reasonably higher, so that the critical speed, except when running up or shutting down, is never reached in ordinary operation.

Where possible forged steel should be used throughout in the construction of the rotor; if this is adhered to considerably less trouble is likely to present itself than would be the case were castings used. In connection with the design of a shaft of sufficient strength to resist whipping, the length between the bearings should be kept down to a minimum. This length, however, is determined by the maximum peripheral velocity allowable on the rotor. With turbine spindles of the Parsons type the ratio of the length between centres of bearings to the diameter at the centre of the shaft is often as high as eleven, and in small generators six to eight. It is often necessary, therefore, to apply balance weights at, or about, the centre as well as at the ends before smooth running can be accomplished. In continuous-current machines provision is therefore often made for applying balance weights to the inside ring of the commutator. With rotors for 1,000-kilowatt generators and upward, this ratio rarely exceeds three, and in the majority of cases in very big machines about 2.5. With this ratio balancing troubles, with the reasonably low speeds now adopted, are never very serious. One of the greatest troubles experienced in maintaining good balance of turbo-generators is due to the shifting of the conductors. This often happens after the machine has been running some time and as the insulation dries it gets compressed by the centrifugal force on the conductor. The slightest shifting of these conductors is likely to throw a big rotor considerably out of balance. Should the machine at one time or another run away and attain the speed of, say, one and one-half times the normal running speed, the severe load resulting is often sufficient to throw the whole rotor out of balance. In all bodies revolving at high speeds there is a period at which excessive vibration will take place, and is called the "critical or whirling" speed. It coincides with a point at which the natural period of transverse vibration of the shaft loaded with the rotating element is equal to the impulses given to the shaft by the centrifugal force acting on a slightly bent shaft; at this speed steady operation of the shaft is impossible. Mathematical investigations of this phenomenon have been carried out and published by Professor Dunkerley and others.

The critical speed for any shaft is given by Foster as: $N = 9.55 \sqrt{Fg/W}$, in which W = weight of rotating mass and a portion of the shaft, and F = force in pounds weight necessary to bend the shaft one foot at the point of attachment of the wheel.

The above formula is for a shaft of diameter D feet.

Then $F = 3EI\ (a + b) \div a^2b^2$, in which E = modulus of direct elasticity in pounds per square foot; I = moment of inertia of the cross-section $= 0.0482D^4$; and a and b = distances in feet of the wheel from the bearings.

The following formula is given by Behrend for turbo-generators: $N_1 = \sqrt{KEI \div ML^3}$. In this case N_1 is the angular velocity at critical speed, E = the moderation of elasticity; I = moment inertia of the shaft in relation to bending; M = mass of rotating element; L = distance between bearings; K = constant whose value is about seventy-five.

Where possible, in the construction of the rotating parts, for turbo-generators, static balance of the respective parts should always be resorted to before assembling. Again, the whole body should be statically balanced before being run; although, of course, it does not necessarily follow that, if it shows perfect balance on the knife edges, it will be correctly balanced when running. In balancing, if the rotor is considerably out of balance, one is very often much tempted to apply considerably more weight than is necessary. If the weights are applied at the periphery of the body, which has a velocity of, say, 300 feet per second, at a radius of one foot, that actual weight applied is multiplied by the centrifugal force 3,000 times. Very small weights, therefore, have considerable effect in throwing the whole body back into balance.

First Electric Railway in Manila.

The electric street railway in Manila, P. I., was formally opened for traffic on April 10.

Official Catalogue of the Exhibition of the German Empire at the Louisiana Purchase Exposition.

The official catalogue of the exhibition of the German Empire at the International Exposition, St. Louis, 1904, has been published. This book is edited by Imperial Commissioner Lewald, and a large portion of it is devoted to a great variety of introductory articles written by men of prominence in their several professions, on trade, industrial and economic conditions in Germany. This material is freely interspersed with statistical and historical data. The list of exhibitors proper occupies less than one-half of the volume. There is a fine plate in colors of the exhibition grounds. The introductory matter, among other valuable articles, contains the following: "Scientific Chemistry in Germany," Dr. Harries, professor, Berlin; "Physics and Kindred Sciences," Dr. Lindeck, Charlottenburg; "German Chemical Industry," Dr. Otto N. Witt, Berlin; "Engineering," Karl Bernhard, Charlottenburg; "Machinery," Wilhelm Hartman, Berlin; "Electrotechnics," G. Klingenberg, Charlottenburg; "Motor Cars," Wilhelm Hartman, Berlin; "Railways," Fritz Herr, Berlin. The volume is splendidly printed in several colors, and is durably and handsomely bound in illuminated sheepskin.

The whole volume reflects a great deal of credit, both upon the editors and those interested in its mechanical development.

The Imperial German Consulate General, at New York city, has a limited number of copies on hand for free distribution, upon written application. Express charges, however, must be borne by the recipient.

Directors' Nominees for Officers for 1905-'06 of the American Institute of Electrical Engineers.

The directors of the American Institute of Electrical Engineers have announced the following nominations for officers for the term of 1905-'06:

President—Dr. Schuyler Skaats Wheeler.

Vice-presidents—Charles A. Terry, Townsend Walcott, Gano S. Dunn.

Managers—C. C. Chesney, Calvert Townley, Bancroft Gherardi, Charles L. Edgar.

Treasurer—George A. Hamilton.

Secretary—Ralph W. Pope.

Balloting is now going on, and election announcements will be made at the annual meeting, which will be held at Carnegie Hall, New York city, May 16, 1905.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

An Automatic Block System.

A description is here given of the automatic electric block system now used on one of the Austrian railways. The system is operated by means of an angle-bar about twenty-five feet long, which is placed alongside of and touching the running rail. This angle-iron is on the inside of the track, and is held in place by four springs. When a train passes, the flange of the wheel enters between the rail and the angle-iron, forcing them apart, and in this way closing two contacts which are operated by a rod pressing against the angle-iron. The closing of this circuit actuates the block apparatus. This consists of an electromagnet, above which is suspended an armature. The armature is attached to one arm of a three-armed lever. The second arm of this serves for attaching a spring. The third arm is curved, and bears a pawl which engages in a ratchet wheel attached to a commutator. When the armature is drawn down by the electromagnet, the movement of the lever throws the commutator around. This starts a one-eighth-horse-power series motor which is mounted on the signal post, and which, in turn, operates the semaphore. The motor is geared by means of a sprocket wheel to a sprocket chain carried by two arms of the operating lever.—*Translated and abstracted from the Elektrotechnischer Anzeiger (Berlin), March* 23.

Steljes's Telegraph System.

A description is here given by M. F. Poncelet of Stelies's automatic telegraph system, which, it is said, has been used with such excellent results by the Russian army during the present war. The advantages of this system are its secrecy, since the receiver has been arranged so that it may be securely locked up in a case; no battery is employed, the necessary current being supplied by a hand-operated magneto of special form. This magneto operates, at the same time, a system of contact levers, which, in connection with the keys of the instrument, effects the signal. The sending device consists of a circular table, around which are arranged a series of keys corresponding to the various letters of the alphabet. When one of these keys is depressed and the handle of the magneto turned at the same time, the arrangement of contacts is such that the circuit is completed, while on a dial are contacts which send out impulses corresponding to the letter. Numerals are sent in the same way by using the same keys and a shifting lever. Any person may use the device in order to send a message. This is an important advantage for war purposes. Two or more messages may be sent over a wire at the same time, or a number of receivers may be connected to the wire and receive the same messages. The speed of the messages necessarily depends upon the skill of the operator.—*Translated and abstracted from L'Électricien (Paris), March* 18.

The Electrical Equipment of Messrs. Harland & Wolff's Shipbuilding Works.

There is being completed at the shipbuilding works of Messrs. Harland & Wolff, in Belfast, Ireland, one of the largest examples of electric driving in the United Kingdom. Mr. J. W. Kempster, who is in charge of the electrical department of this company, has designed and carried out the whole of the conversion to electric driving, including the erection of the power-house. The two most interesting features of the equipment are the employment of both continuous and three-phase current for driving, and the adoption, in almost every shop, of individual driving for the machines, so that an enormous amount of belting and contershafting has been displaced. The chief object in view has been to obtain a maximum output from every machine in every shop. Twelve hundred brake horse-power is supplied by three-phase current, 800 horse-power in continuous current for power purposes, and 1,000 horse-power for lighting. When the electrical equipment of the entire works is completed, at least another 1,000 horse-power will be added. Three-phase current is supplied at 450 volts to the different shops, and preference is given to this system wherever the conditions permit. It has been estimated that the repair bill of the three-phase motors is some twenty-five to thirty per cent less than that for continuous-current motors. Continuous current at 450 volts has been employed for cranes, winches, etc., and for cases in which reversible or variable-speed motors have been called for. The power station is 469 feet long by sixty-eight feet wide. The ground consisted chiefly of saw-mill refuse and soft mud, extending in some parts a depth of from twenty feet to twenty-five feet. Piling was therefore necessary for the foundations, and the main and division walls are carried on about 1,000 larch piles, thirty-five to forty feet long, with ten-inch by nine-inch timber rafts secured to the top of the piles. Concrete footings are laid on and embedded around these rafts. The piles for the engine and chimney foundations are 500 in number, and are twelve inches square pitch pine forty feet long. Under the engine pits the piling was surmounted by eleven-inch by three-inch channel iron, interlaced so as to throw an equal portion of the weight on each pile. There are five boilers of the single-ended marine type, each having a heating surface of 2,225 square feet, and a grate area of 56.75 square feet. Their diameter is fourteen feet eight inches, and their length, ten feet six inches. Space is provided for five more boilers of similar size. Steam is generated at a pressure of 200 pounds per square inch. The engines exhaust into surface condensers, and town water is employed for the make-up feed. The mean temperature of the feed water as supplied to the boilers is 212 degrees Fahrenheit. No economizers are employed. For the main generating plant, horizontal Sulzer engines and Lahmeyer dynamos have been selected. One of the three 1,000-horse-power engines drives a three-phase generator, and both continuous and three-phase machines are connected to each of the other two. These two machines have a capacity of 650 kilowatts, so that the engine can drive one of its two generators at full load, and the other partially loaded, or both at about three-quarters full load.—*Abstracted from the Electrician (London), March* 10.

The Use of an Auxiliary Dynamo for Controlling an Accumulator Installation.

There are many small plants, says Herr B. Jacobi, which might effect an economy in operation by using an auxiliary dynamo for controlling the output of a storage battery installation at night, thus enabling the steam plant to be shut down. This is particularly true for plants which supply current for railways and for lighting at the same time. It is gen-

Digitized by Google

erally supposed that to effect this it is necessary to install two batteries, one for the railway, and one for carrying the night load. This, however, is not the case, for by inverting the rotary converter and its auxiliary booster, the supply may be drawn from the battery and sent out over the ordinary high-tension supply lines. Two cases are then considered and the necessary connections explained in detail. First, a rotary converter and booster are used for charging the batteries, and, when inverted, for supplying the night load. In the second case a three-wire, direct-current system is run in connection with a railway. Here two machines are necessary, drawing a supply from a battery, transforming it, and sending it out over the lighting mains. The switch arrangements in each case are not complicated, and the saving in coal over the method in which a steam plant is run at light loads is considerable. The energy loss in the machines is not great, hence they can have high efficiency. —*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), March* 9.

The Telephone System in Riga, Russia.

A description is here given by Mr. Clarence Bosworth of a modern telephone installation at Riga, Russia. The telephone service in this city was formerly given by a Bell company. The Bell franchise having expired in 1904, an independent company acquired its equipment, and has since put in an entirely new plant, bringing the city's telephone system up to date in all respects. This city is the largest in the Baltics, having a population of something over 250,000. The people are not Russians, but are of a different race, and resemble more nearly the Germans. They are well educated and well advanced industrially. The new installation is designed for 10,000 subscribers. At the present time there are 6,000 telephones working. At each end of the board additional panels are placed, so that each operator can reach all of the multiple jacks. Each section of the board has six panels, arranged upon the three-operator multiple plan. In front of each operator are 160 answering-jacks with sixteen pairs of cords, plugs and keys. The switchboard is of the common battery automatic-signaling type. The ringing apparatus is semi-automatic, and so arranged as to ring the subscriber continuously for three seconds, after which the ringing key automatically restores itself. Large dials are placed over the top of each operator's position. These record the number of connections made by the operator. They are not intended as meters, but merely as a check on the operator's work. The chief operator's desk is arranged with lamps for each operator, and a listening-jack, so that complete supervision is effected. The work of each operator is watched for a certain number of hours each month at unfixed times, and this serves as a check on the dials. At the present time twenty-one positions are served at the switchboard, but the number of subscribers is growing rapidly. The rates for labor are about the same as in the United States. One feature of the distributing board is the double-test jack for each line on the switchboard side of the rack, which is convenient for the purpose of facilitating the location of trouble by inserting a double plug into this jack, the wire chief can at once test either outside or inside, at pleasure, and can tap the line as he wishes, without disturbing the lightning-arrester strips or the fuse coils. The battery consists of ten storage cells placed in lead-lined tanks. The battery room is separated from the other rooms. The charging outfit consists of a direct-current, 240-volt motor coupled directly to a thirty-volt multipolar dynamo. The batteries have sufficient capacity to carry the switchboard during the time necessary to make any reasonable repairs to the charging outfit; hence, a duplicate charging equipment is not needed. Throughout the city the entire system of wires is placed underground. There are no party lines in use at the present time. The service is not measured, except so far as toll lines are concerned, a flat rate being made to the subscribers.—*Abstracted from the American Telephone Journal (New York), April* 8.

The Future of the Electric Automobile.

In dealing with the future of the electric automobile, says Mr. T. G. Chambers, it is impossible to foresee what developments may take place. The discovery of some new accumulator of small weight and great capacity, with phenomenal endurance, would alter existing conditions. It is far more probable that nothing of the kind will be found, and we shall continue to use the same materials that are possible to-day, with all their drawbacks. The elasticity of the electric motor and its ease of control, with silence and absence of odor and vibration, made the electric carriage very attractive at an early date. The inherent disadvantages of the dead load of accumulators and the necessary limit to the available supply of energy which could be carried were not so apparent in the days when automobiles of all descriptions ran at comparatively slow speeds, and when a day's journey of 100 miles without a hitch was a rare occurrence. The electric carriage, more than any other type of self-propelled vehicle, lends itself to the housing and manipulation of large numbers in a depot. The first electromobile garage was opened in London in 1901 by the City and Suburban Electric Carriage Company. The four years that have elapsed since that date have seen very rapid progress in similar directions, and to-day there are in London alone, under the auspices of various companies, six or seven large garages operating an aggregate number of between 400 and 500 electric carriages. The electric carriage is as nearly proof against mishap as any machine can be. Taking the last six months' work of the Electromobile Company's Curzon street garage, the total involuntary stops, excepting those due to power exhaustion, were sixty-one in 159,258 carriage miles. Of these stops, fourteen were due to a mechanical defect in the contact breaker, the possibility of which has since been entirely eliminated by an improved mechanism. Thirteen were due to the blowing of the main fuse, a matter immediately repairable by the driver. This leaves only twenty-five stops in about 160,000 carriage miles necessitating the attention of a mechanic, or, on an average, one stop in every 6,400 miles. When the limitations of the accumulators are understood and recognized, little or no difficulty arises from power exhaustion. With an effective range of from twenty-five to thirty-five miles upon one charge, and with the adoption of interchangeable batteries, a carriage may be run all day, if only time be allowed for its return to a depot to take up a new battery, an operation which takes from two to three minutes. Even with a garage in the most expensive and central position of London, the total costs per year are considerably less than they would be in the case of a horse-drawn vehicle giving a similar degree of luxury. When the electric carriage is used to its full extent, the costs are very considerably less. In certain individual cases, owners have effected an economy of as much as from £200 to £300 per year by exchanging their horse carriages for electric vehicles. In no case are they spending more than they did with their horses.—*Abstracted from the Electrical Review (London), March* 24.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Extensive Power Plant Equipments.

Swift & Company have ordered for their plant at Fort Worth, Tex., a 600-kilowatt, alternating-current, revolving-field, sixty-cycle Bullock generator—three-phase, 240-volt—with a normal of 120 revolutions per minute. This is for supplying both light and power. It will be furnished, together with an exciter, by Allis-Chalmers Company, from its electrical works at Cincinnati.

The Bethlehem Steel Company, of South Bethlehem, Pa., will install in one of its rolling mills at that place another heavy-duty, Reynolds-Corliss non-condensing engine, with cylinder thirty inches in diameter and a forty-eight-inch stroke, for direct-connection to a 500-kilowatt generator. The engine will be built at the West Allis, Milwaukee, works of Allis-Chalmers Company and is to be practically the duplicate of one now running at the South Bethlehem plant.

Mandel Brothers have let the contracts for a large power plant to be installed in the subbasement of their store building at 111-115 Wabash avenue, Chicago, Ill. This is to consist of engines and generators comprising five complete units, with an aggregate capacity of 1,500 kilowatts divided as follows: three of 400 kilowatts each, one of 200 kilowatts and one of 100. There will be three vertical, cross-compound, non-condensing engines, one horizontal engine of similar type and one horizontal single engine, all direct-connected to Bullock generators. The engines will be built by Allis-Chalmers Company at its West Allis, Milwaukee, works, and the generators are to be furnished by the electrical department, the Bullock Electric Manufacturing Company, of Cincinnati. The plant designed for Mandel Brothers is the result of careful study on the part of their consulting engineers, Adams & Schwab, and Holabird & Roche, the architects, and is believed to be especially well adapted to the purposes for which it is intended.

The Mineral Point Zinc Company, of Chicago, has ordered from the Allis-Chalmers Company the complete power equipment for its remodeled plant at Depue, Ill., consisting of two heavy-duty, cross-compound, Reynolds-Corliss engines, each with cylinders twenty-one and forty-two inches in diameter and a forty-eight-inch stroke; two 500-kilowatt Bullock generators, to which the engines will be direct-connected, one 100-kilowatt generator and twenty-four motors ranging in size from ten to seventy-five horse-power, with starters, rheostats, etc. The two power units are designed for operation at ninety revolutions per minute, the engines being especially constructed to meet that condition, but the smaller generator will develop a normal speed of 250 revolutions per minute.

Electricity in Industrial Applications.

A few years ago a great deal was being said about the application of electric motors for industrial service of every variety. At that time the gains being made by motor service in these applications were noteworthy and attracted considerable attention. This application has, however, become so universal that but little is heard now-a-days of the installation of small motors. Great as was the demand for small motors and separate driving units a few years ago, the call for this type of machine is very much greater today. Orders for hundreds of these motors, both alternating and direct current, are received every week by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. An instance of this is to be found in the following contracts: the Alliance Machine Company and the Morgan Engineering Company, both of Alliance, Ohio, recently placed orders for a total of 120 crane motors with an aggregate of 2,000 horse-power. These motors vary in size from one horse-power to 100 horse-power. The Pennsylvania Railroad Company about the same time contracted for twenty induction motors to be added to its present motor equipment, and the Bethlehem Steel Company entered an order for direct-current motors to be used in its mills. Numerous smaller orders would make up a list of applications covering the whole field of motor-driven machines.

The Weiny-Phillips Repeaters.

Several changes have been made in the Weiny-Phillips repeaters, among them the adoption of the Barclay relay magnet. Mr. Walter P. Phillips is now having a plan worked out to simplify the instrument, in the expectation that the price will thus be materially reduced. This repeater is one of the most efficient in use.

Steel-Armored Cable Fittings.

The Sarco Company, 906 Sixth avenue, New York city, is meeting with great success in the sale and installation of Sarco steel-armored cable fittings. Fig. 1 shows the Sarco combined

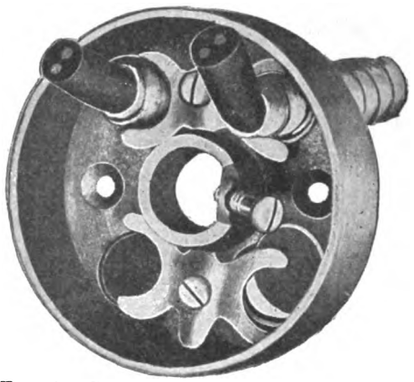


FIG. 1.—COMBINED JUNCTION AND OUTLET BOX FOR STEEL-ARMORED CABLE.

outlet and junction box for steel-armored cable. The box is so constructed as to be readily available for several circuits. It is used with a duplex flat bushing. The box is made with a number of entrances, so that it can be made interchangeable, and will take from one to four cables. The holes which are

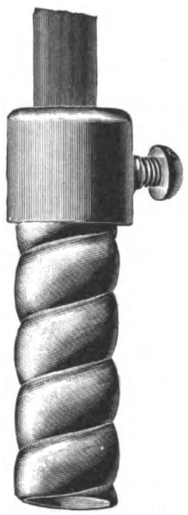


FIG. 2.—CABLE, WITH BUSHING IN POSITION.

not being used are sealed by means of slugs and flat spring clips. This outlet box is made in several different styles. The type A box is for electric service only; the type B box is for a combination of electric service and three-inch gas pipe; the type C box is for a combination of electric service and takes a one-half-inch gas pipe.

Fig. 2 shows a new form of cable bushing which the Sarco Company has recently placed on the market.

Digitized by Google

The "Metaphone."

The "Metaphone" is an interior telephone intended for use in offices, factories, hotels, clubs and residences. The apparatus consists of a transmitter and receiver mounted on opposite ends of a short metal handle. Fig. 1 shows a wall instrument consisting of a "Metaphone" suspended from a movable hanger in a small cylindrical box. This box is furnished in mahogany or black enamel. Upon the box is mounted a switch lever to connect with as many contact points as there are outlying stations. The "Metaphone" intercommunicating sets permit a number of stations to be so connected that from any one station direct telephonic communication to any other station can be automatically established, without the necessity of a central switchboard or switchboard operator. The connection in the present case is made by taking the "Metaphone" from the hook and moving the switch lever to the desired contact point. Pressing the button at the top of the instrument rings a bell at the connected station. Replacing the "Metaphone" upon the hook at the end of the conversation automatically restores the switch lever to its initial position.

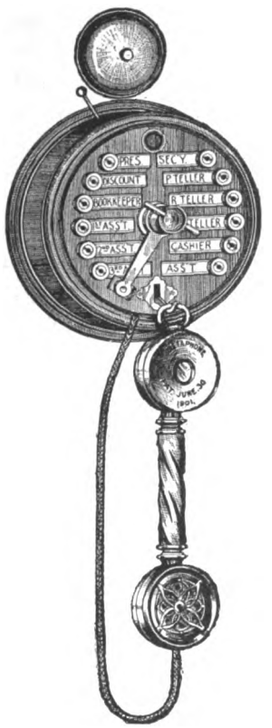


FIG. 1.—WALL "METAPHONE."

FIG. 2.—DESK "METAPHONE."

Fig. 2 shows the new form of intercommunicating desk instrument. Each instrument is supplied with a number of stations, and the desired call is made by lifting the "Metaphone" from the cradle switch and moving the switch lever to the desired contact point. The connection is automatically broken by replacing the "Metaphone" on the cradle switch. If after talking to one station conversation with another is desired, it is unnecessary to replace the "Metaphone" on the cradle switch. The previously connected station is automatically cut out the instant the new connection is made.

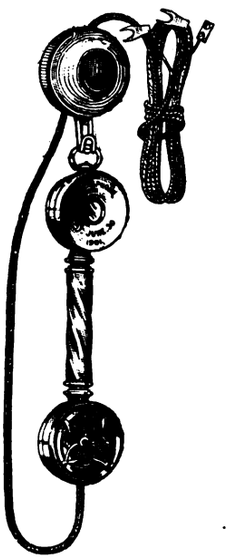


FIG. 3.—PUSH-BUTTON HOUSE "METAPHONE."

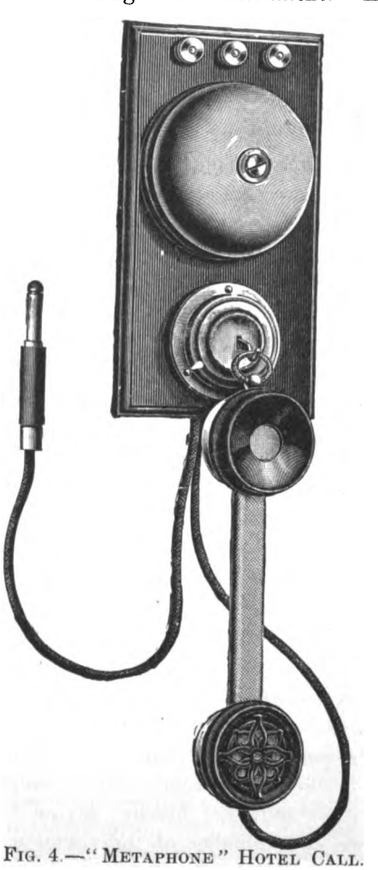


FIG. 4.—"METAPHONE" HOTEL CALL.

Fig. 3 shows a push-button house "Metaphone." This may be connected to an existing electric bell circuit without any alteration or additional battery.

Fig. 4 shows the instrument used with the "Metaphone" hotel system. This establishes telephonic communication between room and office, using the existing bell and annunciator installation. In each room a push-button "Metaphone" is connected to the existing bell wires and suspended by a clip hanger from the push-button. To telephone to the office, the guest pushes the button, takes the "Metaphone" from the hanger, places the upper end to the ear, and talks past (not into) the lower end. In the office a plug board is connected in series between the direct-room wires and the existing annunciator.

The "Innovate" Adjustable Hangers.

When the eyes are in a healthy, normal condition, they are strained and injured by employing artificial light that is stronger than shaded sunlight. It is said that any person who can not see perfectly well when close to a shaded ten-candle-power incandescent lamp requires glasses, but not increased candle-power. By bringing the lights used in any workshop down low over the work, and employing shade reflectors for eye protection and concentration of light, in many instances the quality of illumination for the work in hand is improved, and, at the same time, the cost of illumination is reduced.

Where suspended lamps are used, the employment of a thoroughly dependable automatic cord adjuster makes it possible to bring the lamps down low or push them up out of the way in a second. An automatic cord adjuster, made without weights or springs, and producing no wear on the lamp cord, may be relied upon if properly constructed. It should also be a device approved by the National Board of Fire Underwriters. The "Innovate" adjustable hangers, made by the Innovate Manufacturing Company, 145 Van Buren street, Chicago, Ill., are designed to meet these requirements. The manufacturer claims a saving of sixty per cent in illumination by using these hangers on all suspended lamp cords.

Digitized by Google

Starting-Compensators for Alternating-Current Motors.

A squirrel-cage induction motor of five horse-power, or over, causes an objectionably heavy rush of current if started by connecting directly to the line. Such sudden variations of line load may be obviated by installing a starting-compensator. That built by the General Electric Company consists of an inductive winding with taps, controlled by a switch so as to impress a reduced potential on the motor to bring it up to speed.

The accompanying illustrations show two forms of compensators for starting induction and synchronous motors which are now being produced at the Schenectady works. Fig. 1 shows a compensator of the "wall suspension" type, and Fig. 2 shows one of a type arranged to stand on the floor, for starting two-phase and three-phase induction motors. In each type the compensator consists of a core and windings, a terminal board and a switch, assembled in a cast-iron case, with an external operating handle. The cases may be opened for inspection of the interior, etc.

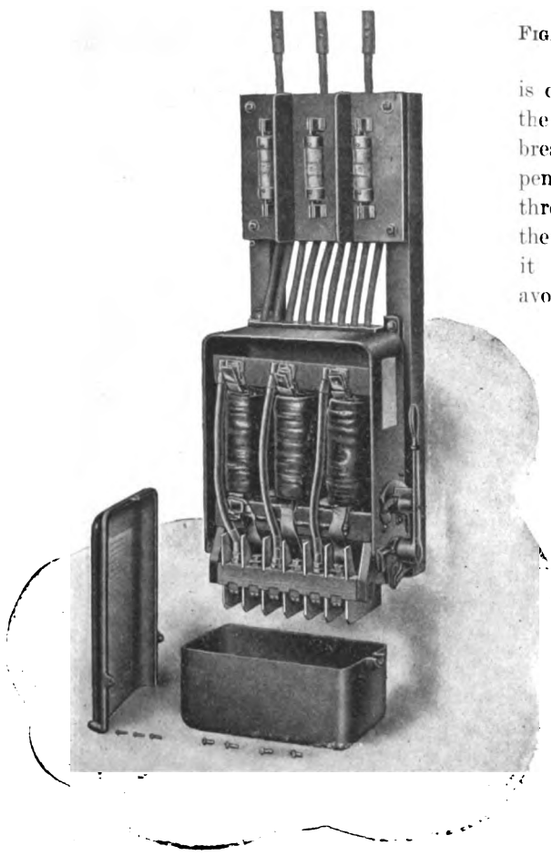


FIG. 1.—WALL TYPE COMPENSATOR FOR INDUCTION AND SYNCHRONOUS MOTORS.

The lever has three positions: "off," "starting" and "running." In the off position (Figs. 1 and 2) both compensator and motor windings are disconnected from the line. In the starting position the switch connects the line to the terminals, and the motor to the taps of the compensator winding, without breakers or fuses in circuit. In the running position the compensator winding

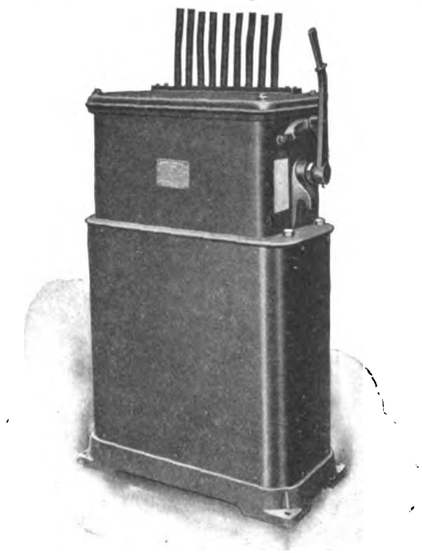


FIG. 2.—FLOOR TYPE COMPENSATOR FOR INDUCTION AND SYNCHRONOUS MOTORS.

is cut out and the motor is connected to the line through suitable fuses or circuit-breakers mounted directly above the compensator. To prevent the attendant from throwing the motor directly on the line, thereby causing a rush of current which it is the object of the compensator to avoid, an automatic latch is provided, so arranged that the lever at "off" can be thrown only into the "starting position" (backward), and can be thrown from thence into the "running position" (forward) only by a quick throw of the lever, whereby any appreciable drop in speed and consequent increase in current in passing from the starting into the running position is avoided. The compensators are designed to bring the motor up to approximately full speed within one minute after the switch has been thrown into the starting position.

For motors of high voltage or large capacity, the switching device is separate from the compensator itself. This arrangement gives an opportunity to start several motors in succession from a single compensator if desired, thereby saving the expense of a number of individual compensators. For starting large synchronous motors, a special equipment can be furnished consisting of a compensator provided with a large number of taps and a controller.

The Manufacture of Armington & Sims Engines.

The Marine Engine and Machine Company, with offices at 80 Broadway, New York city, and factories at Harrison, N. J., makes the following statement concerning the manufacture of Armington & Sims engines:

"We are pleased to announce to the engineering fraternity, steam users and the public generally, our purchase of all drawings, patterns, etc., of the later types of the well-known Armstrong & Sims high, medium and slow-speed engines, as improved and built during the last ten years.

"Mr. Gardiner C. Sims, under whose personal direction and supervision Armington & Sims engines were designed and have been built, has acquired an interest in our business and become its general manager. We are now engaged in building these engines under his personal direction and supervision, which affords ample guarantee that the always high-class character of materials and workmanship heretofore entering into the construction of Armington & Sims engines is carefully considered and fully maintained. From time to time we shall make such changes and improvements in the engines as may be found necessary to keep pace with the varying demands of the trade.

"We shall manufacture Armington & Sims engines as heretofore in sizes ranging from 10 to 3,000 horse-power, and in types horizontal and vertical, side and centre crank, single and in pairs, simple, tandem and cross-compound, triple and quadruple expansion, condensing and non-condensing, high, medium and slow speeds, with single and Corliss valves, and adapted to direct-connected, belted or other power-transmitting requirements.

"With our modern and roomy machine shops and foundries, both amply equipped with all necessary special tools and appliances for doing large and accurate work rapidly, we are in a position to make prompt deliveries of any of the sizes and types of engines we build.

"The undoubted merit and popularity of Armington & Sims engines seem fully attested by the fact that upward of six thousand six hundred of them have been built and sold in all parts of the world.

"We hope to hear from and earnestly solicit the cooperation of all present 'Armington & Sims' friends and customers, hoping to make new ones, and extend to them, as well as to intending purchasers, a cordial invitation to visit and inspect our works."

Digitized by Google

New Form of Hydraulic Governor.

The Lombard Governor Company, Ashland, Mass., has placed on the market a new type of hydraulic governor, especially adapted for present conditions in water-wheel service. The continual increase in the size of prime movers, in both steam and water-power plants, calls for new designs in governors to meet the conditions of increased efficiency and larger production. The necessity for improved accessory appliances is especially marked in water-power stations, where speed control of turbines is, at best, an exceedingly difficult problem.

The type N hydraulic governor is shown in the accompanying illustration. The construction is simple and massive. One large casting forms both the main cylinder and the bearings for the terminal shaft. The base forms the lower cylinder head. The upper cylinder head is integral with the cylinder. With this form of construction, maximum strength, with the least weight of metal, is obtained, while the possibility of the joints loosening under strain is eliminated. The straight cylinder construction with the piston motion along the axis is retained.

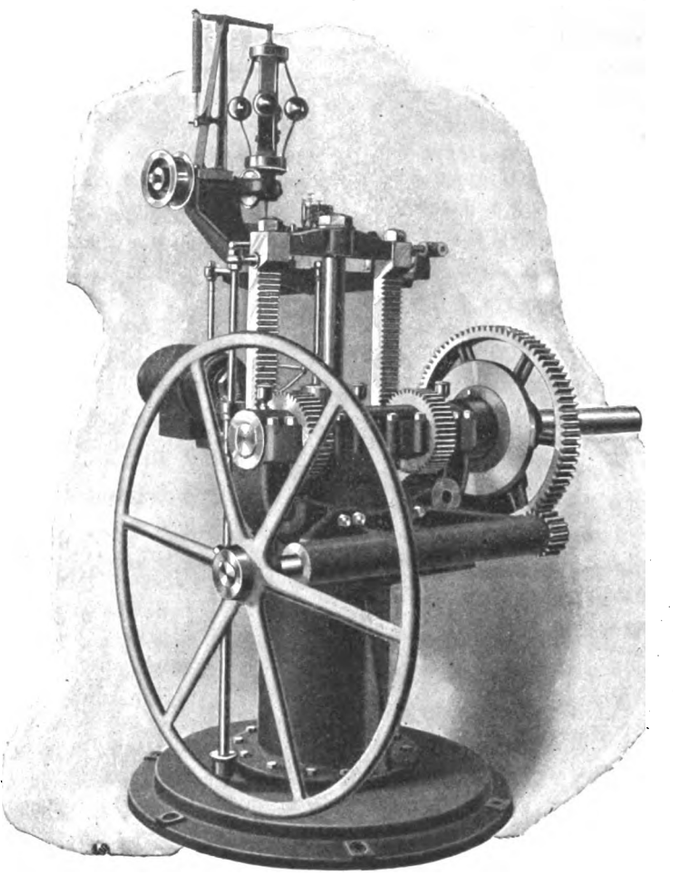
The linear motion of the piston is transformed in a simple manner by rack and pinion to a rotary motion at the terminal shaft. In order to reduce the vertical height of the governor, and also to transmit the great force at the piston to the rotating shaft in the most efficient manner, double racks and pinions are used, the racks being connected to an equalizing yoke. The location of the racks is alongside of the cylinder. The steel terminal shaft is two and fifteen-sixteenths inches in diameter, supported by bearings on both sides of the pinions. The total length of this shaft is twenty-six inches. The releasing clutch mechanism is of the well-known Lombard governor design, properly proportioned for the power of the machine. All keyways are extra wide. The terminal shaft pinions are not only keyed, but also shrunk on at a high temperature. The main piston-rod gland is cup-shaped, so as to prevent leakage. The usual form of hand wheel is employed. This is out of gear when the governor is in regular operation.

The working fluid for this governor is a special oil kept under pressure in a vertical drawn steel tank. Oil is forced into this tank by a powerful pump which is part of the equipment of the governor.

The especially novel feature of the type N governor is the relaying valve mechanism.

The main valve of the governor consists of a large double, hollow piston, contained in a horizontal cylindrical case back of the hand-wheel rim at the left of the illustration. The wearing surfaces of this valve are made of hardened steel, and the cylinder in which it travels has a hardened steel sleeve or bushing through which the ports are cut. The valve itself is balanced perfectly by its construction, so as to require comparatively slight force to move it. Reliance is not placed, however, on this fact, but powerful means are provided to ensure its movement. These means consist of hydraulic plungers supplied from the pressure system of the governor. These hydraulic plungers are under the simultaneous control of a very small primary valve attached to the stem of the centrifugal balls, and of a small valveless displacement pump in the slender vertical cylinder at the left of the illustration. The piston of this pump is attached to, and moves with, the main piston of the governor. The relation of these parts is such that the least displacement of the primary valve by the centrifugal balls causes an instantaneous and positive movement of the large main valve. The main valve is immediately restored to its closed position by the action of the displacement pump, as soon as the primary valve is again closed. There thus results an exact, immediate magnification by the main valve of the movement of the primary valve. This multiplication at the main valve of the minute motion of the primary valve, resulting from slight speed changes of the centrifugal balls, is the principal reason for the accurate speed regulation given by this type N governor.

In any hydraulic governor the least speed variation which will produce motion of the governor depends upon the lap of the valve controlled by the centrifugal weights—the smaller the lap, the greater the sensitiveness. On the other hand, slight lap of valve is conducive to large leakage and short life. With the relay valve form of construction used in the type N governor the lap of the main valve influences in no way the sensitiveness of the machine, and still ensures freedom from leakage. In order to take the utmost advantage of this valuable feature of its construction, the type N governor is provided with a primary valve having an outside micrometer adjustment for varying the amount of lap. By means of this adjustment it is easy to alter the sensitiveness of the governor while it is running, so that it will respond to speed changes of greater or smaller magnitude down to the limit where the governor is kept in motion by speed changes too small to detect. This micrometer adjustment is also a device to take up the loss of lap of the primary valve, due to wear. Sufficient adjustment is provided for many years of constant service.



NEW FORM OF HYDRAULIC GOVERNOR.

The anti-racing mechanism of the type N governor is of the well-known pattern used in the Lombard governors for many years. Certain improvements have been made in the nature of adjustment and in design, so that the effect in making the governor dead-beat is much more marked at the beginning of the stroke, when the water-wheel gates are just opening.

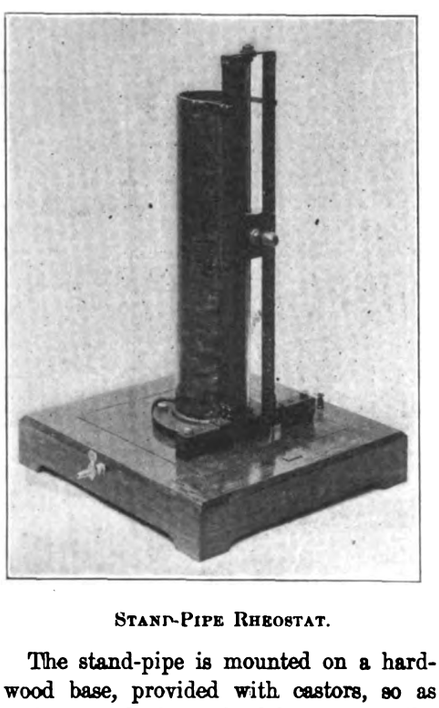
The type N governor is ten inches in diameter, with a twenty-four-inch stroke. Two hundred pounds pressure per square inch is the normal pressure, and the governor then expends 31,000 foot-pounds of energy per stroke. The factor of safety under this pressure is ample. Under emergencies the pressure has been increased over fifty per. cent without harm to the governor.

Digitized by Google

Queen Stand-Pipe Rheostats.

Queen & Company, of Philadelphia, Pa., have recently designed a series of rheostats consisting of a continuous length of wire wound spirally on an iron stand-pipe, about six inches in diameter, of a length depending on the total resistance and the current-carrying capacity required.

The wire is insulated from the iron pipe to withstand an alternating potential of 1,000 volts. The pipe is closed at the bottom and by means of a small pipe, on either side of the base a stream of water can be introduced for cooling purposes. If the rheostats are not used at their maximum capacity, water is not necessary; when only used at their maximum capacity for a few minutes at a time the pipe filled with water, alone, is sufficient; running water is recommended, only when the rheostats will have hard continuous service at their maximum rated capacity.



STAND-PIPE RHEOSTAT.

The stand-pipe is mounted on a hardwood base, provided with castors, so as to be moved about the laboratory easily. Mounted parallel to the upright pipe is an angle iron guide, which carries a slider, to which are attached phosphor-bronze springs which, in turn, make contact against the wire on the pipe. All the parts are insulated except a rod in the centre of the angle iron guides, which is connected with the phosphor-bronze springs by means of a split brass sleeve in the wooden handle. This gives a very smooth even motion, and positive contact is made on every convolution of the wire, which allows adjustments of the current by almost infinitesimal steps.

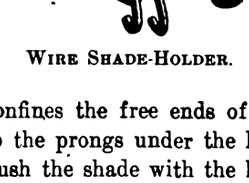
These rheostats are highly recommended for laboratory work in electrolysis, where it is necessary to secure fine graduations of both current and potential. To secure a potential regulation, the rheostat is supplied with two sliders, the terminals of the main conductor are connected with the main current source of supply, and the wires to the apparatus are connected to the two sliders. By putting the sliders close together the difference of potential is very small, whereas by sliding them further apart it can be increased to any desired point.

These rheostats are made in several sizes; a special descriptive circular will be furnished by Queen & Company, on application.

A Simple Wire Shade-Holder

The Jem Shade-Holder Company, 13 East Thirtieth street, New York, has placed on the market a simple form of wire shade-holder, which is designed to be economical in construction, cheap in price, and very easy of application.

In applying this wire shade-holder, all that is necessary is to open the clasp

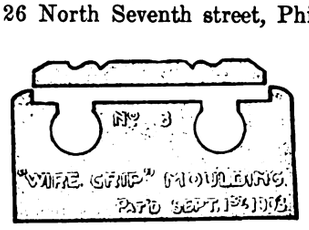


WIRE SHADE-HOLDER.

which confines the free ends of the wire clip, slip the prongs under the lip of the shade, push the shade with the holder attached over the socket as far as possible, press the free ends of the holder together, and fasten down with the clip. The manufacturer claims that the holder is absolutely rigid, and will not allow a shade to droop at any angle.

"Wire Grip" Moulding.

The accompanying illustration shows the new form of moulding made by the Improved Moulding Manufacturing Company, 26 North Seventh street, Philadel-

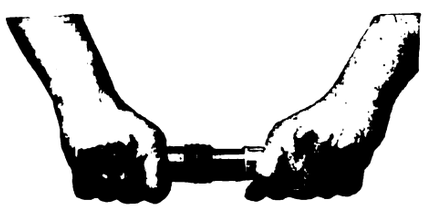


"WIRE GRIP" MOULDING.

phia, Pa. Wire grooves are so cut that the wire will not fall out of the moulding as it is being put in place, obviating the driving of tacks or staples to keep the wire in the run until the finishing board is put in place. The moulding is made of approved wood, and finished with a coat of fire and water-resisting paint. The moulding is also furnished in water-resisting oak, stained finish.

A "Wireless" Electric Battery.

The accompanying illustration shows an electrotherapeutic device manufactured by the Wireless Electric Company, 618 Chestnut street, Philadelphia, Pa. This battery is about nine and one-half inches in length, one and one-quarter inches in diameter, and weighs about twelve ounces.



"WIRELESS" ELECTRIC BATTERY.

The device is a compact cylinder made up of two highly polished tubes fitted over a wood core. One tube is fixed, and contains the charge, and the outer is movable, and is used to start, regulate and stop the electric current at the will of the operator. The wireless electric battery is the invention of Leon W. Pullen, Philadelphia, Pa.

Rock Drills on the Panama Canal.

The last official act of the Panama canal commission before resigning was to close a contract with the Ingersoll-Sergeant Drill Company, of New York, for fifty standard rock drills of that company's manufacture, complete with mountings and equipment. These machines are to be used in the removal of rock in the great Culebra cut through the crest of the isthmus. The commission furthermore authorized the same company to remodel a large number of the French-Ingersoll drills, built in France under the patents of the American manufacturers. These machines remain from the original equipment of the old French company formerly operating on the canal. This act of the commission is interesting as showing the intention of using American machines and American methods in this, the greatest undertaking in the history of rock excavation. While the fact that the old drills are still in a condition to justify their use shows the merit of machinery of American type and design.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

GERMAN WIRELESS TELEGRAPHY—The German government telegraph administration, of Berlin, announces the acceptance, at any office in Germany, of telegrams for transmission by wireless telegraphy to ships so equipped. Twenty cents per word will be charged, in addition to the rate of one and one-quarter cents for internal messages.

BRAZILIAN LIGHT AND TRACTION PROJECT—In the city of Rio de Janeiro, Brazil, there has been formed a company to install electric light plants and electric traction lines throughout the city. The city has hitherto been lighted by oil and gas, and the traction lines have been operated by mules. It is said that the General Electric Company, Schenectady, N. Y., has secured a contract amounting to about $4,000,000.

EXTENSION OF THE PARIS SUBWAY—It is announced that the present subway in Paris, France, is to be extended. The new line will be known as the Annexe Interieure. It will go from the Place de la Concorde, pass under the Rue Royale and follow the Grand Boulevarde to the Place de la Bastille. Thence it will pass under the Seine and return to the Place de la Concorde, *via* Boulevarde St. Germain and the Invalides railway station.

TO PURCHASE THE GAS, ELECTRIC LIGHT AND POWER INTERESTS OF SCRANTON, PA.—A project is said to be under way to purchase all of the water, light, heat, power and trolley companies in the city of Scranton, Pa., and vicinity. The American Electric Light Company for the past six years has been in control of the four leading electric light, heat and power companies: the Suburban Electric Light Company, the Scranton Illuminating, Heat and Power Company, the Scranton Electric Light Company and the Dunmore Electric Light Company. The water and gas companies are controlled by the Scranton Gas and Water Company. The water and gas companies are valued at $10,000,000, and the electric light companies are said to be worth at least as much more.

NEW POWER PLANT IN MAINE—It is announced that, within four months, work will begin on a large plant for the generation of electric power to be located at Bradley, on the Penobscot river, ten miles above Bangor, Me., or at Ellsworth, on Union river. It is planned to generate current on a large scale for use in the operation of manufacturing plants anywhere within a distance of twenty-five miles. The mills of the Eastern Manufacturing Company at South Brewer, near Bangor, will be the first to make use of the power. Several good water powers are available for the purpose, but the choice lies between Ellsworth and Bradley, and depends largely upon the cost of development and of adjacent lands. Mr. F. W. Ayer, president of the Eastern Manufacturing Company, is one of the principal parties interested in the scheme.

LARGE POWER PLANT AT TAYLOR'S FALLS, MINN.—The Minneapolis Electric Company and its controlling interests will spend some $3,500,000 in securing for Minneapolis and St. Paul, Minn., nearly double the present power available for manufacturing and other purposes. The power supplied at the present time by St. Anthony Falls is not sufficient to meet the demands for Minneapolis and adjacent cities. Recognizing this need the Minneapolis General Electric Company has secured a large water power right at Taylor's Falls. All of these privileges will be developed to the extent of 12,000 horse-power at once. This, however, can be doubled at any future time. The additional power will be transmitted at a pressure of 50,000 volts, and a substation will be located approximately on the dividing line between the twin cities. Power will be generated at Taylor's Falls station at 23,000 volts. This will be stepped up by transformers to 50,000 volts, which will be the transmission voltage.

ADDITIONAL POWER AT SAULT STE. MARIE, MICH.—The Edison-Sault Electric Company has let the contract for the construction of a new power-house in the Sault rapids to the McArthur Brothers Company. This is expected to be the first step in another large water-power development at the Sault. The new power-house will be entirely separate and independent of the present power plant, and will probably be constructed 350 feet further out into the stream. The intention is to leave ample room inside of the projected building for the construction of a pulp and paper mill which is eventually designed for that location. The extension, this far out into the rapids, will also necessitate the construction of new dykes in the river and a considerable amount of work above the site of the power-house itself. The building will be constructed entirely of cement. The present plans purpose the construction of a plant with a penstock capacity for six water-wheels, although at the outset but four will be installed. The water-wheels which will be used are expected to develop 720 horse-power each under full head. The structure above the penstocks will be one story in height, and will provide room for housing the dynamos. From the power-house current will be transmitted to the company's distributing station, which will be built during the present year on Arlington street, and distributed from there to all parts of the city as needed. Professor Gardner Williams, of the University of Michigan, will be the engineer in charge for the Edison company.

NEW COMPANIES.

WILMINGTON, DEL.—Becker Electrical Company. To manufacture electrical supplies. Capital, $1,500,000.

DETROIT, MICH.—The Arthur Dairs Electrical Construction Company has been incorporated. Capital, $1,000. Incorporators: Arthur Dairs, Agnes Dairs, James V. Oxtoby.

NEW YORK CITY, N. Y.—Torgal Trust Company. To manufacture electrical apparatus. Capital, $100,000. Incorporators: Charles W. Taylor, M. H. Mark, E. J. Ludvigs, all of New York.

ATLANTIC CITY, N. J.—Atlantic City Suburban Electric Company, electrician. Capital, $100,000. Incorporators: Louis Kuenle, John C. Reed, Atlantic City; H. E. Woodman, Philadelphia.

SPRINGFIELD, ILL.—The Benard Economical Arc Light Company, of Chicago, has been organized with a capital of $15,000. The incorporators are Jeremiah J. O'Donohue, Peter F. Daly and William J. Moore.

CINCINNATI, OHIO—The Electric Speed Meter Company has been incorporated with a capital of $30,000. To manufacture electric meters. The incorporators are W. H. Whitstone, Martin J. Hester, J. C. Short, R. C. Anderson and J. M. Hatton.

SPRINGFIELD, MASS.—The Fretts Electric Switch Company has been incorporated to deal in electrical appliances. The capital stock is $50,000, and the officers are: president, Herbert L. Handy; treasurer, Sayward Galbraith, both of Springfield.

BANGOR, ME.—The Massachusetts Car Fender Company has been organized at Portland for the purpose of manufacturing and dealing in all kinds of car fenders, car guards, etc., with $125,000 capital stock. The officers are: president, Ardon W. Coombs, of Portland; treasurer, Charles H. Tolmon, of Portland.

JERSEY CITY, N. J.—The Electric Composition Company has filed articles of incorporation with the county clerk. The company will manufacture type-making machinery under special patents. The capital stock is fixed at $1,000,000, and the incorporators are John H. Keppleman, Gilbert H. Montague, Ross A. Mackey, H. Scoville and John J. Treacy.

PROVIDENCE, R. I.—Articles of association have been filed with the secretary of state by Herbert B. Rust, Thomas Beswick and William C. Halstead for the H. B. Rust Company, for the purpose of engaging in the business of electrical contracting, engineering, constructing and dealing in electrical and other supplies. The capital stock is $50,000, and the concern will have headquarters in Providence.

Digitized by Google

TELEPHONE AND TELEGRAPH.

MANSON, IOWA—The Central Telephone Company's system in Manson is being reconstructed.

DOVER, TENN.—The Farmers and Merchants' Telephone Company has completed its lines to Dover.

MONROE, WASH.—The Sunset Telephone Company is rebuilding its line between Monroe and Machias.

PANA, ILL.—The Pana Telephone Company has voted to increase its capital stock from $15,000 to $30,000.

ATHENS, ALA.—A new telephone line, covering twenty miles of territory in the southwestern part of Limestone County, is being built.

BUFFALO, N. Y.—The Bolivar Telephone Company has increased its capital stock from $2,750 to $15,000, and will extend its lines into new territory.

FARGO, N. D.—The Tri-State Telephone Company has secured the right of way for the construction of a long-distance line through the city of Fargo.

ORANGE, TEX.—The Orange-Newton Telegraph and Telephone Company has made connection from its office at Orange with Fields, La., Stark and Niblett's Bluff.

NEW ORLEANS, LA.—A site has been purchased by the Cumberland Telephone and Telegraph Company for the establishment of a second branch exchange.

ATLANTIC CITY, N. J.—The Delaware & Atlantic Telephone Company's plans for the extension of its conduit system have been approved by the city council of Atlantic City.

COLUMBUS, OHIO—The Jackson County Home Telephone Company, an independent concern, has passed into Bell control for about $150,000. The company controls lines in Jackson, Wellston, Coalton, Oak Hill and Hamden.

LINCOLN, ILL.—Construction work will soon commence for the installation of a complete telephone service in Menard County by the Interstate Telephone Company. The company expects to build lines to Petersburg, Athens and Tallula.

LEBANON, IND.—With the exception of the Thorntown Cooperative, all of the independent telephone companies in Boone County have formed themselves into an organization to be known as the Protective Telephone Association of Boone County.

BRISTOL, S. D.—An independent telephone line is being constructed by the farmers living east and south of Bristol. The line has been extended already to the homes of a large number of farmers. When the line is completed steps will be taken to extend it into Bristol.

CHILI STATION, N. Y.—An agent of the Home Telephone Company, of Rochester, has been securing the right of way for a line through the south and central part of Chili, which will develop a large farming district. The right of way has been granted, and work will begin immediately.

SIOUX CITY, IOWA—The new building of the Sioux City Telephone Company on Jones street, Sioux City, has been completed. The building is of brick, and has two stories and a basement. The switchboards will have a capacity of 2,000 instruments. The automatic system has been adopted.

MAGNOLIA, MISS.—Local capitalists and others, whose business interests will be promoted, are endeavoring to form a company to construct a telephone line from Magnolia to Tylertown. The distance is twenty-one miles, and telephone interests would greatly facilitate the business interests of both places.

CANANDAIGUA, N. Y.—The Bell Telephone Company announces that it expects to expend $250,000 in extending and improving its services throughout the division which includes Canandaigua. A line is to be run from Canandaigua to Rushville, and through the Middlesex valley. Other extensions are contemplated.

BEALLSVILLE, PA.—The Beallsville Telephone Company has been organized by residents of West Pike Run township with the following officers: president, W. H. Wilson; secretary, F. L. Weaver; treasurer, E. Deems. Nearly all the farmers in the southeastern section of the county have taken stock.

TERRA HAUTE, IND.—The board of county commissioners has granted a franchise to the Farmers and Merchants' Telephone Company, conveying the right to build and maintain a telephone line through Sugar Creek and Fayette townships. A franchise had already been procured for a passage through West Terra Haute.

RENSSELAER, N. Y.—The Hudson River Telephone Company has purchased a site upon which it will construct a modern telephone exchange. The new building, for which plans and specifications have been drawn, will be a two-story brick, fireproof structure, and is to have a frontage of forty feet and a depth of thirty feet.

OMAHA, NEB.—The citizens of Council Bluffs have voted to grant a franchise to the Independent Telephone Company. The plans of the company provide for the raising of $100,000. The first step will be the construction of toll lines to Missouri Valley, Pacific Junction and through the county in the direction of Des Moines, to connect with all the independent lines.

RIVERSIDE, CAL.—The Southwest Home Telephone Company has been granted permission to extend its lines to San Jacinto, Perris and the Perris Valley country. The request was granted with the understanding that within one year the telephone company is to expend $15,000 in improvements, and another $5,000 before the end of the third year.

SULPHUR SPRINGS, COL.—The Colorado Telephone Company contemplates letting contracts for new copper wire lines from Sulphur Springs, across the Gore range to Steamboat Springs and other Routt County points, also stringing extra wires to Denver *via* Georgetown. The rapid growth of the country and increasing business make these improvements necessary.

BRISTOL, TENN.—The American Long-Distance Telephone Company is making preparations to extend its long-distance lines from Lynchburg, Va., to Knoxville, Tenn., *via* Bristol, which will give it direct connection with southwest Virginia and east Tennessee, a territory that is now being rapidly developed. It is stated that the work will be commenced this spring, with a view to having it completed by next fall.

MARYSVILLE, CAL.—The Bear River Telephone Company has been organized at Wheatland. E. T. Manwell is president and A. C. Stagner secretary. The company has a barbed wire telephone system in the southern part of Yuba County and in Sutter County. The line connects a large number of farms and several towns. It is now proposed to complete the system between Sacramento and Marysville.

SALT LAKE CITY, UTAH—Superintendent H. H. Hempstead, of the Rocky Mountain Bell Telephone Company, states that a new line will be constructed from Bancroft to Soda Springs, Ida., and another line will be started at Minidoka, which will follow the line of the new railroad being built by the Oregon Short Line. Eventually this line will penetrate all parts of the valley to be irrigated by the Twin Falls canal, including the new Twin Falls City.

LAFAYETTE, GA.—The Walker County Telephone Company has finished its new line as far as Menlo, and work is being pushed to finish the entire line, which, when completed, will extend to Menlo, Liberty and Ringgold. This company has changed hands recently, and work has been begun to make this one of the best lines in Georgia. The following are the new officers: W. S. Witham, president; R. M. W. Glenn, general manager; S. A. Hunt, Jr., secretary and treasurer.

FORT WAYNE, IND.—The annual meeting of the National Telephone and Telegraph Company was held recently, when the board of directors was reelected as follows: H. C. Paul, C. S. Bash, G. Max Hofmann, W. L. Moellering, William Bohn, August E. C. Becker, E. M. Popp, Sam S. Fisher and James McKay. Officers were then elected as follows: president, H. C. Paul; vice-president, C. S. Bash; secretary, W. L. Moellering; treasurer, William Bohn. The annual report showed a great increase of business, and the officers were authorized to expend $15,000 the coming year in improvements. Much of this money will be used to put in heavier wires for the long-distance business. The company now has connections with Cleveland, Toledo, Indianapolis, Louisville and many Michigan points, and expects to extend its connections the com-

Digitized by Google

ing year into Chicago, Pittsburg and Philadelphia. There will also be extensions made for connections with St. Louis.

COLUMBUS, GA.—The Southern Bell Telephone Company has bought the Adams telephone lines in Georgia and Alabama, and will begin the erection of a line from Columbus to Omaha, Ga., the headquarters of the Adams system.

TAYLORSVILLE, KY.—E. B. Stratton, manager of the Cumberland telephone exchanges at Taylorsville and Bloomfield, has secured the requisite number of subscribers at Chaplin, and the company will install an exchange at that place at once.

DOYLESTOWN, PA.—Linemen of the Bell Telephone Company are at work building a line from Buckingham to Wycombe and Pineville. The exchange will be at Wycombe. During the summer an exchange will also be installed at Plumsteadville.

ROCHESTER, N. Y.—Through the efforts of J. George Kaelber, president of the Rochester Electrical Signal Company, that corporation has been merged with the American District Telegraph Company, which will combine the former company's system with its own signal system. The Rochester company, formerly known as the Standard Electric Signal Company, has fire-alarm signal boxes in many residences and buildings. The American District Telegraph Company, which is practically the Western Union Telegraph Company, has a system consisting of messenger and police calls and registering of watchmen.

PITTSBURG, PA.—All preparations have been completed by the management of the Pittsburg & Lake Erie Railroad for the completion of the final work on the new long-distance telephone line which will extend from Pittsburg to Youngstown (sixty-eight miles), and which will connect there with the telephone system of the Lake Shore, giving the Pittsburg officials a through line to Chicago and New York, by which all important offices of the Vanderbilt system can be reached directly by private wire. The private long-distance wire will be connected with the Lake Erie private exchange in the South Side terminal building, and with the Lake Shore private exchange at Youngstown.

EDUCATIONAL.

VIEWS OF THE MICHIGAN COLLEGE OF MINES—The Michigan College of Mines, Houghton, Mich., has issued a book of views which is supplemental to the catalogue descriptions and reports of the work at the college. The views include the various buildings, interiors of laboratories, photographs of squads of students on field work, and a picture of the college glee club for 1904.

THE WASHINGTON AGRICULTURAL COLLEGE AND SCHOOL OF SCIENCE, of Pullman, Wash., announces that the recent act of legislation changed the name of the institution to the State College of Washington. Liberal appropriations were made for increased equipment in the mechanical and electrical department, and large additions are being planned for the electrical laboratories.

SUMMER SCHOOL FOR ARTISANS—The University of Wisconsin will conduct a summer school for artisans, under the direction of the College of Engineering, beginning June 26 and ending August 4. The courses will cover engines and boilers, applied electricity, mechanical drawing and machine design, materials of construction, fuel and lubricants, shop work and manual training. The requirements for admission do not extend beyond a working knowledge of English and arithmetic.

UNIVERSITY OF MINNESOTA—On Friday afternoon, March 17, Mr. Charles E. Downton, of Pittsburg, gave a very interesting lecture before the engineering students of the University of Minnesota, describing the works of the Westinghouse Electric and Manufacturing Company. With the aid of a moving-picture machine he took his audience from the Union depot in Pittsburg, along the Pennsylvania railway, past the various factories of the Westinghouse companies, thence through several shops of the electric factory, showing numerous steps in the construction and testing of electrical machinery. Of particular interest were several series of views showing heavy work in progress in the forge shop and foundry. The audience was much impressed by the magnitude of the works and by the long lines of employés leaving the factory and taking the trains, some twelve thousand employés being engaged.

THE ENGINEER AND HIS EDUCATION—"The Engineer and His Education" is the title of a brochure by Professor William Kent, dean of the Lyman C. Smith College of Applied Science, Syracuse University. Professor Kent differentiates the calling of the civil engineer, the mechanical engineer and the electrical engineer. He combines the complete engineer, however, with all three of these professions. A well educated and experienced engineer, he says, is not a skilled workman or artisan, but he is a man who knows how the artisan should do his work. He draws attention to the essential conditions to which the young man must adapt himself upon entering his course in engineering. The prospects of the engineering profession are pointed out. The great prizes are only for the few. A comfortable maintenance is for the majority, and the failures are no greater in number than in other professions.

PURDUE UNIVERSITY CATALOGUE—The 1904-1905 catalogue of Purdue University has been received. The number of students in attendance during the year 1904-1905 was 1,528, representing thirty-six states of the Union and ten foreign countries. Of the total enrolment, 410 were students of electrical engineering. The freshman class—by far the largest in the history of the university—numbered 461 students, the sophomore class, 389 students; the junior class, 261 students, and the senior class, 203 students; postgraduates, twenty-eight; students of pharmacy and special students, eighty-one. The number of graduates in electrical engineering in June, 1904. was fifty-six, and the number of electrical engineers to be graduated in June of this year will be sixty-five. The university offers courses in electrical, mechanical and civil engineering, science, agriculture and pharmacy. The number of professors, instructors and assistants in the faculty last year was 109.

NEW PUBLICATIONS.

"DEVELOPMENT OF THE LAKE SUPERIOR COPPER MINES DURING 1904"—This is the title of a book brought out by Arthur L. Carnahan, mining editor of the *Daily Mining Gazette*, Houghton, Mich. The book is 6 by 10 inches, bound in paper, and sells for fifty cents. It treats of the improvements made in the various mines during the past year.

"ELECTRIFICATION OF THE LONDON UNDERGROUND ELECTRIC RAILWAYS COMPANY'S SYSTEM"—This is a reprint of an article by Mr. S. B. Fortenbaugh, which appeared under the above title in the *Street Railway Journal*. It describes the Chelsea generating station and substations, the tunnel lighting and signal apparatus, the telephone system, the timekeeping system, the cars, and other electrical equipment of the system.

PROGRESS IN ELECTROCHEMISTRY IN THE UNITED STATES SINCE 1900—A bulletin entitled "Progress in Electrochemistry in the United States Since 1900," by Charles A. Doremus, New York city, has been reprinted from the report of the Fifth International Congress of Applied Electrochemistry, Berlin, 1903. This publication is a particularly valuable index of the development of electrochemical research in recent years. The materials touched upon are numerous, and embrace practically everything that has been attempted in electrometallurgical and electrochemical reduction. Several illustrations are given, showing forms of apparatus used for the fixation of nitrogen from the atmosphere.

THE CLARKSON BULLETIN—The Clarkson bulletin for January, issued by the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., has been received. The contents of this number are as follows: "The Science and Practice of Civil Engineering," Founder's Day address, by William Sooy Smith. "A Modified Westphal Balance for Solids and Liquids," by F. M. Williams. Abstracts of graduating theses presented for baccalaureate degrees, June 17, 1904, as follows: "Micrographic Examination of Steel Construction of Apparatus Used," Samuel Fitch Carlisle; "Discharge of the Raquette River at Potsdam, N. Y.," Charles A. Gridley and Ralph D. Hayes; "An Investigation of the Waste Liquor of the Sulphite Pulp Process," Frank Casper Zapf; "Vegetarian Dietaries," Bessie E. Andrews and Anna L. Smith. An index of the Clarkson Alumni Association, with notes on the student organizations, and a sketch of the Clarkson summer school, are given.

Digitized by Google

NEW INCORPORATIONS.

McCONNELSVILLE, OHIO—Home Telephone Company. $25,000.

DETROIT, MICH.—Davis Electric Construction Company. $1,000.

DES MOINES, IOWA—Dayton Telephone Company. Increased to $25,000.

MONTREAL, QUEBEC—The Richelieu Light and Power Company. $500,000.

NASHVILLE, TENN.—Southwestern Dixie Telephone Company, of Carroll County. $1,000.

BORDEN, IND.—The Farmers' Union Telephone Company. $1,000. J. G. Scott, president.

NEW LONDON, IOWA—Henry County Telephone Company. Increased from $15,000 to $30,000.

CHICAGO, ILL.—The Chicago, Kankakee & Champaign Electric Railroad Company. $100,000.

DYSART, IOWA—Geneseo Mutual Farmers' Telephone Company. $2,000. L. R. McElhinney and others.

PIERRE, S. D.—Farmers' Epiphany Line. $1,750. Incorporators: Henry Roth, Theodore Roster and others.

DOVER, DEL.—American Telephone and Telegraph Company. To operate telephone and telegraph lines. $50,000.

SANFORD, ILL.—The Sanford Mutual Telephone Company. $5,000. Incorporators: C. A. Ray, W. Smith, J. M. Art.

FARNHAMVILLE, IOWA—Farnhamville Mutual Telephone Company. $10,000. Incorporators: Charles Rose and others.

BONDVILLE, ILL.—Bondville Telephone Company. $2,500. Incorporators: William H. Scott, George A. Keller, Otis W. Norton.

MANITOWOC, WIS.—Fox River Valley Railway Company. $25,000. Incorporators: Henry Byersdorf, Fred Byersdorf, L. H. Bazlen.

DOVER, DEL.—Central Light and Traction Company. To construct and dispose of plants for lighting, heating and power. $1,000,000.

ALBANY, N. Y.—Bennington Electric Company. $125,000. Incorporators: A. H. Beckman, W. D. Eaton, G. D. Martin, all of New York city.

CHICAGO, ILL.—Brennan Electric Construction Company. $5,000. Incorporators: William F. Brennan, Joseph P. Early, Daniel F. Cleary.

ALEXANDRIA, VA.—Opequon Telephone Company. $1,000. Officers: president, C. W. Snapp; vice-president, H. T. Snapp; secretary, E. J. Snapp.

WOODBURY, N. J.—The Gloucester County Electric Company. $50,000. Incorporators: Enos R. Artman, Manasses K. Treichler, Edward F. Johnson.

LITTLETON, ILL.—Schuyler County Central Mutual Telephone Company. $1,200. Incorporators: George Leonard, W. C. Chipman and W. H. Kettering.

MONROE, N. Y.—The Grange & Rockland Electric Company. $50,000. Directors: Zael Paddleford and Luther Terwilliger, Monroe; G. M. Roe, Chester.

WINCHESTER, VA.—Frederick & Clarke Telephone Company. $5,000. Charles Mullikin, president; H. F. Byrd, vice-president; Shirley Carter, secretary.

MUNCIE, IND.—Citizens' Electric Light Company. $200,000. Directors: Charles E. Hinkley, H. J. Keller, W. C. Braun, C. Roy Hathaway and William F. Warner.

NEW WINCHESTER, IND.—The New Winchester Farmers' Mutual Telephone Company. $1,000. Incorporators: Henry Beckley, Francis Sheets, Harvey Hays, Jr.

LOS ANGELES, CAL.—Redonia Home Telephone Company. $40,000. Directors: C. F. Guthridge, C. L. Zahn, D. F. Boyce, C. P. Platt and A. Wright, all of Los Angeles.

RALEIGH, N. C.—Wilmington & Southport Telephone and Telegraph Company. $5,000. Incorporators: D. I. Watson, L. J. Pepper, Richard Dosher, W. B. Cooper and S. F. Craig.

NASHVILLE, TENN.—Tennessee Power Company. $100,000. Incorporators: C. H. Ackerman, W. B. Dinsmore, Jr., F. F. Culver, C. H. Hart, T. M. R. Meikleham, Granville Whittlesey.

ASHTABULA, OHIO—Wayne Telephone Company. $6,000. Incorporators: S. A. Babcock, R. P. Miner, A. C. Bogue, D. L. Ketcham, William Dolan, R. Dillon and O. H. Ketcham.

HOOPESTON, ILL.—Interstate Traction Company. $100,000. Incorporators: James H. Dyer, James A. Cunningham, A. H. Trego, Charles C. Williams and J. S. McFerren, all of Hoopeston, Ill.

ALTUS, O. T.—The Altus Light, Power and Ice Company. $25,000. Incorporators: A. Reumelli, of St. Louis, Mo.; Henry Braun, of Guthrie; D. R. Rankin, H. H. Lloyd and E. W. Newell, of Altus.

CHICAGO, ILL.—Morris Terminal Railway Company. $50,000. Incorporators: Charles E. Hook and Oscar Harberle, of Ottawa, Ill.; Edward C. Curtis, of Grant, Ill., and George T. Buckingham, of Danville.

WERNERSVILLE, PA.—The Wernersville Light, Heat and Power Company. To supply light to the borough of Wernersville. $5,000. Incorporators: George W. Wertz, Robert W. Wertz and David Froelich.

SALT LAKE CITY, UTAH—Fairview Electric Light and Power Company. $15,000. Peter Olson, president; A. V. Miner, vice-president; Peter Sundwall, secretary and treasurer, all of Fairview, Sanpete County.

DAYTON, OHIO—Dayton & Northern Railroad Company. To construct an electric line from Dayton to Kenton. $100,000. Incorporators: M. W. Chambers, F. H. James, Webster W. Shuey, Hugo Cook and John J. Hall.

HELENA, MONT.—Madison River Power Company. $600,000. Directors: Pressley E. Bisland, Bronxville, N. Y.; Allen J. Nichols, Charles R. Ganter and Albert S. Ridley, New York city, and William S. Brayton, East Orange, N. J.

GULFPORT, MISS.—The West Gulfport & Race Track Street Railway Company. $25,000. Incorporators: Phil A. Dolan, J. R. Hill, J. R. Pratt, S. P. Moorman, E. S. Burrill, W. R. Batchellor, J. T. Richardson and P. H. M. Tippin.

HARTFORD CITY, IND.—Indiana, Hartford City & Eastern Traction Company. $25,000. Directors: Charles G. Buell, Alfred M. Weeden, Robert G. Kirkpatrick, Thomas F. Colbert, William R. Garver, John Feiger and Frank L. Scott.

PORTLAND, ME.—Cascade Light and Power Company. To manufacture and deal in electricity and gas for heat, light and motive power. $100,000. Officers: president, C. A. Hight, of Boston, Mass.; treasurer, L. L. Hight, of Portland.

RICHMOND, VA.—The Lincoln Telephone Company. To construct, maintain and operate a telephone line in the county of Loudoun, and to do a general telephone business. $5,000. Officers: W. T. Smith, Lincoln, president; H. T. Pancoast, secretary and treasurer.

ATLANTIC CITY, N. J.—The Atlantic City Suburban Electric Company. The company is to do a general electric business, to manufacture and deal in electrical heat and light and power. $100,000. Incorporators: Louis Keuhnle, Harry E. Woodman and John C. Reed.

CLINTON, N. Y.—Clinton Home Telephone Company. To operate in Clinton, Kirkland and Clark's Mills in Oneida and Madison counties. $25,000. Directors: C. D. Hayes, G. T. Caldwell, H. S. Powell, M. S. Powell, all of Clinton; C. H. Poole and T. H. Ferris, of Utica, and G. R. Fuller, of Rochester.

OTTAWA, ONTARIO—The Grand Falls Power Company. $200,000. Incorporators: Sir William C. Van Horne, of Montreal, Redfield Proctor, of Proctor, Vt.; Richard B. Angus, of Montreal; Hugh Havelock MacLean, of St. John, New Brunswick; Frank C. Partridge, Proctor, Vt.; Frank Ray Kimberley, of New York, and Ernest Alexander, of Montreal.

ALBANY, N. Y.—The Savannah Telephone Company, of Savannah, Wayne County. To construct lines connecting Savannah, Clyde, Port Byron, Wolcott, Red Creek, Seneca Falls, Cato and other points in Wayne, Cayuga and Seneca counties. $4,000. Directors: Charles A. Mead, Crossman A. Coleman, Fred W. Hadden and Edson S. Wood, of Savannah; Marcus S. Fowler, of Butler, and George P. Vandewater, of Spring Lake.

Digitized by Google

PERSONAL MENTION.

MR. R. S. WHEELER has resigned his position as manager of the Cumberland Telephone and Telegraph Company's office at Paris, Tenn., and has taken charge of a crew on construction work for the company.

MR. RICHARD DEVENS, who has for some years been connected with the European office of the Brown Hoisting Machinery Company, Cleveland, Ohio, has been appointed manager of the company's New York office at 26 Cortlandt street, to succeed Mr. W. A. Stadelman who has resigned.

MR. GEORGE CUTTER, whose name has been connected with Chicago ever since the early days of electric lighting, has moved to an entirely new location. The finishing touches are now being put on his new factory at South Bend, Ind., where the George Cutter Company will be located after April 15.

MR. WALTER I. BARNES has been appointed assistant general manager of the Narragansett Electric Lighting Company, Providence, R. I. He succeeds Mr. Arthur B. Lisle, resigned. Mr. Barnes has been with the company for thirteen years, the first part of the time being in the treasurer's office. For the past six years he has held the position of general superintendent.

MR. ARTHUR B. LISLE, well known in electric lighting circles of New England, and for years associated with the Narragansett Electric Lighting Company, has entered the banking business, becoming a member of the firm of D. A. Pierce & Company, Providence, R. I. This company is a leading banking and brokerage house of Rhode Island, and Mr. Lisle's association with it will undoubtedly be of mutual advantage.

MR. LOUIS B. MARKS has associated with Mr. Henry Floy in consulting engineering work, with offices at No. 220 Broadway, New York city. Mr. Marks will make a specialty of illuminating engineering, in which field he has had great experience, and which he believes will offer large opportunity for new work. He has been appointed illuminating engineer for the new buildings of the College of the City of New York, which are now being erected on St. Nicholas terrace. The architects are Messrs. George B. Post & Sons.

MR. L. G. RICHARDSON, president of the Central Union Telephone Company, has been elected president of the Cleveland Telephone Company, the local Bell exchange at Cleveland, Ohio. The Central Union company embraces the Bell exchanges in Ohio other than Cleveland, and in Indiana and Illinois. President Richardson will be able to devote much of his time to the development of the Cleveland company, and is said to be thoroughly in sympathy with an aggressive campaign which the local Bell people have begun.

MR. T. T. LYMAN has been appointed general sales manager of the H. W. Johns-Manville Company, of 100 William street, New York city. The position will call for the installation of various comprehensive systems in connection with the work of its branches in Milwaukee, Chicago, St. Louis, Boston, Philadelphia, Pittsburg, Cleveland, New Orleans and San Francisco, enabling the company to keep pace with the growth of the business in its territory, and will contemplate the opening up of new territory as the interests of the company may require.

MR. W. E. BELLMAN has been appointed manager of offices for the ninety branches of the Western Union Telegraph Company in St. Louis, Mo. Mr. Bellman began as telegraph operator twenty years ago, and has been employed in every branch of railway, commercial and newspaper telegraph work. He was appointed chief operator at Cedar Rapids, Iowa, in 1889, and resigned a year later to enter the brokerage business. He worked first as an operator at Kansas City, and later became manager of a broker's office in Chicago. He was with the Wabash Railroad from 1893 to 1898 as manager of a railway office, and was later train despatcher, and lastly, chief clerk and superintendent of telegraphs. Since that time he has been with the Western Union company, holding positions as operator, division chief, traffic chief and solicitor. During the St. Louis World's Fair he was manager of the Western Union branch on the exposition grounds.

ELECTRICAL SECURITIES.

Apparently a strong upward tendency has been developed during the past week. The feeling of apprehension which accompanied the reaction of two weeks ago has entirely disappeared, and prices in many cases are again at the high levels quoted just before the break. From every quarter comes news of returning confidence and enthusiasm. A period of beneficent weather conditions would do much to keep this enthusiasm kindled, and make ready for a real boom in all directions. Railroad earnings are more favorable, and the iron and steel industry appears decidedly busy and prosperous.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 8.

New York:	*Closing.*
Brooklyn Rapid Transit	69⅞
Consolidated Gas	205⅝
General Electric	188½
Interborough Rapid Transit	209
Kings County Electric	200
Manhattan Elevated	166½
Metropolitan Street Railway	122¾
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	196⅞

The Brooklyn Rapid Transit Company has applied to the New York Stock Exchange to list $1,750,000 additional refunding mortgage 4 per cent bonds of 2002.

Boston:	*Closing.*
American Telephone and Telegraph	144⅞
Edison Electric Illuminating	256
Massachusetts Electric	68
New England Telephone	139
Western Telephone and Telegraph preferred	101

The New England Telephone and Telegraph Company has filed its statement of financial condition with the Massachusetts secretary of state as of date December 31, 1904, as follows: assets—real estate, $702,561; cash and debts receivable, $3,827,201; merchandise, $1,284,554; plant and franchise, $24,815,829; miscellaneous, $1,132,567, a total of $31,762,713. Liabilities—capital stock, $23,180,000; debts, $5,265,064; reserve, $1,720,245. This makes the surplus for the year $1,597,403. The directors of the company have declared the regular quarterly dividend of 1½ per cent, payable May 15 to stock of record April 20.

The railroad commission has authorized the Boston Elevated to issue $7,500,000 4 per cent, thirty-year bonds.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	86½
Electric Storage Battery preferred	86½
Philadelphia Electric	11¼
Philadelphia Rapid Transit	31¼
United Gas Improvement	115¾
Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61
National Carbon common	52
National Carbon preferred	115
Union Traction common	9½
United Gas Improvement	40

The Chicago Telephone Company reports a gain of 1,919 new telephones during March. The total number now in use is 123,284.

The Metropolitan West Side Elevated Railroad Company has issued its report for the year ended February 28, 1905. The income account is as follows: gross, $2,160,941; expenses, $1,059,107, leaving net of $1,101,834; charges, $860,409, making the surplus for the year $241,425, as compared with $216,107 for 1904. The report shows about 2¾ per cent earned on the preferred stock. The daily average of passengers was 114,232, and the percentage of increase was a little over 1 per cent. At the company's annual meeting 124,070 shares were represented. Benjamin Allen, F. A. Delano, C. C. Adsit and R. F. Clinch were elected directors, the latter two succeeding President D. McAllister and Clarence S. Day.

Digitized by Google

ELECTRIC RAILWAYS.

OROVILLE, CAL.—Work of surveying a line for the Northern California Electric Transportation Company has been begun.

ZANESVILLE, OHIO—The town council of Roseville has granted a franchise to the Southern Ohio Railway, Light and Power Company.

JOPLIN, MO.—A. H. Rogers, E. Z. Wollawer and A. G. Nisley have been granted a franchise by the city council of Webb City to build an electric line.

OAKLAND, CAL.—The Oakland city council has granted to the Oakland Traction Consolidated a franchise for a street car line on Linda avenue from Piedmont avenue north to the charter line of the city.

PALATKA, FLA.—Prominent citizens are agitating the formation of a stock company for establishing an electric car line from East Palatka to Hastings. It is estimated that the system could be installed for $25,000 or $30,000.

DAVENPORT, IOWA—The Davenport-Iowa City Traction Company, which purposes to build an interurban railway, through Tipton and Davenport, has been granted a franchise for its terminals in Iowa City by a majority of 1,374 votes.

TACOMA, WASH.—The Tacoma Railway and Power Company, during the coming summer, will extend its McKinley street line to Bismarck, a thriving suburb southeast of Tacoma, having a population of 1,400 people. The new line will be two miles long.

ONEIDA, N. Y.—Consents have been obtained along the highway between Oneida Castle and Sconondoah for the proposed Rome-Oneida trolley. This would make a straight road from Rome to the castle somewhat longer than the original project of entering Oneida at or through Madison street.

LORAIN, OHIO—Besides preparing to make a bid for Elyria business the Lake Shore Electric Railroad is about to extend its line to Oberlin from Lorain. Surveyors are engaged running a line from South Lorain through to that place, and a portion of the right of way has already been secured.

SHAWANO, WIS.—The Red River Valley Electric Railroad Company has made application to the city of Antigo for a franchise to construct and operate an electric railway system in the streets of the city. The line is to have connection with the projected interurban line from Eland Junction.

NEWARK, N. J.—The Public Service Corporation held its annual meeting on April 4. The company has twenty-eight directors, and they elect eight each year. The following eight directors were elected: Mark T. Cox, W. H. Hamill, William C. Heppenheimer, Lewis Lillie, J. F. Shanley, C. A. Sterling, P. Farmer Wanser, Leslie D. Ward.

SIOUX CITY, IOWA—The Sioux City Traction Company has more than doubled its original appropriation for the Sioux City improvements during the coming summer. According to the plans of the company at present the amount of money invested in improvements will exceed $400,000. Of this sum $280,000 will be expended this summer.

LA CROSSE, WIS.—An electric line between La Crosse and the Twin Cities has been proposed. The La Crosse & Northern now has franchises and right of way as far as Galesville. The project calls for the construction of the line to Galesville, and its extension to Winona. The remainder of the route is to be built by the St. Paul Street Railway Company.

BUCYRUS, OHIO—The Columbus, Delaware & Marion electric line, which is preparing to build an extension into Crawford County, has let the contract for the necessary machinery to equip its power-house just south of Delaware. The plant will be finished by July 1. Turbine engines will be installed throughout, and the equipment will be of the most modern type.

GENEVA, N. Y.—The report that the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company, operating an electric line between Geneva and Cayuga Lake Park, had sold the road has been confirmed. The new owners are the recent purchasers of the Rochester & Eastern. It is said the road will be rebuilt and that instead of the tracks being laid in the highway the route will be through private property.

ALBANY, N. Y.—The Findley Lake & State Line Street Railway Company, of Chautauqua, has been incorporated to construct a thirteen-mile electric railway in Chautauqua County. The capital is $130,000, and the directors are: F. R. Nicholas, of Titusville; T. E. Milkie, G. O. Elston, J. F. Austin, James R. Graves, T. H. Coggswell, Jackson Reymond, I. A. Pond, of Corry, Pa.; E. A. Austin, of Cutting. The principal office is at Findley.

INDIANAPOLIS, IND.—Work has begun on a short electric line to connect Lebanon and Thorntown. It is being constructed by the Lebanon-Thorntown Traction Company, of Indianapolis. The line will be only ten miles in length, and will serve as little more than a feeder for the Indianapolis & Northwestern. The officers of the company are: Howard M. Atkinson, of Indianapolis, president; Robert P. Woods, secretary and chief engineer; Frank M. Reed, of Indianapolis, vice-president; Richard E. Niven, of Thorntown, treasurer. Empson T. Lane, of Lebanon, is the other director.

STRATFORD, ONTARIO—At this session of the legislature application will be made for a charter to incorporate a company to build and operate an electric railway to run from Stratford to Grand Bend and Lake Huron. It is purposed to build the line through the townships of Downie, Fullerton, Blanshard, or Hibbert, in Perth County, and Usborne and Stephen, in Huron, passing through the village of Exeter. It is also contemplated to run a branch to New Hamburg, and thence to Tavistock. This railway will serve one of the finest of farming communities in western Ontario.

GRAND JUNCTION, COL.—The Grand Junction city council has approved the bond of George Smith, of Grand Junction, and C. A. Steyn, of Denver, in the sum of $15,000, the condition being that two miles of the electric line between Grand Junction and Palisades be constructed within the next eighteen months. The Grand Junction Construction Company has been organized with Judge G. Van Hoorebeke, of Grand Junction, as president, William Campbell as vice-president, and George Williams as secretary and treasurer. The latter is the county treasurer. The company will build the road.

SUFFOLK, VA.—The stockholders of the Seaboard Traction Company, which will run a trolley from Norfolk to Suffolk and Smithfield, and possibly to Richmond, has elected the following officers: L. R. Britt, president; William H. Robinson and George L. Barton, vice-presidents; George H. Lewis, general manager; W. D. Southall, treasurer; Lee Britt, secretary. An agreement has been entered into with a construction company to begin road building. The company will start operations at three points simultaneously—Norfolk, Suffolk and Smithfield. It expects to have trains running within eight months.

BUFFALO, N. Y.—The Buffalo Southern Railway Company, which was the Buffalo, Hamburg & Aurora Railway and the Buffalo, Gardenville & Ebenezer Railway, has entered into a contract with J. B. Rumsey, whereby he is to construct a first-class, high-speed railroad, from the city line of Buffalo through the towns and villages of West Seneca, Ebenezer, Spring Brook, Elma, Elma Center and Jamison to East Aurora, a distance of about thirteen miles, principally on private rights of way. It is expected that the work will be commenced immediately, and the line finished and in working order in a few months. Several prominent local business men are directors in the new company.

NEWBURGH, N. Y.—The Wallkill Transit Company, of Middletown, a reorganization of the Middletown-Goshen Electric Railway Company, has been incorporated at Albany with a capital of $350,000. The directors of the new company are: H. B. Royce and Marcus Benjamin, of Middletown; W. W. Sponsler, W. A. Sponsler, Jr., of Philadelphia; E. R. Sponsler, W. M. Ogelsby, Charles H. Bergner and W. S. Bergner, of Harrisburg, Pa., and David Hackett, of Bloomsburg, Pa. The reorganization takes over all the rights and franchises of the old Middletown-Goshen Traction Company and the Middletown-Bloomsburg Electric Company, together with the Middletown-Goshen Electric Railway Company, which was a reorganization of the two former companies.

Digitized by Google

ELECTRIC LIGHTING.

WEBSTER, MASS.—The Webster Electric Company has extended its line to Oxford.

SAN ANGELO, TEX.—Sonora, Sutton County, will have an electric light plant this year.

VUDAN, ILL.—The Vudan city council has granted a twenty-year electric light franchise to Charles W. Carr.

SIBLEY, IOWA—The Sioux City Interstate Supply Company contemplates installing an electric light system.

KINGWOOD, W. VA.—It is proposed to purchase a new dynamo and install new wiring for the town electric light plant.

JAMESTOWN, OHIO—The Jamestown Electric Light Company will install a new alternating-current incandescent dynamo.

NORTHWOOD, IOWA—The Northwood electric light plant will install an engine, two generators and switchboard apparatus.

READING, OHIO—The Reading council is preparing to call an election to vote on issuing $25,000 for improvements to the electric light plant.

CORNING, IOWA—C. K. Munns, owner of the Corning Electric Company, expects to make a number of improvements during the spring.

CARROLLTON, OHIO—The Carrollton Electrical Company will in the spring add a new engine, dynamo and boiler. E. L. Swann is manager.

TACOMA, WASH.—An electric lighting and power plant will be built by the Equitable Finance Company, of Portland, on the Nisqually river. It will cost $750,000.

KELSO, WASH.—The council has granted to the Kelso Light and Power Company a twenty-five-year electric light franchise. The plant is to be in operation inside of six months.

ROSSLAND, B. C.—The West Kootenay Power and Light Company has commenced an elaborate scheme of development of the upper falls of the Kootenay river at Bonnington.

MASSILLON, OHIO—Press reports state that it is proposed to bond the city for $500,000, to be used for the construction of waterworks, an electric light plant and city hall.

NEW YORK, N. Y.—The Westchester Lighting Company is supplying Mount Vernon with electricity from its plant in Eastchester. The old works in that city have been discontinued.

READING, PA.—A five-year lighting contract has been awarded to the Metropolitan Electric Light Company. It is for arc and incandescent lights, illuminating city hall and the police patrol wagon stable.

DOYLESTOWN, PA.—The Georgetown, S. C., Electric Light Company's plant has been sold to Harry Case, of Newtown, Bucks County, for $60,000. The concern was capitalized at $30,000, and bonded for $40,000.

BUTTE, MONT.—It is reported that a deal has been closed whereby the Butte Electric Light and Power Company becomes the owner of the property of the Bozeman Company, having bought out the latter corporation.

SALIDA, COL.—The Edison Electric Company has been granted an eight-year franchise, by the Salida city council, to furnish the city with lights. The company has commenced work on a large power plant which will require the expenditure of $100,000.

RENFREW, ONT.—The new electric lighting and power plant built by the town of Fenelon Falls at a cost of $30,000 is now in running order. The work, which was begun early last summer, involved the construction of a concrete dam 200 feet long.

NIAGARA FALLS, N. Y.—The Canadian Niagara Power Company, it is reported, may erect a power transmission line toward Queenstown. It is said the power-house of the Niagara Falls Park and River Railway, at that point, will receive current over the new line.

BAYONNE, N. J.—A bill has been introduced in the New Jersey legislature, at the instance of Mayor Thomas Brady, authorizing the city of Bayonne to erect an electric light and power plant. The bill contains a referendum clause, and is applicable to any municipality.

BAKER CITY, ORE.—It is stated that eastern interests have purchased the Baker City electric plant for $400,000. The plant is located on Rock creek, about twenty miles from the city, and has a capacity of 1,500 horse-power. The only improvement to be made this year is the extension of the power lines to more distant properties.

DECORAH, IOWA—The Decorah Electric Light Company purposes developing a water power and transmission line to operate its Decorah plant, and one at Waukon. There will be required, besides a dam, two 200 to 250-horse-power wheels, two 128-kilowatt, 6,600-volt, three-phase, sixty-cycle generators, and 250 kilowatts in transformers.

SAN FRANCISCO, CAL.—The board of supervisors of Inyo County, Cal., has granted a franchise to W. E. Condon, representing the Owens River Light and Power Company, to construct and operate electric systems along the public highways. The work of construction is to begin within six months and must be completed within eighteen months.

FLORENCE, COL.—The board of trustees of the town of Rockvale has granted to the Arkansas Valley Electric Company, of Florence, a franchise, giving it the privilege of erecting poles and stringing wires within the town limits, for the purpose of furnishing electricity for light and motive power. The franchise is for one year, with the privilege of renewal.

CHARLOTTE, N. C.—It is stated that the Mountain Island Power Company, which owns the Mountain Island mills, 1,100 acres of land and the water rights along the Catawaba river for several miles, has been sold to a party of capitalists headed by W. G. Wylie, of New York, the purchase price being $300,000. It is stated that the purpose of the new company is to furnish power to a large number of mills in adjoining counties.

OTTAWA, ILL.—The waterworks and electric lighting systems of Marseilles are now under control of a new corporation, known as the Consolidated Water and Light Company. Heretofore the waterworks and street lighting systems have been operated by the Water and Light Company, and the incandescent system by the Land and Water Power Company, both owned by W. D. Boyce. The new syndicate is headed by John M. Nicholson.

PITTSBURG, PA.—The Mifflin Light and Power Company, which was granted a charter recently, has commenced work on its power-house in Mifflin township, the cost of the power-house being estimated at $30,000. The company was about a year ago granted a franchise by the Homestead council. The directors are the owners of the Homestead & Mifflin Street Railway Company, which operates a line from Homestead to Lincoln Place, in Mifflin township.

PORTCHESTER, N. Y.—The certificate of election of directors of the Westchester Lighting Company has been filed in White Plains. It shows that the following directors were chosen for the ensuing year: W. R. Addick, L. L. G. Benedict, James C. Brady, Harold Brown, R. A. Carter, H. E. Gawtray, William E. Hall, Thomas E. Murray, W. W. Screwgham, John W. Sterling, F. A. Stratton. There were 1,363,989 votes cast; each director received 123,999 votes.

NEWARK, N. J.—The annual meeting of the board of directors of the United Electric Company, of New Jersey, which the Public Service Corporation absorbed, was held recently, and all the officers of the concern were reelected as follows: president, Thomas N. McCarter; vice-president, A. B. Carlton; treasurer, James P. Dusenberry; secretary, Frederick Evans. Directors were reelected as follows: John J. Burleigh, Thomas C. Barr, Mr. Carlton, A. R. Kuser, T. N. McCarter, Uzal H. McCarter, Charles A. Sterling and John I. Waterbury.

WATKINS, N. Y.—Justice Albert H. Sewell has granted a judgment of foreclosure and sale in the case of the People's Bank of Wilkesbarre, Pa., *vs.* the Watkins Consolidated Gas and Electric Light Company. Charles M. Woodward, of Watkins, the referee named for that purpose, will sell the property of the company at the court house, April 21, to satisfy the claim which approximates $108,416.69, to which must be added interest from March 6, 1905, and court allowances. The property consists of three parcels of land, with gas and electrical equipment and all rights of way, powers, privileges, franchises and contracts granted to and enjoyed by the defendant company. The electrical plant of the company was practically destroyed by fire a few weeks ago.

Digitized by Google

INDUSTRIAL ITEMS.

THE NEWARK GAS ENGINE COMPANY, 220 Broadway, New York city, will be pleased to send descriptive matter and a list of users of its gas and gasoline engines.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago and New York, is distributing a valuable leaflet entitled "Sulphate of Iron in Agriculture." This bulletin has been compiled by H. E. Horton.

C. W. HUNT & COMPANY, New York, have issued catalogue No. 053, describing the Hunt noiseless conveyer and accessories. The book contains a large number of photographs and line-cuts, illustrating the application of the conveyer in numerous power plants.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is distributing catalogue No. 119, describing machinery for cement making. Processes are described, and complete plants are shown. All types of mills and other machinery used are described and illustrated.

THE ARCHBOLD-BRADY COMPANY, Syracuse, N. Y., announces that it has removed its offices to temporary quarters at 237 James street. After May 1 it will occupy permanent quarters in its new structural shop at Greenway avenue and the West Shore railroad.

THE HOWARD MINIATURE LAMP COMPANY, 58-60 Reade street, New York city, has issued a new catalogue on miniature lamps. Nearly sixty types of miniature lamps are illustrated. This company is also about to place on the market a new line of medical batteries.

THE RELIANCE MACHINE AND TOOL COMPANY, Cleveland, Ohio, has printed a new catalogue describing Reliance bolt threading, pipe threading, nut-tapping machinery and accessories. Illustrations are given in half-tone and in diagram, and the apparatus is fully described.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., is distributing a booklet, illustrating the various types of storage batteries made by this company. These include batteries for power station, for telephone work, railway signal systems, car lighting, gasoline ignition and electric vehicles.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., has brought out catalogue No. 16, describing the direct-current fans made by this company. These include ceiling, electrolier, column, desk telephone booth and counter fans. The catalogue contains about thirty pages, and is very attractively got up.

THE ELECTRIC GAS LIGHTING COMPANY, 115 Purchase street, Boston, Mass., is distributing an elaborate catalogue descriptive of its telephone and annunciator practice. This work gives a few examples of representative installations. The book is handsomely printed, and the references are complete and easily understood.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is calling attention to its "Sun" soldering stick. This material is for work that demands good solder, but where it will not pay to use high quality flux. The "Sun" soldering stick makes a strong, quick joint, keeps the solder tight, saves scraping, and gets in under the dirt and rust.

THE GRIGGS MANUFACTURING COMPANY, 79-81 Fifth avenue, Chicago, Ill., will be pleased to send its descriptive matter relative to the Griggs improved desk telephone-holder. This holder is made in three styles of finish—black japaned, copper oxidized and nickel-plated. The holder is very simple in construction, and is claimed by the manufacturer to be very durable and of great practical value.

THE DIAMOND-STONE BRICK COMPANY, Wilmington, Del., announces that it has closed contracts in Philadelphia for over 5,000,000 of its new Diamond-Stone brick, which is manufactured on the sand-lime principle. The company states that it makes a large variety of special colored bricks, and also spotted and rough bricks, which are especially recommended for resistance to severe weather.

THE WATERBURY BRASS COMPANY, Waterbury, Ct., has brought out a new catalogue. This catalogue contains complete tables and weights of seamless-drawn brass and copper tubes, and brazed tubes; also brass and copper in rods, wire and sheets. Tables, which are short-cuts in figuring on tubes, are also given. A complete list of the stock carried on hand is also incorporated in the catalogue.

THE NEW YORK TELEPHONE COMPANY, 15 Dey street, New York city, is distributing a handy reference calendar. This calendar has been devised for handy reference to the last and coming month, as well as to the present month. The company also reminds one that the use of the telephone has not been sufficient in the past, and that the present is the proper time to provide for the telephone facilities of the future.

THE NORMAN W. HENLEY PUBLISHING COMPANY, 132 Nassau street, New York city, has brought out a boiler-room chart which sells for twenty-five cents. The chart is a drawing in isometric perspective, and shows all the mechanisms in a modern boiler room, arranged in their proper relation to each other. The various parts of the different appliances are numbered, and a reference table, giving their correct names, is printed on the side of the chart.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., manufacturer of Christensen air brakes and electrical machinery, will remove its New York city offices to a new suite on the twelfth floor of the Trinity Building, 111 Broadway, one of the largest and most modern buildings in the city. The present quarters of the company at 135 Broadway are too small to accommodate the increased sales organization. The Trinity Building will be ready for occupancy about May 1.

THE UNITED TELPHERAGE DEPARTMENT, DODGE COAL STORAGE COMPANY, 49 Dey street, New York city, will be pleased to send circular No. 55 upon request. This circular describes and illustrates telpherage equipment for transporting machinery, castings and general merchandise from one part of a works to another. This circular illustrates a number of typical instances where telpherage equipment has been installed, greatly improving the efficiency of the operation of conveying parcels from one point to another.

THE NATIONAL CONDUIT AND CABLE COMPANY, 41 Park row, New York city, manufacturer of bare copper wire, weatherproof wires and cables, lead-covered wires and cables for telephone, telegraph and electric and power work, has issued its bulletin, "Copper Gossip," dated March 20. This bulletin gives notes on the general business outlook, the copper market situation, the London copper market, New York and London copper prices, exports of copper, imports of copper, copper mining news and developments, and European copper statistics.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending out to the trade a new price list dated April, 1905. This price list applies to the company's 1903 catalogue. This combination should be secured by every one interested in buying electrical material. On the title page of the price list is shown a view of the company's new location at 207-211 East Jackson Boulevard, and on the back page a picture of the ruins of the old building at 264-270 Fifth avenue. The book contains the latest prices in force, and the company requests the holders of its catalogue who have not received a copy to write for one at the earliest possible moment.

THE WIRT ELECTRIC COMPANY, 3108 Germantown avenue, Philadelphia, Pa., has distributed circular No. 316, describing and illustrating the Wirt theatre dimmer. The Wirt dimmers have a metallic resistance, and are entirely enclosed in iron cases, making them practically fireproof. They have fifty steps, which are tapered to take care of the variation in amperes, and have a laminated switch, ensuring easy movement and good contact. They require 180 degrees movement to cut the resistance either in or out. These dimmers are made in various forms for installation on the wall, for dimmer stands and either interlocking or non-interlocking.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 16. NEW YORK, SATURDAY, APRIL 22, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY, ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Measuring the Efficiency of the Incandescent Lamp. . . . 643
The Light of the Future . . . 644
The Manufacture of Electrical Machinery in Japan . . . 645
Station Interruptions . . . 645
Telephony . . . 646
In the Early Days, by Frank B. Rae . . . 647
German Electrical Firms Combine . . . 648
Letters to the Editor . . . 648
The Manufacture of Electrical Machinery in Japan, by William Dinwiddie . . . 649
The Great African Telegraph Line . . . 653
Telephone Rates in Great Britain . . . 653
How to Remember the Wire Table, by Charles F. Scott . . . 653
Electric Tramways and Light Railways in England . . . 654
Semi-Annual Convention of the National Machine Tool Builders . . . 655
The United States Navy's Floating Repair Ship, by George E. Walsh . . . 656
Electrical Apparatus for Measuring Speed . . . 656
Notes on the Use of Rare Earths in Electric Illuminants, by Murray C. Beebe . . . 657
BOOK REVIEWS . . . 661
The Legislative Enquiry on New York City Lighting . . . 662
The Magnetic Club . . . 663
National Electric Light Association . . . 663
The Franklin Institute . . . 663
The International Railway Congress . . . 663
The Motor Drive for Machine Tools . . . 664
The Automobile Parade . . . 664
Panama Directors . . . 664
Electrical Patents . . . 665
New York Electrical Society . . . 665
American Institute of Electrical Engineers . . . 665
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 666
INDUSTRIAL SECTION:
An Apparatus for Automatically Transcribing Morse Signals . . . 668
Construction of Telephone Systems . . . 668
Alternating-Current Ceiling Fan . . . 669
Extensive Additions to the Allis-Chalmers Milwaukee Works . . . 669
Westinghouse Choke Coils . . . 670
The Economy Switch . . . 671
Motor Omnibuses and Tram Cars in England . . . 671
Magnetic Couplings and Accelerators . . . 671
A Prize Contest for the Design and Finish of Motor Cars . . . 672
A One-Cent Telephone Call . . . 672
CURRENT ELECTRICAL NEWS . . . 673

MEASURING THE EFFICIENCY OF THE INCANDESCENT LAMP.

In a letter, which appears on another page of this issue, Dean William Kent, of the College of Applied Science, Syracuse University, raises a number of questions regarding our conception of light which, in general, the photometrist is satisfied to refer to the physicist, and to accept his dictum. It must be said that our methods of measuring light are not altogether satisfactory. In fact, our knowledge of what it is we are trying to measure is far from perfect. The physicist tells us that radiant energy is merely a vibration of the ether which surrounds and penetrates all matter. He tells us, also, that there is an infinite number of possible rates of vibration; that the lower rates which human senses are able to detect are those which are recognized as heat. As the rate of vibration increases, a point is reached where the vibration affects the retina of the eye, producing the sensation recognized as light. We see first the red rays, and then pass up through the spectrum until we finally reach a point beyond which the eye again becomes insensible to the vibrations, although the rate of vibration will go on increasing—how far we know not.

Light is a physiological effect, and we know of no physical means of measuring this effect. We know that the effect on the eye is more or less proportional to the energy represented by the vibration of the ether. Whether all the energy of a visible ray is utilized in producing the effect of light we do not know, and we have no way of telling. But the physicist has taken the bull by the horns, and calls those radiations having a rapidity which will produce the effect of light in the eye "light," although, strictly speaking, "light" and "heat" are the effects produced and not the causes.

Accepting this definition, the photometrist works on the principle that all of the energy of the luminous rays is effective in producing light. He therefore says that if he measures the energy of the visible radiations, and compares this with the total radiant energy given off by the luminous body, he will obtain a ratio of the effectiveness of that particular body as a light producer; and this ratio he calls the luminous efficiency of the body.

That this is not a strictly accurate method is well recognized, but, for lack of a better, we put up with it. To show that it is not free from defects, it is sufficient to state that the eye is less sensitive to certain colors than to others. A given amount of energy in a radiation which appears as red produces less effect upon the eye than a similar quantity of energy in a green ray. It is customary in general photometric work to pay no attention to this phenomenon, and to be satisfied with a measurement of the total luminous energy.

The method of measuring these radiations is simple. The radiation is allowed to fall upon a body, which absorbs it completely, converting it into heat. By a proper arrangement of apparatus, a comparison may be made of the heat produced by the total radiation and that produced by the luminous radiations only. For instance, Angstrom's method, mentioned in our previous editorial, to which Dean Kent refers, consists in measuring the total radiation by means of a thermopile, a device which produces an electrical effect proportional to the heat developed in it, and comparing this measurement with that obtained from the luminous radiations only. The invisble radiations are eliminated by means of a prism which disperses the radiation into a spectrum, when the invisible rays which extend on each side of the visible rays are cut off by screens. The visible rays are then reassembled by a lens, and thrown on the thermopile. This, of course, is a measurement of energy in each case, but,

Digitized by Google

as mentioned above, the photometrist assumes that the energy of the visible radiations is luminous energy.

Now, as to the other questions raised by Dean Kent: the formula for the heat produced by an electric current is merely an equation expressing the relation between the electrical energy and the heat energy developed by it in a conducting body. If the temperature of a body is sufficient to render it luminous, part of the energy is given off as light, but this light is merely a special form of heat. Strictly speaking, light is only produced when this energy falls upon the eye. The luminous radiations nevertheless represent energy given off by the body, and hence must be included in the equation if it is to balance. Joule's law, as this expression is called, was deduced for bodies which did not become luminous. It is nevertheless strictly true for all bodies, whether they are luminous or not, if, instead of the symbol for heat, we substitute one for energy. In other words, it is a particular form of the law of the conservation of energy.

Accepting the physicist's idea that light is merely a particular form of heat, there is no difficulty in imagining what becomes of the light produced in a building. It is reflected from point to point, suffering absorption at every reflection, until it is transformed from a higher vibration to one of a lower period. In other words, it is converted into invisible heat. In support of this view is the fact that there are a number of physical instruments, such as the thermopile and the bolometer, which respond to a luminous radiation in the same way as they respond to a heat radiation.

As to the method of producing light in an incandescent lamp, the generally accepted idea is that the electrical energy merely produces heat. If more heat is produced at a point than can be radiated, the excess is stored up. This process goes on in the incandescent lamp until the filament becomes incandescent, finally reaching a temperature at which the energy radiated is just equal to that supplied as an electric current. We prefer to think that the electrical energy is the means of setting the atoms of the filament into vibration. The heat rays, whether luminous or non-luminous, result from the motion of the carbon filament particles. If the motion of the carbon particles is violent enough, light is given off. Strictly speaking, we do not see the carbon filament: we see the effect produced on the retina by the state of the carbon filament.

We assume light to be a form of radiant energy which is propagated through space, and is not stationary; hence it is hardly analogous to a vibrating spring which maintains a fixed position. If light is energy in motion, and produces an effect only by being converted into another form of energy when absorbed by the retina, then, obviously, for a continuous luminous effect there must be a continuous supply of energy.

There are photometric methods more refined than those usually employed, but in any case the final decision must be made by the eye. The accuracy with which this can be done is dependent largely upon the skill and training of the observer, and the possibility of error is not small. For this reason we are justified in using the simpler methods of measuring and comparing luminous radiations.

THE LIGHT OF THE FUTURE.

In an interesting article on the electrical manufacture of light, and the lamp of the future, contributed by Dr. J. A. Fleming to the March issue of the *Electrical Magazine* (London), the author gives rein to his imagination, and describes, somewhat indefinitely, his idea of the ideal lamp toward which we should strive. This lamp, he imagines, will be an exhausted glass tube containing a small body which can be made to phosphoresce when bombarded with electrons. Placed at suitable points about this body will be electrodes arranged so as to project the electrically charged matter leaving their surfaces upon the body, and thus bring it into brilliant phosphorescence. The substance which phosphoresces will be selected so as to produce, if possible, only luminous rays; or, if this can not be done, the luminous rays must greatly preponderate. In other words, we must have a cold light. We must so use the electrical energy as to produce light without converting it into heat.

The idea of using phosporescent bodies is old. The problem, of course, is to obtain a lamp which can be made to phosphoresce at will, and which will give sufficient light for practical use. Dr. Fleming's plan is based upon the following idea: it is thought by some that the luminous energy radiations which we recognize as light are produced only by vibrations of the corpuscles themselves. The longer or so-called heat rays are due to vibrations of the atoms of matter as a whole. If we can cause the corpuscles to vibrate without setting the atom as a whole into motion, we should, according to this idea, be able to produce cold light. This does not mean that the radiations do not represent energy, but merely that there are none of these lower vibrations which we usually class as heat.

We are, of course, a long way from this ideal. At the present time, we are, for a lack of a better method, forced to produce light through the medium of heat—that is to say, according to the newer idea of the method of producing luminous rays to make a body luminous, we simply, by heating it, set its atoms into such violent motions as to get the corpuscles of the atoms themselves into vibration. The useful work done is then only that which sets the corpuscles into motion. The movement of the atom as an atom gives rise to the heat rays, and except in so far as it brings about the more rapid vibrations of its corpuscles, is useless, and represents a waste of energy. We are probably as far from this ideal lamp as we are from what might be described as an ideal telephone. This we may imagine to consist of a small device somewhat similar to a mirror. When one desired to communicate with another the central would make the proper connection, and the image of the person to whom he wished to speak would appear in the mirror. He might converse with this image as he would with his friends. How this can be brought about we have no more idea, if as much, as Dr. Fleming has of his ideal light, but should our grandchildren ever reach this stage, they will wonder how their forefathers ever put up with unsympathetic hard-rubber instruments, one of which he forced against his ear, and through the other of which he talked, trusting that the person at the other end of the wire was the one to whom he wished to speak.

Digitized by Google

THE MANUFACTURE OF ELECTRICAL MACHINERY IN JAPAN.

During the World's Fair, held at St. Louis last year, much interest was shown in the few pieces of electrical apparatus exhibited in the Palace of Electricity by Japanese manufacturers. It will be remembered that there were shown telephone and telegraph apparatus and other small appliances. Besides, there was a continuous-current dynamo and a testing transformer for 150,000 volts. These machines had a very familiar look, and it seemed strange to see Japanese characters on the base instead of the name of some well-known American manufacturer. Naturally, the machines exhibited there were not large, for they had to come a long way; but the Japanese have been building fairly large electrical machinery for some years past. On another page of this issue we publish an article by Mr. William Dinwiddie, which describes the Shibaura Engineering Works, one of the two factories in Japan where the principal electrical manufacturing work is being carried on. It will be seen from this that some of the machines turned out are of a respectable size, and the photographs show that they have a very presentable appearance. It is particularly interesting to learn that these machines have not only been built by Japanese labor, but have been designed by Japanese engineers. Although the engineers who designed them were trained in foreign technical schools, and the companies have, of course, profited by the experience of others, the machines themselves stand as a product of Japanese skill and industry.

While the factories themselves and the products which they put out are interesting, probably that part of Mr. Dinwiddie's article which will be of most interest to us is the reference to the small cost of manufacturing electrical machinery in Japan. It is said that, although the Shibaura shops at which these machines were constructed are not, by any means, up to date in their equipment, electrical machinery can be turned out for thirty per cent less than the price for which the American manufacturer can deliver similar apparatus in Japan, and the question is asked what could this company do with a thoroughly up-to-date equipment? As one illustration of the methods used in Japan, it is said that the insulation of the wires is all wound on by hand, one man drawing the wire through a winding machine while the other wraps on the insulation. When a double thickness is required, this process is repeated. This is a slow method, and in this country it would be expensive. On the other hand, the Japanese have the faculty of doing things thoroughly and conscientiously, and as skilled labor is cheap, it is probable that all the work is done in a first-class manner.

Although much of the machinery used in the Japanese factories is not of the latest types, the Shibaura Engineering Works are driven in a modern manner by means of induction motors. To explain the lack of new machinery, it is said that the royalties which are asked for the use of such machines are practically prohibitive.

There are one or two other points in Mr. Dinwiddie's article which should be of interest to our manufacturers. One is the fact that the heavy machinery found in Japan, such as shears, punches and steam hammers, is all obtained from Glasgow, and Mr. Dinwiddie says that he has found this to be the case throughout the world, as the Glasgow factories have the reputation of turning out castings which are more dependable than those made in this country. Whether this belief be due to prejudice or some more substantial reason, it is time that it should be changed.

Another point of interest is the statement that the iron and steel used in Japan are secured in England. One may ask why this should be so when we are able to compete with the English manufacturer in his home market. The trip by water from the Atlantic coast to Japan is not much longer than from England to the same country, and a slight difference in time is a matter of no consequence.

Japan, at the present time, produces her own copper and mines her own coal. She is developing large iron mines in the northern island of Hokkaido. Thus, in addition to cheap skilled labor and plenty of it, she expects, within a few years, to have cheap raw material. She will then be in a position to compete with American and European manufacturers for the electrical trade of the East, and it is difficult to see how we can prevent her from getting the lion's share of it.

The electrical developments in Japan are not limited to the manufacturing side, for she possesses many valuable waterfalls, and has already entered into the development of them. This should add to her cheap raw materials and cheap skilled labor, cheap power. What more can she desire?

STATION INTERRUPTIONS.

It is reported that, during the three years of its operation, the interruptions to the service of the Northern California Power Company have amounted to but two hours and fifty-four minutes. These interruptions were due, not to any neglect of the men in charge of the plant, but to what seem to be unavoidable accidents. One was caused by a flood from the Sacramento river; two were due to short-circuits on the line, one being caused by an eagle, and the second by a goose. This is an excellent record, particularly when one remembers that the lines of this company are carried mostly across country, where there are many chances for such accidents to occur.

As an example of what may be done in city operation, where the wires are placed underground, and where there is an enormous station to care for any unexpected overloads, the record of the New York Edison Company may be mentioned. It is said that the lines of the company have not been without current for over ten years. Of course, certain circuits have been disconnected at times, but there has been no time at which some part of the system has not been in operation. Naturally, the conditions of a large city differ widely from those of a high-tension cross-country line. When the conducting wires are placed underground they are no longer exposed to the fortuitous juxtaposition of a wandering goose. There is no temptation for eagles to use them as perches. They encounter other troubles, it is true, but these seem to be less serious than the dangers to which overhead construction is exposed.

Digitized by Google

Telephony.

Mr. Herbert Laws Webb delivered the fourth and last of his series of Cantor lectures on "Telephony" before the London Society of Arts, says *Engineering,* on Monday, April 3. Having already dwelt upon the engineering side of telephone work and the details of the apparatus employed, Mr. Webb devoted the concluding lecture to a comparison of the telephonic development in various countries, and the different methods of charging in vogue. He remarked that when once telephone tariffs were mentioned a very controversial ground was entered upon; but that as far as possible he would abstain from taking advantage of his position as a lecturer to make controversial statements without giving the grounds on which they were based.

The growth of telephony, said Mr. Webb, was not extraordinary when one considered the advantages it possessed as a means of communication over its only rival in speed—the telegraph. A table on the walls of the lecture room gave the detailed steps involved in sending a message and receiving a reply by the two methods, and the approximate time required for each step. The average time from first to last for a reply to be obtained to a telegram was given as eighty-five minutes, whereas on the telephone only two minutes and forty seconds were required. The telephone service was also much cheaper, for a telegraphic message and reply cost at least one shilling, while a local conversation from a public telephone station costs only threepence, and the cost to a subscriber was no more than one penny. An alternating method of sending messages in towns was by a district messenger, but here the minimum charge was sixpence, and that only for distances not greater than half-a-mile. For long-distance messages the telegraph certainly appeared the cheapest means; but when one compared the directness of a telephonic conversation and the amount of business that could be transacted in three minutes, with the few written words of a telegram, it was evident that the telephone gave far better value for the money than the telegraph. The long-distance telephone really constituted a serious competitor with the railway, and its effect in this direction had been strikingly shown in America. Formerly, if a business man in New York wished to speak to another in Chicago, he had to make a railway journey occupying about three days, and costing perhaps £15; whereas now he naturally preferred to spend from £8 to £10 for half-an-hour's conversation over the telephone, and save, in addition, the time and discomfort of traveling. The same thing applied in a less degree in England; the double journey from London to Glasgow, for example, taking the best part of two days, and costing several pounds.

Much of the difficulty, Mr. Webb said, in connection with the telephone tariff was due to the fact that a radically wrong unit had been adopted as a basis of charging. The telephone instrument was not the proper unit; it in no way represented either the capital expenditure or the operating charges of the installation. It had become the general unit because the earliest telephone systems were of a co-operative nature, connecting up private concerns; and the flat annual rate which was equitable under such circumstances had continued after the conditions had altered. In comparison of telephone charges the flat rate was often quoted; but this was a most unfair criterion, as the cost of the service differed so greatly in different cities on account of rents, rates, and other local features. Further, when telephone matters were discussed the disputants often made statements unsupported by facts; as an example of which the lecturer mentioned that he had heard it gravely declared in New York ten years ago that the London system contained 100,000 subscribers, a flat rate of £5 was charged, and all cables were underground.

It was early discovered that the proper unit of telephone business was the message. The value of a message varied in different places with the area covered by the local system, and its cost to the company was influenced by the length of the lines it occupied. An astonishing variety of methods of charging existed in various places, of which Mr. Webb mentioned about half-a-dozen, saying that the annual flat rate, with no installation charges, was the most general. All were liable to be modified by mileage charges, by the business or residential character of the subscriber's premises, by the length of the contract, and by the size of the system—the rate sometimes increasing as the number of subscribers increased. The message rate was inaugurated in the year 1880, and found to be popular wherever applied, except in the case of the very largest telephone users. This system of charging also varied according to local circumstances. Sometimes there was a fixed "maintenance" rate in addition to a charge for each message; sometimes the maintenance rate was reduced as the contract wore out; sometimes the subscriber had to guarantee payment for a minimum number of calls; and, finally, in other places the tariff was a message rate pure and simple. It had been generally found necessary to fix a minimum charge of some sort, but the lecturer believed in time the companies would find it profitable to put in a line anywhere, and charge a simple message rate only.

To show how greatly the value of the service increased with the complexity of the system, Mr. Webb called attention to diagrams on the walls. In a simple system consisting of one exchange, with subscribers' lines radiating therefrom, the travel of a message was limited to the combined length of the two longest lines; but when two such systems were joined by trunk lines, the travel of a message was increased by the length of the trunk, and the number of intercommunications possible was more than quadrupled. In all large cities a multiple exchange area existed, every exchange being directly connected to every other one, so that no message within the area need be handled by more than two exchanges. The capital charges of connecting subscribers could be kept down by the use of a party-line to the exchange on which a number of subscribers were connected in parallel. Of course, with this method only one subscriber could use the line at a time, and messages could be overheard; but in some circumstances the cheapness of the installation outweighed these disadvantages. In some of the sparsely populated districts of America from twenty to forty subscribers used a single party-line; and telephonic advantages were thus available in districts which could not be profitably served by independent lines. On the other hand, a large telephone user often had a double connection with the exchange; one line serving for incoming and the other for outgoing calls; and manufactories and other establishments frequently had a small exchange on their own premises, allowing intercommunication, or connection with the public exchange, from every instrument.

In a city system so large a proportion of the calls had to be handled by other stations that a considerable amount of switchboard space had to be devoted to the trunk connections. In addition to this, there had to be a monitor's board to take several operators, whose duty it was to handle all difficult calls and enquiries from subscribers, which might cause delay to the regular operators. Subscribers might have changed their address, or the caller might not know their number; and calls of this nature might amount to as

Digitized by Google

many as 20,000 or 30,000 per day. In large stations it was the custom to issue a daily printed directory to keep the monitors and supervisors posted up as to the changes that took place in the system. All these facts tended to show how much greater, proportionately, was the work in serving a large area than a small one.

As regards the development of the telephone service in different countries, America was far and away ahead of Europe; in fact, it might be said that in Europe the telephone had hardly begun to be used. The state of the service in various countries and cities was shown by diagrams and tables suspended in the lecture room; some of the latter we reproduce in abstract below:

COMPARISON OF TELEPHONE SERVICE AND POPULATION IN DIFFERENT CITIES.

Town.	Telephones.	Population.	Inhabitants per Telephone.
New York.....	144,353	2,100,000	14.5
London	93,598	4,614,000	49.5
Berlin	66,744	1,931,000	29
Paris	49,444	2,660,000	54
Vienna	21,723	1,762,000	83
St. Petersburg..	6,000	1,334,000	223

TELEPHONES PER 1,000 INHABITANTS OF THE CHIEF COUNTRIES.

United States	44.8
Sweden	21.4
Denmark	16.7
Switzerland	15.9
Norway	13.8
Germany	8.9
United Kingdom	8.7
Holland	5.56
Belgium	3.5
France	3.15
Austria-Hungary	1.55

TELEPHONES PER 100 INHABITANTS IN THE CHIEF CITIES.

Stockholm	13.7
New York	6.87
Christiania	5.45
Copenhagen	4.83
Zurich	4.76
Berlin	3.45
London	2.02
Paris	1.85
Brussels	1.36
Vienna	1.21
Amsterdam	1.12

The remarkable number of telephones per inhabitant in Stockholm was due to special causes, among which was a specially active competition between the government department and a private company, in which, so far, the company had a very long lead. Strange to say, the municipal authorities were on the side of the private company, and hampered the government by preventing it from laying underground cables in the streets, to the use of which the company had the sole rights. Altogether, however, in America the development was far greater than in Europe. In some of the western parts twenty-nine per cent of the population of the district were connected up, and in a large town like San Francisco, where no competition existed, there were over 40,000 telephones, and twelve per cent of the population were connected up. Some very interesting lantern slides were shown, illustrating the different sizes and natures of the areas served by the large city systems. The London area was by far the largest, being more than thirty miles across in several directions, and covering 640 square miles. On the outline of the London area, the other city areas to be compared were thrown in succession, and made clear the enormously greater extent of the former. The Paris area, covering thirty-one square miles, appeared a compact black spot in the centre, Paris having practically no outlying suburbs, and forming an ideal telephone area. The Berlin system covered twenty-eight square miles, the suburbs being treated as separate systems. Vienna covered eighty-two square miles, much of which, however, was park and even forest land. The St. Petersburg area was twenty square miles, of which part was covered with water. Liverpool was twenty square miles, and Boston thirty-seven, this being less than one-third of the solidly built-up part of London; the Boston suburbs had separate rates which was a much more scientific method of charging. The Chicago area was very large, but only fifty square miles were as yet built up. The area of Greater New York, although much less than that of London, was treated in a much more rational way; no attempt being made to serve it as one system, but a trunk line charge being made for connections between the various quarters.

Much careful study was needed, the lecturer stated, before a suitable tariff could be drawn up for any particular district. The probable growth of the district must be considered, and the load-factor of the various portions. Subscribers were continually leaving or removing, and new ones coming on, one company having had to connect up 12,900 subscribers in eleven months, and take out 7,400 stations, which necessitated over 20,000 changes in the plant for a net increase of 5,500 customers. In another case, during three years 62,500 new stations were installed and 25,000 taken out, or 87,500 changes made in the plant for an increase of 37,000 subscribers. That sort of thing was typical of telephone work, and could only be met by providing very large facilities for alterations, otherwise the development of the system would be arrested. In St. Petersburg there was such an unsatisfied demand for extensions of the telephone system that people would pay a premium of £50 to obtain a discarded line; and in Tokio, where there were 14,000 lines in use, there were 8,000 more subscribers waiting to be connected up. Things had got into such a state that subscribers' applications were dealt in on the Stock Exchange there, and commanded good prices.

IN THE EARLY DAYS.

BY FRANK B. RAE.

The engineering department and the draughtsman were having a discussion about bonds—and deference was being given to the arguments of the draughtsman, as due to a graduate of a prominent agricultural college backed by a salary of fifteen per week. The engineering end of the debate contended that it was better to make the bonds of No. 6 iron wire instead of No. 9—that copper rivets of three-eighths-inch diameter were better than the one-fourth-inch iron rivet in vogue and that the iron wire should not only be twisted tightly around the rivets, but it should be soldered thereto; with this construction cross-bonds and longitudinal reenforcement would be unnecessary, but the draughtsman would not agree that such a radical departure from the good old way was advisable. "It might be," he said, "a good idea to solder the wire to the rivet, but iron rivets were cheaper: it was easier to drill a one-fourth-inch hole than it was to drill a three-eighths-inch hole, and a No. 9 wire made just as good an electric contact as a No. 6 wire would make—the fish-plates were the things anyway."

In the midst of the discussion, Mike came up from the front office, pointed a dirty fist with an apple core in it at the engineering department, and said, "The boss wants youse." The engineering department mussed up his hair to show he had been working, grabbed his slide-rule to keep up the bluff while passing through the testing room and went down to the room with a carpet on the floor where the general manager shaped the destinies of the street railway companies of the Middle West, carefully closing the door so that shop secrets might not reach our competitors *via* the bookkeeper. The general manager said, "You know, that I believe that in a concern like this—that is, so to speak, blazing the trail for the mightly onmarch of street railway progress—that one man can not do everything, and it is desirable to have the advice of others. I have been talking with Thompson—he was, you know, with the Mather company for several years—and he says, 'The Mather company makes a shunt motor and it has been very successful; now while your motor works and runs a car all right, Thompson says it's just a common series motor and what we need is a shunt

Digitized by Google

motor. If you know how to make a shunt motor we think you better do this."

The engineering department said he could make a shunt motor all right and while it was a good thing to run a pump with, it did not appeal to him as a street-car motor, but this was put down as professional jealously by the general manager, and the orders to make a shunt-wound street-car motor were imperative.

The discussion about bonds, the advisability of soaking battery carbon in oil for motor brushes and other things were postponed while the engineering department and the draughtsman got busy on a street-car motor of the shunt type. The motor part was easy but the speed regulation required some study. It was solved finally with a shunt field wound for nearly complete saturation, a rheostat to turn on the armature current and another to weaken the shunt field. Speed! Well, as nearly as we could figure it, speed was simply a question of the motorman's nerve, and sparkless commutation was, or was not, as Allah willed.

The outfit was sent to Saginaw to be tested and Talbot was instructed to put it under a car, and both Talbot and the car were at the depot when the engineering department arrived for the trial run. "Does she make good time—is she fast?" Frank was asked. "Time," he said, "fast" —"say! it takes two men to see that car go by—one says 'Here she comes' and the other says 'There she goes'—all that car wants is notice of a clear track."

When we passed the Bancroft House, a few minutes later, we were making about seventy-five miles an hour and we only hit the high joints from there to the end of the main street where the track made a right angle turn on an old horse-car curve, with a radius of about twenty-six feet. Talbot contended that he slowed up for this curve—perhaps he did, but it was only when we hit the curb that we noticed it, and then the retardation was quite apparent; anyway, Talbot's remarks, including those over the telephone calling for one of the common series motors to pull us back to the barn, were quite unfit for print, and some more of the stockholders' money had been used to help the "mighty onward march of street railway progress."

German Electrical Firms Combine.

A plan is announced for the amalgamation of the Lahmeyer Electrical Company, of Frankfort a. Main, with the firm of Felten & Guilleaume, of Muhlheim. The latter firm takes over the Lahmeyer company's manufacturing department, the Lahmeyer company continuing only as the financing company. **The combination will have a capital of $13,750,000.**

LETTERS TO THE EDITOR.

Steel Wire Worth $80,000 a Ton.

To the Editor of the Electrical Review:

Your issue of April 8 contains an editorial headed "Diamond Dies," referring to the use of such dies in drawing fine sizes of wire. The conditions governing their use are properly described with the exception that specifying 0.025-inch diameter as a size below which it is customary to draw wire through diamond dies, is somewhat misleading. The writer believes that most manufacturers of iron and steel wire have found that steel dies may be used for sizes as fine as 0.010-inch diameter.

Your editorial refers to copper wire drawn to three one-thousandths of an inch, and running six miles to a pound. A better idea of the fineness of wire is afforded by a steel wire drawn at the Roebling works. This has a diameter of one one-thousandth of an inch. One pound of the wire will reach nearly seventy miles. The wire is made from steel, the commercial value of which, in the billet, is about fifty dollars a ton. The expense of drawing is so great that a ton of the finished wire would be worth more than $80,000.

Alfred N. Barber.

Trenton, N. J., April 10.

The Efficiency of the Incandescent Lamp.

To the Editor of the Electrical Review:

In an editorial on "The Efficiency of the Incandescent Lamp," in your issue of April 8, you say: "the luminous efficiency of the incandescent lamp is generally accepted as being somewhere between four and six per cent—that is to say, of the total amount of electrical energy delivered to the lamp, only four to six per cent is believed to be converted into luminous rays." I wish you would write another article making it clear to your readers how the luminous efficiency is determined. Also what reason is there for believing that any of the electrical energy is converted into light or that light is a form of energy.

If part only of the electrical energy delivered is converted into heat and part into light, how are the two parts separately measured? If any of the energy is converted into light, what finally becomes of that light? We know that so much of the electrical energy as is converted into heat within the walls of a building finally escapes as heat by radiation or conduction into the surrounding atmosphere. The heat energy can not be destroyed without converting it into some other form of energy; but if light is produced inside the walls of a building, what becomes of it? Or if it is said to be converted into heat, how can this be known or proved?

Suppose an incandescent lamp receives current of 0.5 ampere at 100 volts or fifty watts of energy. According to the formula for generation of heat, $H = I^2R\,t$. The heat generated by this current is fifty watt-seconds, but if six per cent of the energy is converted into light then only forty-seven-fiftieths is converted into heat.

Again, supposing a platinum wire is heated successively; first, to a temperature just below the point at which light rays are visible; second, to a bright red heat, and third, to an intense white heat. At what point does the electric energy begin to be converted into light, if light is a form of energy? Is it just when the human eye recognizes the light, or is it at some lower temperature?

Is not the statement that light is a form of energy a hypothesis? And is not the statement that light is a condition of vibration just as good a hypothesis? It takes mechanical energy to cause a steel spring to vibrate, but after it has been brought up to its normal period of vibration it requires no further expenditure of energy to keep it vibrating except that necessary to overcome the resistance of the air and possibly a trifling molecular friction. So it may take heat energy to make a platinum wire white hot and to put in vibratory motion the surrounding ether, which motion causes the physiological sensation of light, but after the vibration is once established at a certain rate it may take no further energy to keep this rate constant, although it does require the continued expenditure of energy to make up for the heat lost by radiation, just as the metallic spring in vibration requires a continued expenditure of energy to overcome the air resistance.

I hope you will try to make this matter clear in a new article and that in the words of your editorial on "Popular Electricity," such an article "should recognize the necessary limitations of the man who has not, and who does not pretend to have, much knowledge of higher physics."

Wm. Kent.

Syracuse, N. Y., April 15.

[The questions raised in the above letter are dealt with in the editorial pages of this issue.—Ed.]

Digitized by Google

The Manufacture of Electrical Machinery in Japan.

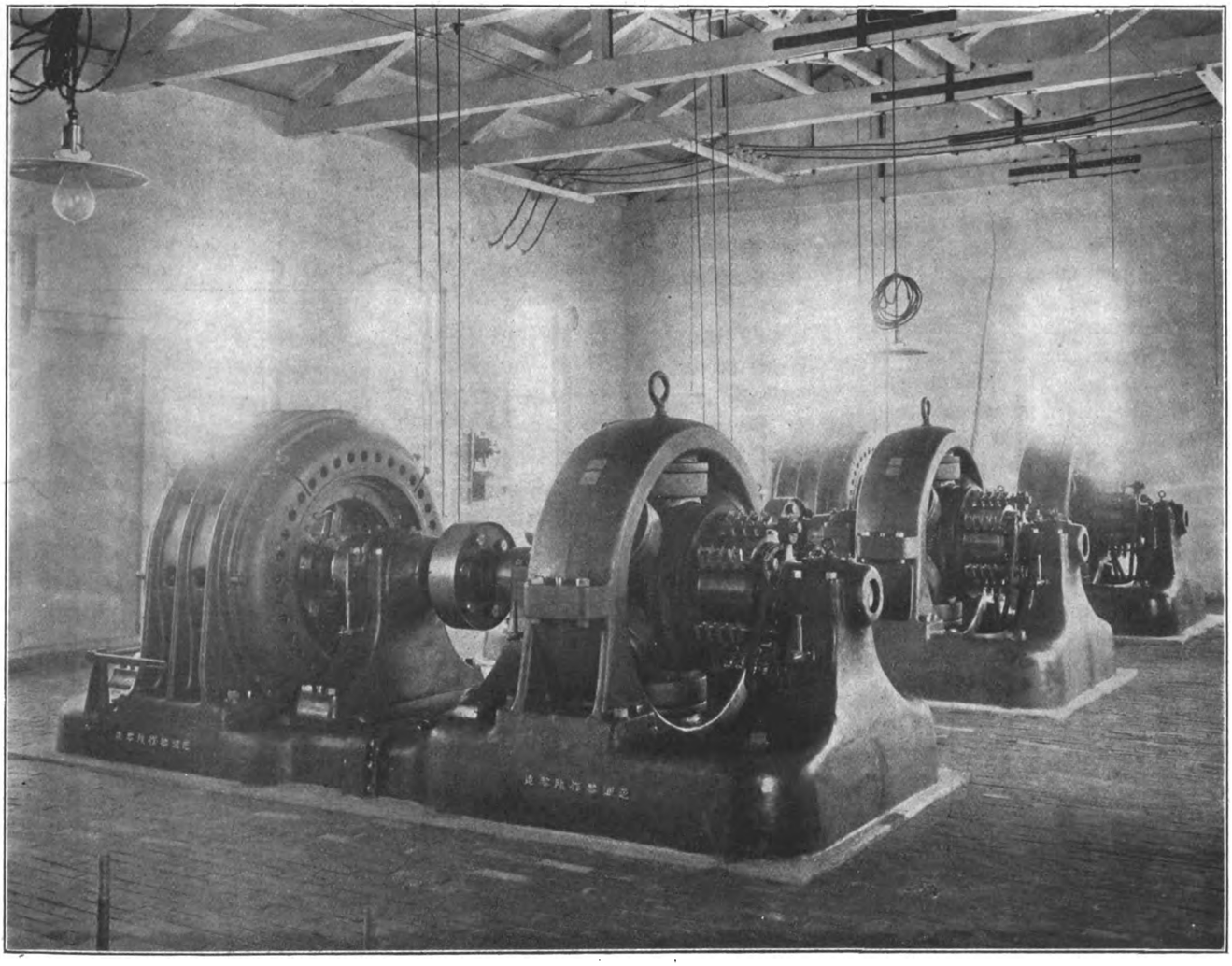
By William Dinwiddie.

AT A RECENT meeting of Japanese captains of finance and industry, one of them casually let drop the remark that the home manufacturers of electrical appliances, such as dynamos, motors, and transformers, were turning out excellent types at a cost of thirty per cent less than the same machines could be laid down in Yokohama, duty free, by any of the big American firms.

Following up this clue, the writer found that there were two well-established manufactories of electrical machinery in Japan, both less than ten years old—one at Osaka, known as the Osaka Electric Lighting Company, and one at Tokio, called the Shibaura Engineering Works, though, as a matter of fact, it is a branch of the great Mitsui Company, of Japan, which now controls one-sixth of the foreign trade of the country.

This latter plant covers several acres along the shore of Tokio bay, which offers opportunity for cheap water transportation in coasting steamers, while the other side of the works is flanked by the Tokaido double-track railway, giving access to the entire islands by rail.

The shops are all single-storied buildings, and rather cramped for floor space by the amount of machinery; as a generalization, it might be said that the quarters are inadequate and badly planned for the most economical output of the many different classes of machinery, electric and otherwise, which are manufactured.



120-Kilowatt Motor-Generators Used by Tokio Street Car Company, Tokio, Japan. Three-Phase Induction Motors, 175-Horse-Power Each. Built Entirely in Japan.

The following is a list of what this company manufactures:

Direct-current generators and motors; polyphase alternating-current generators; transformers; direct-coupled, direct-current generators; polyphase induction motors; geared-motor hoists for mines and ships; ammeters, voltmeters, switches and complete control boards; electric cranes; rheostats; ground detectors; lightning arresters; fuse blocks; single-cylinder, high-speed, automatic cutoff engines; compound, high-speed, automatic cutoff engines; marine engines, direct-coupled to dynamo; Corliss engines, simple, compound and triple expansion, condensing and non-condensing; geared pumping engines; rotary pumps and blasts; Lancashire and Cornish type boilers; turbines; seismic-proof chimneys; hand wharf-cranes; aerial wire-rope tramways; steam fumigators; Miyabara's patent water-tube boilers.

The staff and workmen are exclusively Japanese, and no foreign experts have ever been employed. The engineers are all graduates of foreign technical institutes, and the skilled workmen have either graduated from Japanese technical

Digitized by Google

colleges, or are attending night classes in these schools.

While the shops are fairly equipped with modern machinery, such as lathes, planes, gear cutters, shears, punches and screw cutters, a trip through the machine shops, the foundry, the pattern shops, the blacksmith shop, the testing rooms, and the assembling shops shows there are many special machines and labor-saving accessories missing, and some crudities are observed in handling the machines and the materials. The query naturally arises, if this factory can undersell the biggest American manufactories of electrical machinery by thirty per cent with the present equipment, what can it do with a thoroughly up-to-date plant?

For example, all the wire insulation is done by a hand winder; one operator winds on the single insulation, while another controls the reels and draws the wire through, as required. For double insulation, the wire must be passed through a second time.

In the machine shop, the writer noted a planer in operation, straightening a two-inch edge of an armature casing. The bed of the planer was traveling its full stroke, some five feet, thus leaving the cutting-tool idle fifty-nine sixtieths of the time, though a few minutes spent in adjusting the planer would have saved an hour's time.

Field and armature coils were all laid on by hand, and the wire pounded into place with wooden mallets, but the work was most carefully and conscientiously executed.

Outside of one hand-driven traveling crane, a few fixed cranes and a small tramway between the various buildings, there were no devices for expeditiously handling the heavy parts and materials.

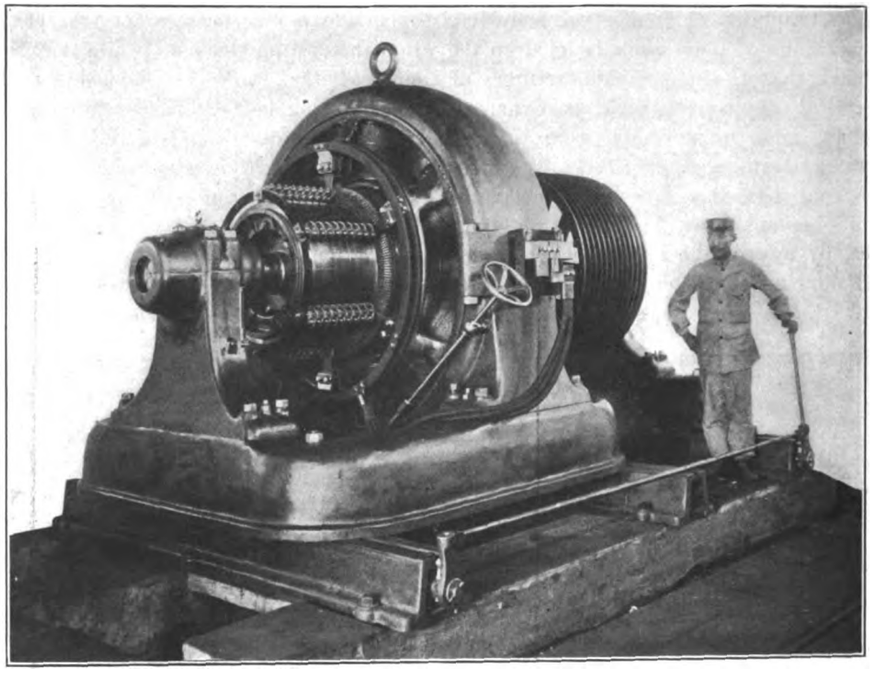
The cupola of the foundry was of ancient design and questionable efficiency.

These are all unfavorable criticisms; against them must be placed much in commendation: the machinery was all driven by a central power plant of electric generators which operated induction motors in each shop. The machinery throughout was kept in fine condition, and the hundreds of workmen were alert, quick of motion, and kept constantly at work.

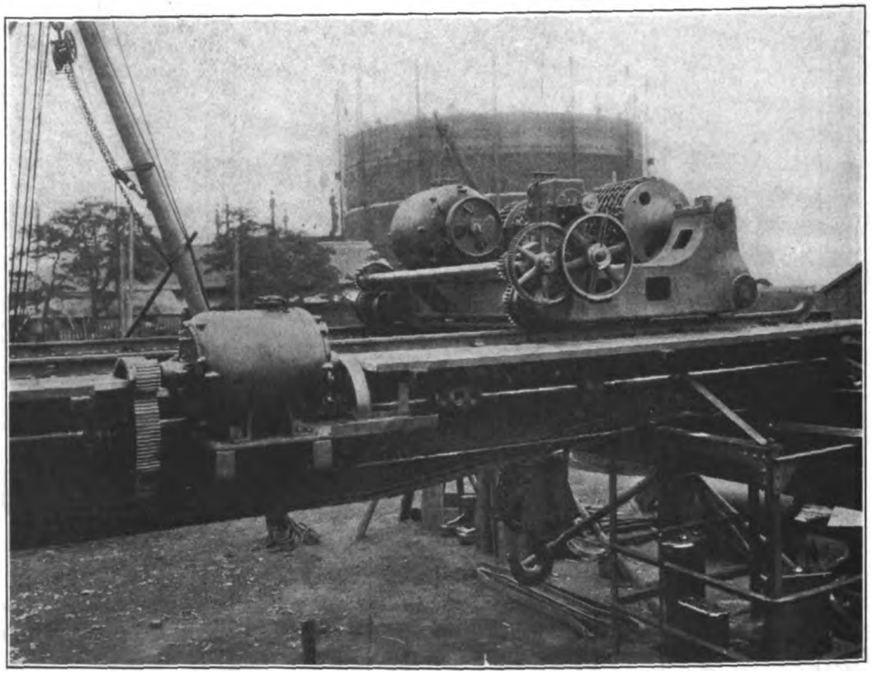
An explanation of the lack of special machines is to be had in the fact that most of the machinery for the production of electrical machinery is patented and registered in Japan by the great manufacturing firms of foreign countries, and, when they are not held for exclusive use, the royalties demanded make their employment almost prohibitive. Admitting this to be true, there must then be great opportunities in Japan for branch manufacturing companies of the corporations which control the specialized and patented machinery.

Most of the machinery is of American make, and no particular machine firm seems to have been given a preference. The heavy machinery, such as shears, punches and steam hammers, is of Glasgow manufacture, and in this connection let it be said, incidentally, the writer has noticed that the trade generally, throughout the world, usually buys its massive machinery in Scotland, in preference to the United States, and the answer to the "Why" is often that it is more dependable, having less flaws in the castings.

As will be seen from the list of goods manufactured, this company furnishes complete electric plants for power and lighting, and it also installs the same. The largest generator so far manufactured is a direct-current generator of 373 horse-power for the Imperial Dock-



280-KILOWATT, DIRECT-CURRENT GENERATOR, USED BY THE IMPERIAL DOCKYARDS, YOKOHAMA.



TWENTY-TON ELECTRIC CRANE, USED BY NIPPON RAILROAD COMPANY. THE FIRST ELECTRIC CRANE BUILT IN JAPAN.

Digitized by Google

yards, at Yokosuka, which has been in constant use for two years driving motors. The largest engine ever built by it is over 1,000 indicated horse-power. It is in use in one of the large southern cotton mills.

The Tokio Electric Street Car Company has three pairs of 120-kilowatt motor-generators, produced by this works. The motors are of the three-phase induction type and operate at 3,000 volts. The Street Car Company originally bought its current, but now generates it itself.

The first electric crane ever manufactured in Japan was made by the Shibaura company for the Nippon Railway Company. It is of twenty tons capacity and has been in constant use for five years.

The growth of the company, electrically, in four years is shown in a very interesting series of production cards which carry data on the number of machines, the energy and the repairs required. In 1901 twenty-three direct-current generators with an aggregate of 340 kilowatts were manufactured; in 1904 the number had risen to sixty-five and the capacity to 1,450 kilowatts. For the same years the alternating generators stood, respectively, four and twelve, with capacities of 275 and 1,300 kilowatts. Direct-current motors increased from five to thirty-six with capacities of 190 and 600 horse-power and alternating-current motors from forty to sixty with energies from 250 to 1,550 horse-power. Transformers in the same time rose from 350 of a total of 1,450 kilowatts to 910 of 4,050 kilowatts.

The repair cards for the guaranteed generators, motors and transformers show a steady falling off in percentages until in 1904 the necessary repairs represented something less than five per cent of the output. The managers explain this reduction as due to the increased skill gained by the operators of electrical devices; it is also probably due to greater excellence of the factory product.

All the copper wire is made in Japan of copper from Japanese mines. The fibre insulation is also of home manufacture, but all the steel and iron plates and bars come from England, as well as most of the insulating materials, such as mica and asbestos. Some pig iron is brought from England, but a large part of it is from Japanese furnaces.

The iron and steel supply is brought from England, it is said, because so far the United States market has not been able to meet Great Britain's prices. Though the difference in time of transportation of such materials to Japan is fully two weeks in favor of the United States, the railway tariff across our continent more than overbalances the cheap, slow, all-water transportation from England.

The story of the low-cost price of production in the manufacture of electrical

ARMATURE, FIELD COIL AND TRANSFORMER WINDING SHOP, SHIBAURA ENGINEERING WORKS, TOKIO, JAPAN.

Digitized by Google

machinery in Japan—and, in fact, of most of the other manufactured products—is told in the three words, cheap, skilled labor. The technical experts and engineers of the firm under discussion receive salaries of seventy-five dollars per month; first-class mechanics receive sixty cents gold a day; armature and field finishers, sixty-five cents a day; the finest pattern-makers—and they equal our expert men—get seventy-five cents gold, and the smith, moulder and boilermaker receive sixty cents gold.

The working-day is ten hours long.

The great industrial future of Japan is assured for four reasons: 1, the workmen are naturally clever and skilful with their hands, learning their tasks easily and rapidly, and, though short in stature, they are heavily muscled and of robust constitution, which makes for sustained manual effort and maximum production; 2, the immense population in a limited area, increasing annually over half a million souls, assures an abundant supply of cheap labor; 3, the markets of the great Far East are at her very doors, and 4, she has an abundant supply of coal and copper at home—and probably also of iron.

The coal production of Japan in fifteen years has increased eight times; in other words, in 1904 it was over ten million tons, as against a little over a million tons, and to-day sixty per cent of the coal is exported, while forty per cent is used for home consumption. Large iron mines are being developed in the northern island of Hokkaido, and it is believed that ore can be laid down from these mines in the southern ports of Japan at $1.75 gold per ton. In 1904 seven million yens' worth of copper from Japanese mines was exported to China and several million yens' worth was consumed at home.

It will thus be seen that in a few years, with cheap labor and raw products at home, Japan will be in a position to compete with foreign countries not only for the electrical supply trade of the East, but she will enter the market for most of the manufacture of iron, as she is already in the China field with engines and boilers.

However, that the home products of electrics have not yet become a serious menace to the foreign trade is evidenced in her import figures of these supplies. In 1900 she imported $150,000 gold worth of electric machinery, and in 1904 half a million dollars gold, of which latter sum three hundred thousand dollars' worth were purchased from the United States.

As a matter of fact, Japan is only in her infancy, electrically, but with the many corporate lighting and power schemes now on foot and being discussed she may be expected to grow tremendously in another ten years.

The mountainous islands, girt with narrow seaboards, offer wonderful possibilities in economical water power, but so far no attempt at long-distance trans-

Assembling Shop for Generators and Motors, Shibaura Engineering Works, Tokio, Japan.

Digitized by Google

mission of electricity has been made with the single exception of a lighting and power plant at Hiroshima, on the Inland sea where a 10,000-volt current is carried twenty miles to the city. A 5,000,000-yen company has been incorporated in Tokio for the purpose of establishing a high-potential line into the city from the Katsura river falls some forty miles distant. It is the intention to deliver at the start 10,000 horse-power at the Tokio end of the line.

The rapid expansion of the use of electricity in Japan for the next few years, at least, will offer opportunities to the foreign markets of which our dealers should be on the alert to take advantage, but by far the greater return is to be had by establishing well-equipped and modern manufacturing plants in Japan itself.

The Great African Telegraph Line.

The telegraph line which is to run from the Cape to Cairo, the length of the continent of Africa, has reached, from the south, Udshidshi, on the shores of lake Tanganyika, in German East Africa. A survey is now being made to find the best connecting route with the north, and the line already established is to be examined and improved. It is presumed that the connecting link will run along the east shore of the great Victoria lake, thence in a northerly direction to reach Rosares, at present the last telegraph station in the Soudan. Considerable difficulty will have to be overcome, as a swamp of 100 miles in length exists north of Udshidshi, where it will be difficult to run a reliable air line. It was intended to run around this swamp, but it has now been determined to utilize wireless telegraphy for communication across. This system, however, will probably be temporary.

Telephone Rates in Great Britain.

In an editorial in the Canadian *Engineer* for April, the following interesting table relative to telephone rates in Great Britain and Ireland is given:

LONG-DISTANCE TELEPHONE CHARGES AND TERMINAL FEES IN GREAT BRITAIN AND IRELAND.

	Distance. Miles.	Long-Distance Charge. Dollars.	Terminal Fee. Cents.	Total. Dollars.
Up to	25	0.06	6	0.12
"	50	0.12	6	0.18
"	70	0.18	6	0.24
"	100	0.24	6	0.30
London to Birmingham	105	0.36	6	0.42
Nottingham	110	0.36	6	0.42
Manchester	165	0.48	8	0.56
Swansea	170	0.48	8	0.56
Liverpool	180	0.48	8	0.56
Plymouth	200	0.60	8	0.68
Newcastle-on-Tyne	260	0.72	8	0.80
Edinburgh	340	0.96	12	1.08
Glasgow	365	1.10	12	1.22
Dundee	377	1.10	12	1.22
Belfast	404	1.34	12	1.46
Aberdeen	435	1.22	12	1.34
Inverness	453	1.34	12	1.46
Dublin	491	1.58	12	1.70
Cork	619	1.94	12	2.06

HOW TO REMEMBER THE WIRE TABLE.[1]

BY CHAS. F. SCOTT.

The wire table for the B. & S. gauge copper wire has a few simple relations, such that if a few constants are carried in the memory the whole table can be constructed mentally with approximate accuracy.

Resistance—A wire which is three sizes larger than another wire has twice the weight and half the resistance.

No. 10 wire has a resistance of 1 ohm per thousand feet; No. 7 wire, which is three sizes larger, has 0.5 of an ohm per thousand feet; No. 4 wire, which is three sizes larger than No. 7, has 0.25 of an ohm; No. 13 wire, which is three sizes smaller than No. 10, has 2 ohms; No. 16 wire, which is three sizes smaller than No. 13, has 4 ohms. It is easy, therefore, knowing the resistance of No. 10, to find the resistance of No. 7, No. 4, No. 1 and No. 000; also of No. 13, No. 16, No. 19, etc.

A wire which is ten sizes larger than another wire has ten times the weight and one-tenth the resistance.

As the resistance of No. 10 is 1 ohm per thousand feet, the resistance of No. 0 is 0.1 of an ohm, and the resistance of No. 20 wire is 10 ohms. As the resistance of No. 4 is 0.25 of an ohm, the resistance of No. 14 is 2.5 ohms and of No. 24, 25 ohms.

In the following table the first column contains the sizes of wire which differ from one another by three sizes. The resistance of each wire in this column is seen to be twice that of the next larger size and one-half that of the next smaller size. There is, therefore, no difficulty in remembering this column. In the second division of the table the wires are ten sizes smaller than those in the first division; thus No. 11 corresponds to No. 1 and the resistance is ten times as great. In the third division of the table the wires are ten sizes larger than those in the first division; thus No. 0 corresponds with No. 10 and the resistance is one-tenth as great.

Size.	Ohms.
No. 1	0.125
No. 4	0.25
No. 7	0.5
No. 10	1
No. 13	2
No. 16	4
No. 19	8
No. 22	16
No. 25	32
No. 11	1.25
No. 14	2.5
No. 17	5
No. 20	10
No. 23	20
No. 26	40
No. 29	80
No. 32	160
No. 35	320
No. 0000	0.05
No. 0	0.1
No. 3	0.2
No. 6	0.4
No. 9	0.8
No. 12	1.6
No. 15	3.2

From this table several new relations may be observed.

If the wire is one size smaller the resistance is twenty-five per cent greater. For example: compare No. 11 with No. 10, No. 12 with No. 11, No. 13 with No. 12, etc.

If the wire is two sizes smaller the resistance is sixty per cent greater. For example: compare No. 12 with No. 10, No. 16 with No. 14, No. 15 with No. 13.

If the wire is one size larger the resistance is eighty per cent of that of the smaller wire. For example: compare No. 9 with No. 10, No. 10 with No. 11.

If the wire is two sizes larger the resistance is sixty-three per cent of that of the smaller wire. For example: compare No. 11 with No. 13, No. 4 with No. 6.

From the foregoing the following are the ratios of resistance between the wires of consecutive sizes:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

Weight—The weight of a wire is inversely proportional to its resistance. Therefore, the foregoing relations are the same for weight as for resistance, excepting that the weights increase as the size of the wire increases, instead of diminishing. The weights of successive sizes of wire, therefore, bear the following relation, beginning with the smaller wire:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

If the weight of any size of wire is known, it is therefore seen that the weight of the next larger size is twenty-five per cent greater; the weight of the second larger size is sixty per cent and the weight of the third larger size is double; also, the weight of the sixth larger size will be four times as great, and the weight of the tenth larger size will be ten times as great.

The weight of 1,000 feet of No. 10 copper wire is 31.4 pounds. Therefore, the weight of No. 7 wire is 62.8 pounds; the weight of No. 0 wire is 314 pounds. The weight of No. 5 wire is 100 pounds per thousand feet, which is a convenient figure to remember. The weight of No. 2 wire is, therefore, 200 pounds, and the weight of No. 00 wire is 400 pounds.

AREA.

The area of No. 10 wire is approximately 10,000 circular mils (more pre-

[1] *Electric Club Journal*, April.

Digitized by Google

cisely 10,380). The area is proportional to the weight. The area of No. 7 wire is, therefore, about 20,000 circular mils, of No. 0 wire 100,000 and of No. 0000 wire 200,000. The precise area of No. 10 wire is 10,380 circular mils. Taking this figure for easy calculation as 10,400 and following the process above indicated, the area of No. 0000 wire is found to be 208,000, which is very nearly 211,600, the figure in the wire table.

DIAMETER.

The diameter of No. 10 wire is approximately 0.10 inch (more precisely 0.102 inch). The diameters follow the same ratio as the circular mils and weights except that this ratio applies to alternate sizes. Therefore the sixth smaller size has half the diameter and the twentieth smaller size has one-tenth the diameter. Therefore, as No. 10 is 0.10 inch, No. 16 is 0.05 inch and No. 30 is 0.01 inch; also No. 4 is 0.20 inch, and No. 000 is 0.40 inch; also No. 0 (two sizes smaller than No. 000) has eighty per cent less diameter, or 0.32 inch. No. 00, lying between these sizes, may be presumed to be about ten per cent less than No. 000, or 0.36 inch; the diameter given in the wire table is 0.3648.

Reference to a complete wire table will show that the figures in the above examples and other figures which may be determined in the same way are correct within a few per cent. A little practice in mental arithmetic will enable any one to determine the approximate weight and resistance of wire of any size.

SUMMARY.

The things to be remembered regarding B. & S. gauge copper wire are the following:

A wire which is three sizes larger than another wire has half the resistance, twice the weight and twice the area. A wire which is ten sizes larger than another wire has one-tenth the resistance, ten times the weight and ten times the area.

No. 10 wire is 0.10 inch in diameter (more precisely 0.102); it has an area of 10,000 circular mils (more precisely 10,380); it has a resistance of 1 ohm per thousand feet at twenty degrees centigrade (68 degrees Fahrenheit), and weighs thirty-two pounds (more precisely 31.4 pounds) per thousand feet.

The weight of one thousand feet of No. 5 wire is 100 pounds.

The relative values of resistance (for decreasing sizes) and of weight and area (for increasing sizes) for consecutive sizes are:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

The relative values of the diameters of alternate sizes of wire are:

0.50, 0.63, 0.80, 1.00, 1.25, 1.60, 2.00.

CIRCULAR MILS.

Conductors of large size are usually specified in circular mils; for example, 500,000 circular mils, 750,000 circular mils.

As No. 10 wire has approximately 10,000 circular mils and a resistance of 1 ohm per thousand feet and as the length of a wire which has a given resistance is proportional to its area, it follows therefore that the length in feet of a copper conductor having a resistance of 1 ohm may be found by dropping one cipher from the number expressing its circular mils, for example, No. 10 wire has 10,000 circular mils and a resistance of 1 ohm per 1,000 feet; a 300,000 circular mil conductor has a resistance of 1 ohm per 30,000 feet and a 1,000,000 circular mil conductor has a resistance of 1 ohm per 100,000 feet. The weight of a given length is proportional to the area; therefore, the weight of a conductor having 500,000 circular mils is greater than that of No. 10 wire in the same ratio that its area is greater. Five hundred thousand circular mils is fifty times that of No. 10 wire or approximately fifty times thirty-two pounds, which equals 1,600 pounds per thousand feet. In this way the approximate characteristics of copper conductors of all sizes may be quickly ascertained.

To find resistance, drop one cipher from the number of circular mils; the result is the number of feet per ohm.

To find weight, drop four ciphers from the number of circular mils and multiply by the weight of No. 10 wire.

Electric Tramways and Light Railways in England.

Under date of February 22, 1905, United States Consul-General H. Clay Evans, London, transmits the following article, published in the London *Daily Express* of even date, under the heads of "Triumph of Electricity," and "Remarkable Figures as to Its Use on British Tramways." In the printed extract herewith pounds sterling have been reduced to dollars in the Bureau of Statistics.

"The triumphant march of electricity, as applied to tramways and light railways, is shown in a Board of Trade return issued yesterday, giving the figures for street and road tramways for 1903-'04, with comparative statistics for past years.

"The return covers the period from 1878 to 1903-'04, and divides it into three periods—horse, steam and electricity. The maximum year of the horse period was 1879, that for the steam period 1898, while the use of electricity is still growing. A selection from the figures given in the return shows some of the results of the new method of traction:

LENGTH OF LINES, NUMBER OF PASSENGERS CARRIED, NET AND GROSS RECEIPTS, AVERAGE FARE PER PASSENGER, AND CAPITAL INVESTED ON BRITISH TRAMWAYS, 1879, 1898 AND 1903-'04.

Item.	1879.	1898.	1903-'04.
Miles of route open	269	1,604	1,840
Passengers carried	146,000,223	858,485,542	1,799,342,673
Passengers carried, per mile	469,641	806,703	977,961
Net receipts ....dollars..	1,123,947	5,120,682	14,171,783
Gross receipts ....do....	5,349,602	22,191,853	41,875,668
Average fare per passenger....cents..	3.68	2.46	2.2
Capital ....dollars..	20,475,069	80,262,547	235,788,952

"In 1898, 38,777 horses and 589 steam locomotives were employed on the tramways. In 1903-'04 there were only 15,353 horses and 249 steam locomotives. The places of those which have gone have been taken by 7,132 electric cars. In other words, over 1,460 miles of tramway and light railway line are now under electric traction, and only 235 under horse and 108 under steam.

"Of the total of 312 tramway and light railway undertakings in the United Kingdom, 162 are now owned by local authorities, with a total of 1,147 miles of track. A total capital expenditure of £28,060,524 ($136,556,541) has been incurred by local authorities.

"From the profits of these municipal undertakings a sum of £207,087 ($1,007,789) was, in 1903-'04, handed over to the relief of the rates. Among the places at which this satisfactory result was achieved were the following:

SUMS HANDED OVER FROM THE PROFITS OF MUNICIPAL TRAMWAYS AND LIGHT RAILWAYS TO THE RELIEF RATES OF CERTAIN CITIES.

Cities.	Paid to the Rates.
Leeds	$253,058
Manchester	243,325
Liverpool	134,661
Glasgow	124,662
Nottingham	63,264
Salford	58,398
Hull	55,955

"Other interesting figures given in the return show that the tramways and light railways paid £287,733 ($1,400,253) in rates and taxes, and that £1,239,121 ($6,030,182) was paid in dividends."

Digitized by Google

SEMI-ANNUAL CONVENTION OF THE NATIONAL MACHINE TOOL BUILDERS.

SPRING SESSION HELD AT WASHINGTON, D. C., APRIL 11 AND 12.

The semi-annual convention of the National Machine Tool Builders was held at the Arlington Hotel, in Washington, D. C., April 11 and 12, and proved to be one of the most interesting and important meetings which that organization has held. The association was organized four years ago and is doing valuable work in promoting the interests of its members. It holds two meetings each year, the regular annual meeting in New York city, in the autumn, while the spring meetings are held at various other places. The membership of the association comprises the following manufacturing firms and corporations:

The Hendey Machine Company, Torrington, Ct.

B. F. Barnes Company, Rockford, Ill.

Detrick & Harvey Machine Company, Baltimore, Md.

Baush Machine Tool Company, Springfield, Mass.

P. Blaisdell & Company, Worcester, Mass.

Draper Machine Tool Company, Worcester, Mass.

Prentice Brothers Company, Worcester, Mass.

F. E. Reed Company, Worcester, Mass.

Whitcomb Manufacturing Company, Worcester, Mass.

Woodward & Powell Planer Company, Worcester, Mass.

Norton Emery Wheel Company, Worcester, Mass.

C. E. Sutton Company, Toledo, Ohio.

Flather & Company, Incorporated, Nashua, N. H.

Mark Flather Planer Company, Nashua, N. H.

Binsse Machine Company, Newark, N. J.

Gould & Eberhardt, Newark, N. J.

W. P. Davis Machine Company, Rochester, N. Y.

W. A. Wilson Machine Company, Rochester, N. Y.

The American Tool Works Company, Cincinnati, Ohio.

Bradford Machine Tool Company, Cincinnati, Ohio.

Bickford Drill and Tool Company, Cincinnati, Ohio.

Cincinnati Milling Machine Company, Cincinnati, Ohio.

Cincinnati Planer Company, Cincinnati, Ohio.

Cincinnati Shaper Company, Cincinnati, Ohio.

Dietz Machine Tool Company, Cincinnati, Ohio.

Fosdick Machine Tool Company, Cincinnati, Ohio.

Greaves, Klusman & Company, Cincinnati, Ohio.

Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

R. K. Leblond Machine Tool Company, Cincinnati, Ohio.

The King Machine Tool Company, Cincinnati, Ohio.

The Queen City Machine Tool Company, Cincinnati, Ohio.

Rahn, Mayer Carpenter Company, Cincinnati, Ohio.

Schumacher & Boye, Cincinnati, Ohio.

Hamilton Machine Tool Company, Hamilton, Ohio.

Springfield Machine Tool Company, Springfield, Ohio.

Owen Machine Tool Company, Springfield, Ohio.

Jones & Lamson Machine Company, Springfield, Vt.

The Ridgway Machine Tool Company, Ridgway, Pa.

G. W. Fifield, Lowell, Mass.

Stockbridge Machine Company, Worcester, Mass.

Windsor Machine Company, Windsor, Vt.

John Steptoe Shaper Company, Cincinnati, Ohio.

Builders' Iron Foundry, Providence, R. I.

The delegates in attendance at the Washington convention were the following:

William Lodge, president of the association, representing Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.

P. E. Montanus, secretary of the association, representing the Springfield Machine Tool Company, Springfield, Ohio.

Enoch Earle, treasurer of the association, representing P. Blaisdell & Company, Worcester, Mass.

F. W. Boye, Jr., Schumacher & Boye, Cincinnati, Ohio.

B. B. Quillans, Cincinnati Planer Company, Cincinnati, Ohio.

H. L. Flather, Flather & Company, Incorporated, Nashua, N. H.

Chas. S. Gingrich, Cincinnati Milling Machine Company, Cincinnati, Ohio.

Geo. O. Gridley, Windsor Machine Company, Windsor, Vt.

L. M. Anderson, Cincinnati Shaper Company, Cincinnati, Ohio.

Fred. L. Eberhardt, Gould & Eberhardt, Newark, N. J.

C. H. Alvord, Hendey Machine Company, Torrington, Ct.

Murray Shipley, Dietz Machine Tool Company, Cincinnati, Ohio.

Edward M. Woodward, Woodward & Powell Planer Company, Worcester, Mass.

W. P. Davis, W. P. Davis Machine Company, Rochester, N. Y.

V. F. Prentice, Prentice Brothers Company, Worcester, Mass.

J. W. Carrol, Draper Machine Tool Company, Worcester, Mass.

W. A. Wilson, W. A. Wilson Machine Company, Rochester, N. Y.

O. M. Flather, Mark Flather Planer Company, Nashua, N. H.

J. S. Detrick, Detrick & Harvey Machine Company, Baltimore, Md.

E. P. Bullard, Bullard Machine Tool Company, Bridgeport, Ct.

The proceedings of the convention were conducted in executive session in accordance with a standing rule of the association. The subjects announced for formal report and discussion were as follows:

"Conditions of Trade."

"Standardization of Motor Drives."

"Tariff Revision."

"How Best to Offset the Exceeding Diligence of the German Nation in the Acquisition of the Markets of the World."

"A Revision of the Apprenticeship Question."

"A Further Revision and Addition of the Prices of Detail Parts of Machine Tools."

"Relative Cost of Power for Belt-Driven and Motor-Driven Machine Shops."

"Patent Laws Particularly Applicable to Machine-Tool Builders."

"Types of Machine Tools to Sell at Their Proper Value."

"Advantages of the Motor Drive and Greater Power Necessary in the Belt Drive for Machine Tools"

"Foundry Work and the Advantages of an Up-to-Date Foundry for the Machine-Tool Manufacturer."

Mr. G. Herbert Condict, vice-president of the Electro-Dynamic Company, of Bayonne, N. J., appeared before the convention, by invitation, and explained the principles and construction of the motor made by his company and answered questions propounded by the members regarding its applicability to the various needs of the work in which they are engaged. Mr. Condict had on exhibition before the convention one of his latest motors which elicited the greatest interest and admiration. It was run at greatly varying speeds, under all conditions of load, and could be instantly reversed at any moment. The general sentiment of the delegates favored the substitution of independent electric motors for the cumbersome and inconvenient systems of shafting and belting now in use in many of the factories.

The convention finally adjourned at twelve o'clock on Wednesday, April 12, and the rest of that day was spent by the delegates in visiting points of interest in Washington.

Digitized by Google

THE UNITED STATES NAVY'S FLOATING REPAIR SHIP.

BY GEORGE E. WALSH.

One of the most unique and, in its particular field, most important crafts constructed in recent years by the Navy Department is the new floating repair ship shortly to be launched from the New York navy yard. As a miniature floating navy yard, the craft possesses many features entirely new in the field of marine architecture. Work has been progressing rapidly on the ship lately, and it will be in service within a short time. The experimental nature of the boat must eventually demonstrate the value of a floating repair shop which can perform all the work for ordinary warships without necessitating dry-docking.

The design and construction of the ship is due to Naval Constructor William J. Baxter, and the development of the idea has been the result of many years of study on the part of the best marine architects connected with the navy. The cost in time and money to dock a modern cruiser or gunboat for making some slight repairs either to the craft or the guns and armament has always been a serious problem. Frequently these repairs are of so slight importance that they are deferred from time to time, and in the end they cause a good deal of trouble through delay. The use of a dry-dock for making small repairs, or even the use of the navy yard, complicates matters by delaying work of a more important character on other ships. A floating repair ship could therefore simplify the problem by doing the work off Tompkinsville, S. I., or anywhere in the bays or rivers of the coast.

The efficiency of such a floating repair shop naturally depends entirely upon the completeness of its equipment, and no effort has been spared to make this as perfect as possible. The new craft when put in commission will represent the most perfect naval repair shop in existence. Economy of space has been considered so that every possible square inch above and below decks has been made available.

The floating repair ship is 120 feet in length, 40 feet wide, and designed to draw only six feet of water. This will permit it to float in shallow bays and rivers to do work on small draught gunboats, torpedo boats and torpedo-boat destroyers. With this object in view the boat has been constructed with a generous beam, and with watertight compartments which can be filled and emptied at ease.

Constructed entirely of steel it can stand almost any strain imposed upon it. It is practically non-sinkable, and it can be towed through almost any kind of a sea that a cruiser can navigate. It will contain no self-propelling power, for every square inch is utilized for machinery for repairing other ships.

At one end of the ship is built a steam derrick with a total lifting capacity of twenty tons. This derrick is intended to lift the heavy ordnance and gun carriages from cruisers and torpedo boats, and to lower them in the shops below decks. The weight of this derrick at one end is offset by the boilers and furnaces located at the opposite end. The boilers furnish steam for driving the different machines and dynamos on the ship as well as to operate the huge derrick.

The repair shop is divided into two sections—the deck shop and the interior shop below. Work that can be performed better on the deck will have the advantage of more space and freedom of operation. The two repair shops are located amidships, and there will be found in them practically every tool and machine that the ordinary navy yard is equipped with. These include a miscellaneous assortment of electrical and pneumatic tools—lathes, drills, slotters, shears and punches.

The roof of the repair shop is fitted with big skylights which can be automatically removed to admit parts of another ship to be repaired. By means of the huge steam derrick, guns, carriages and other parts of a cruiser can be lowered through the open skylights, and when closed work can progress in stormy weather. Sufficient light filters through the glass covering to enable the workmen to operate their machines in ordinary weather. But a perfect system of electric lighting has been installed so that no cessation of work need be caused by the weather. Provisions are made for night and day shifts of workmen, and in emergencies repair work on cruisers could go on twenty-four hours in the day.

Provision is made for repairing the superstructure and deckwork of small cruisers and gunboats. By running the repair ship close up to a cruiser, the pneumatic and electrical tools and machines could be carried on the deck or along the side of the craft. Thus riveting and bolting of loosened plates could be repaired. A cruiser that had collided with a dock or another ship could have her bow entirely replaced with new plates without going into dry-dock. Work can be carried down to the water line on the damaged ships, and only injuries extending below the water line would necessitate the dry-docking of ordinary small cruisers, gunboats and torpedo crafts.

The portable nature of the electric tools is a feature of the new floating shop. Electric current furnished by the dynamos can be carried to any part of the deck of a cruiser by uncoiling wires, and the small drills, slotters, punches and lathes can thus be carried to the far side of the ship. Workmen can operate over a wide field by means of this system, and power is always furnished them in abundance. While riveting plates is thus carried on simultaneously on both sides of the cruiser, other workmen in the repair shop proper below decks can forge and shape new bars, plates and miscellaneous articles. All parts of the repair shop are kept busy in this way.

Should the navy craft prove all that is expected of it, there is little doubt that it would be the pioneer of the whole fleet of such floating repair shops for general commercial use. Their construction would not be confined to the shipbuilding plants of our few Atlantic ports, but one or more would be fitted up for every seaport of importance on the Great Lakes and on either coast. That there is need for such ships is quite evident, and modern designing of electrical and pneumatic tools and machines makes their construction practical. Such floating repair plants would have to be designed to do nearly all the ordinary repairing of a modern ocean liner, from replacing wrenched and loosened iron plates to erecting new smokestacks or fitting on a broken screw or shaft. Repairs below decks as well as on the superstructure would come within the province of the workmen. Portable tools, drills and punches that could be carried down below, and derive their power from the electric plant of the repair ship, would greatly simplify work on ordinary tramp and freight steamers. To be able to fit up a disabled steamer in this way without taking her out of commission would save thousands of dollars to her owners.

Electrical Apparatus for Measuring Speed.

An ingenious device for measuring speed is now employed by Lahmeyer & Company, Frankfort, Germany, for use on the locomotive supplied to the Royal Railway at Frankfort-on-the-Main. The apparatus depends for its action upon the change in impedance of an inductive circuit with the frequency. A transformer is arranged, upon which are three coils. Through one of these is passed a current which is drawn from the supply circuit. Through another is passed a current which is interrupted by a commutator driven from the axle of the locomotive. The third coil is attached to a voltmeter, the indications of which vary with the frequency of the interruption of the current, hence giving an indication of the speed.

Digitized by Google

NOTES ON THE USE OF RARE EARTHS IN ELECTRIC ILLUMINANTS.[1]

BY MURRAY C. BEEBE.

As scientists and engineers have come to a realization of the inefficiency of existing methods of illumination, the problem of improving upon these inefficient methods has received considerable attention. While the element carbon has, heretofore, been almost exclusively used commercially in both arc and incandescent lamps, the rare earth oxides, so called, have recently been found to possess desirable properties for use as illuminants.

We are already familiar with the work of Auer von Welsbach in producing gas mantles of thoria and ceria. To use the rare earths in electric illuminants was a logical step. However, the problem possessed difficulties not encountered in the production of a serviceable gas mantle. We should remember that an illuminant, to be an improvement over the Edison or carbon filament lamp in the matter of efficiency, must be capable of withstanding a higher temperature than the carbon filament for a length of time sufficient to make it commercially attractive. One might at first suppose that it would be difficult to improve upon the carbon filament in the matter of efficiency, or the ability of the filament to operate commercially at a very high temperature, since carbon is practically infusible and the rare earths are fusible. Carbon, however, slowly vaporizes at the temperature at which it operates in the incandescent lamp, and finally, after 400 to 600 hours, has depreciated in light-giving power to such an extent that it is best to replace it. It is the vaporizing properties rather than the melting points of the materials, with which we are concerned in this problem. It has long been known that substances which are commonly regarded as insulators, such as glass and porcelain, become quite good conductors of electricity at higher temperatures.

Professor Buff, in 1854, read a paper "On the Conductivity of Heated Glass for Electricity," and "Faraday's Researches," gives a number of examples of such conductors. Jablochkoff attempted to use refractory materials, such as lime, to separate and insulate the carbon electrodes of his Jablochkoff candle. He soon found that these supposed insulators in reality became conductors and emitted light by virtue of the current passing through them from one electrode to another. He even designed terminals with which to carry the current of electricity to the lime conductor, with the idea of making a lamp based on this principle. It is safe to say that were it possible to produce electricity as cheaply then as now lamps of the Nernst type would have been known commercially much sooner than they were, for Jablochkoff's persistent attempts at commercial exploitation were baffled largely by the undeveloped state of electrical engineering.

That the rare earth oxides are exceedingly refractory and do not readily vaporize at high temperatures makes the Welsbach mantle possible; that these oxides will conduct electricity when hot makes the Nernst lamp possible. Of all the oxides which conduct electricity but few are refractory enough for an efficient filament or glower. It was in determining the most desirable of these and in fixing the best proportions to use that Nernst did his greatest work.

Ordinary red iron oxide, when formed into filaments and baked, will conduct electricity at ordinary temperatures, but such filaments do not withstand sufficiently high temperatures to be used as light sources. Magnesia and thoria, on the other hand, withstand exceedingly high temperatures, but these conduct electricity only with great difficulty. In general, mixtures of two or more oxides conduct better than a single oxide, and, in turn, the fusing point of the mixture is lower than that of either oxide alone. It seems that the vaporizing point is not necessarily lowered, judging from the fact that thoria and the small amount of ceria used in a Welsbach mantle form quite a stable mixture, or possibly a chemical combination, while ceria alone or uncombined is a somewhat undesirable oxide from its rather marked tendency to vaporize.

It would be a long story to take up the various properties of all the rare earth oxides and the possible combinations with one or more of the others. A mixture which is used largely in lamps of the Nernst type is composed of eighty-five per cent zirconium oxide to fifteen per cent of yttria earths. Zirconium is not properly classified among the rare earths, though it is customary to do so. The term "yttria," as used here, means in reality a mixture of many oxides occurring together in certain minerals and closely allied in physical and chemical properties. Zirconia was used in comparatively large quantities for the first Welsbach mantles, and hence, considerable attention had been given to various methods of producing it for such use. While many of the experimental glowers were made from zirconia bought from chemical supply houses, it was impossible to obtain uniform results from such material. Good zircon ore, which is a zirconium silicate, occurs in abundance in Henderson County, North Carolina, and this ore contains about sixty-seven per cent of zirconium as oxide. By treating this ore in the following manner, quite uniform results are possible:

The ore is ground very fine in a ball mill and mixed with twice its weight of crude acid potassium fluoride. This is placed in an ordinary graphite crucible and heated slowly until thoroughly fused, and the ore is completely dissolved. The fused mass is then ground and dissolved in hot water containing a quantity of crude hydrofluoric acid equal to about one-tenth the weight of the fused mass. The silica remains undissolved as potassium silicofluoride (K_2SiFl_6) and the potassium zirconium fluoride (K_2ZrFl_6) is drained off while boiling hot into a silver-lined vessel. Upon cooling, the filtrate develops crystals of potassium zirconium fluoride, and, doubtless, small quantities of other elements in similar crystal form. Iron and many other impurities which are present in the ore, or have been introduced by the use of crude reagents, remain in the liquor which is drained from the crystals. The crystallizing process may be much hastened by artificial cooling. Rinsing the crystals with cold water is likewise beneficial in removing all traces of the mother liquor. The crystals are gathered and fused in a platinum dish. By this means, any silica present seems to be vaporized off, and other impurities, like titanium, are made insoluble. The fused mass is ground and dissolved in hot water and crystallized as before. A few of the first crystals are removed; or, instead, alcohol may be added to the solution until a small amount of crystalline precipitate is formed. These first crystals contain much of the undesirable impurities. They are, therefore, removed and the crystallizing process is continued. The pure crystals are then dissolved in hot water and the solution is made rather acid by the addition of pure hydrofluoric acid. Ammonia is now carefully added to the hot solution until a small amount of precipitate is formed. If the solution of crystals has been made acid, the addition of ammonia, even until alkaline, will precipitate out iron and some other foreign metals but will leave the zirconia in solution until it is cooled and diluted.

This method was found to be an exceedingly simple one for removing iron from zirconia, which, by other methods, is a troublesome operation. The hot filtrate,

[1] Paper read at meeting of the chemical section of the Engineers' Society of Western Pennsylvania, March 28, 1905.

Digitized by Google

after removing the precipitate of iron, is dropped directly into a cold ammonia solution which at once precipitates zirconia as a hydrate. Up to this stage of the process, it has been necessary to use vessels and utensils not affected by hydrofluoric acid. The last precipitate may be made in glass or wooden receptacles. The precipitate is washed several times by decantation, and then pressed out on suction filters and after a thorough drying by heat is powdered and sifted through fine bolting cloth and is then ignited in a platinum dish, over a very gradually increasing temperature and with constant stirring. The ignition process requires several hours, or sometimes days, the final temperature being a good red heat. Traces of silica are removed by this operation.

The physical condition of the precipitate is dependent to a great extent upon the amount of hydrofluoric acid in excess. When precipitated from an almost neutral solution, the precipitate dries into hard pieces translucent in appearance, and which are difficult to pulverize. With the greater excess of acid, the material dries in lumps resembling starch, in which condition it is much more suited to our purpose.

The zirconium made by this process seems to be reasonably pure. Precautions must be taken to keep out dirt, and to that end it has been found advantageous to purify the air admitted to the rooms where the glower materials are prepared by passing it through a water spray. An absolutely pure zirconia is not required and though a trace of silica improves the efficiency and seems to diminish the initial depreciation of candle-power of a glower, it is a dangerous element to have present, for slightly more than a trace will cause a rapid change in potential difference at the glower terminals besides causing lack of uniformity in the behavior of glowers of one batch, due to the fact that the silica becomes unevenly distributed among the glowers by vaporization and condensation occurring in a roasting process, which will be described later.

Although the purest materials make the best glowers for direct current, it can not be said that an absolutely pure zirconia is desirable for alternating-current glowers. Silica is particularly undesirable in direct-current glowers. In general, a glower which operates well on direct-current, showing almost no change in potential difference, will show a greater change when operated upon an alternating-current circuit.

The purity of the zirconia may be controlled, to some extent, by the number of times the material is crystallized during the purifying process, though each operation is attended with some loss of material. Physical properties are quite as important as chemical properties and the procedure above described was evolved to give proper physical, as well as chemical, properties to the material.

After all, "handsome is as handsome does"—and the real test for the glower material lies in its ability to make good glowers. Test glowers have been made from hundreds of lots of zirconia and these tests, together with careful chemical records of each lot, have been the guide in developing the chemical process necessary for the production of good glowers. For direct-current glowers, a crystallizing process is also considerably used, but from a solution of zirconia in hot dilute hydrochloric acid. After two or three such crystallizations, it is necessary to precipitate from a hydrofluoric acid solution, as in the first process, to get the material into proper physical shape.

As to the yttria used, this is principally obtained from the minerals gadolinite or yttrialite. Gadolinite is found in Norway and Sweden, and also in Llano County, Texas. The Texas deposit seems to be confined to a very small district and there is every evidence that it is a result of a volcanic eruption. It is found in crystalline form associated with yttrialite, crytolite, fergusonite, rowlandite, allanite and other minerals. The ores from the Llano County district are radioactive and the presence of a pocket in the quartz is generally indicated by bluish discolorations radiating from the pocket through some distance of the surrounding quartz. It is also claimed that the ores contain small quantities of confined helium gas. Gadolinite contains, roughly, 42 to 45 per cent of yttria earths, 23 per cent of silica, 13 per cent iron as oxide, and 9 to 12 per cent of beryllia. Yttrialite contains 43 to 47 per cent yttria earths, 30 per cent silica, 5 to 6 per cent ceria, didymia, and lanthan, as well as small percentages of urania. Fergusonite contains 32 to 42 per cent yttria earths, 32 to 46 per cent niobia. Rowlandite contains 47 to 62 per cent yttria earths, 26 per cent silica and small percentages of iron and magnesia. Allanite contains 26 per cent ceria and didymia, with a small percentage of yttria earths and considerable percentages of iron, calcia and alumina.

It is a comparatively simple matter to obtain and purify the yttria earths from gadolinite and yttrialite so that they are suitable for glower making. About one thousand grammes of ground ore are dissolved in crude aqua regia. The residue is filtered off and the solution evaporated to dryness, repeating this operation several times, or until all silica is removed. The neutral solution is then diluted to several litres and the addition of a hot solution of oxalic acid to the hot solution containing the earths, brings down the rare earths as oxalates, leaving iron and other impurities in solution. The oxalate is washed thoroughly with hot water and ignited, and the crude yttria earths are dissolved in dilute hydrochloric acid, just sufficient in amount to dissolve the oxide. To the rather dilute and neutral solution, which is cold, crystals of potassium sulphate are added in excess. After standing twenty-four hours, the cerium group has been quite thoroughly separated as double sulphates and the filtrate is then treated with ammonia to bring down the hydrates of the rare earths, thus freeing them of the great excess of potassium sulphate. The washed precipitate is dissolved in a quantity of pure hydrochloric acid just sufficient to dissolve it, and again treated with boiling oxalic acid solution, as before. This brings down the rare earth oxalates in sufficiently pure form. The oxalates are thoroughly washed with hot water and ignited, and any remaining potassium is separated from the ignited oxides by washing upon a filter with hot water.

With the yttria, as well as the zirconia, physical properties are important; and the oxalate method gives an exceedingly fine precipitate which requires no mechanical treatment.

Experiments indicate that the yttria earths of the greatest atomic weights give the most satisfactory results in glowers. In other words, ytterbia is better than yttria. Owing, however, to the great difficulty of separating the yttria earths from each other, which is so far possible only by laborious fractionation processes, entailing great losses, not much has been done toward using the higher atomic weight yttria earths beyond selecting ores which are rich in these earths.

The Llano County ores seem to be superior to the foreign ores in this respect, the atomic weights being

Yttrialite	115
Rowlandite	107
Fergusonite	103
Gadolinite	100

while the foreign ores may be as low as 90 or 92.

The zirconia and yttria earths mixed in the proportions given above; namely, about eighty-five and fifteen, or ninety and ten, and about five per cent of starch or gum tragacanth, are thoroughly mixed

Digitized by Google

and kneaded into a hard dough and squirted by pressure through a die of proper size. This string, as it may be called, is dried and then broken into suitable lengths which are roasted to an intense white heat in a platinum box. The pieces are then ready to have terminals placed upon them.

A Nernst terminal is made by winding stranded platinum wire about the end of the stick of material and then pasting over with a paste composed of ground glowers and zirconium chloride, thus forming a hard cement.

The Hanks terminal has the platinum embedded in the glower material, the operation being carried on by the aid of an electric arc in which the glower material is fused.

Certain it is that the mode of conducting the current is electrolytic in character. The specific resistance varies with the relative proportions of the constituents. In order to obtain glowers of the same specific resistance, when using yttria earths of high atomic weights, as when low atomic earths are used, it is necessary to have the presence of the higher atomic weight materials in proportion to the atomic weights.

Upon direct-current circuits, the positive end of a glower generally runs much hotter than the negative end, and a black discoloration appears at the negative end, especially if impurities are present. In fact, this is one of the most certain indications of the presence of an impurity.

A glower operated in vacuum soon destroys the vacuum, probably due to oxygen gas liberated by electrolytic action. That all the current is carried by electrolytic means seems incredible, for the current carried per square unit of cross-section is far greater than can easily be accounted for by our usual conceptions of electrolytic laws. For example—upon direct current and calculated by electrochemical equivalents, the entire glower would be decomposed into the constituent elements in a very few minutes. Doubtless electrolytic decomposition and recombination do take place, but is it possible to account for the entire transport of current in this way? The assumption that the current is all so carried seems unnecessary in view of what is known of the power of highly incandescent bodies to ionize air to render it conducting. The air in the neighborhood of a glower is conducting, and to such an extent that the leakage current from glower to heater had to be reckoned with early in the experimental work, and the difficulty was obviated by the use of a double-pole cutout which disconnected the heaters completely from electrical connection with the remainder of the lamp after the glower started.

In connection with these speculations as to the real nature of the process by which the current traverses the glower, it is a fact that glowers which have operated for even a short time upon direct current will, when the current strength is diminished sufficiently to maintain the glower at only a good red heat, explode with considerable violence. This may be accounted for by considering that the conductivity at low temperatures is insufficient to ionize the surrounding and contained gases. The means of conducting the current then being largely electrolytic in character, the combination of the products of electrolytic decomposition can not so readily take place, since the ions can not so readily traverse the length of the glower to combine at the lower temperature; consequently disruption occurs.

The suggestion that has so often been made; namely, that the current be reversed in direction at intervals, as, for instance, every time the lamp is started, is altogether impracticable for the reason that a glower once operated upon direct current must never have its poles reversed, for a reversal means almost instant disruption. The potential difference across the terminals of the glower immediately after such a reversal is lower, indicating something analogous to polarization effects as we know them in aqueous electrolytes.

In general, with the Nernst terminal, the potential difference across the glower at the normal current value is the same with alternating or direct current. With the Hanks terminal, or embedded type, the potential difference with direct current may be as much as twenty volts lower. The Hanks terminal will operate on direct current, but not satisfactory as a commercial proposition. The life of the alternating-current glowers is greater upon high frequencies than upon low frequencies, again suggesting electrolytic conductivity, at least in part.

The small glowers, up to 0.5 ampere, are made solid in cross-section, the largest ones are generally made tubular; and, in fact, one-ampere glowers must be made so. The reason for this is not that greater efficiency is sought by increasing the ratio of surface to volume, which is, of course, a fallacy, but inasmuch as the glower possesses a decided negative temperature coefficient as regards electrical conductivity, the centre of a large glower would become molten before the outside surface reached an efficient temperature, the centre being the better conductor. Glowers which have been greatly overrun, often exhibit this truth by the appearance of a nodule of molten material which has spurted out to the surface.

GLOWER IN VACUUM.

A glower will operate in vacuum but the vacuum rapidly deteriorates, as before stated. A blue aurora or luminous haze surrounds the glower thus operated, either with direct or alternating current, and has been thought to be due in some way to vaporized metal (zirconium or yttrium) recombining with the slight amount of oxygen liberated. This idea seems plausible from the facts that objects such as wire or glass near the glower become coated with a white deposit of the glower oxides in a comparatively short time.

It would seem that oxygen necessarily plays a part in conducting the current, for a glower in an atmosphere of hydrogen or nitrogen behaves similarly to the one operated in a vacuum. In carbon monoxide or dioxide the glower exhibits the same characteristics as in air. The glower operated in vacuum exhibits a peculiar sluggishness in responding to changes in voltage at its terminals.

A commercial glower must operate at a high temperature to be efficient. Nernst glowers operate at about 2,300 degrees centigrade, it is supposed from determinations made by photometric means, and at about twice the efficiency of a carbon incandescent lamp. The spectrum of a glower is a continuous one and no evidences of selective emission in any particular region are noted. During the life of a glower, which averages about 800 hours under normal conditions of manufacture and voltage regulation, a depreciation of candle-power takes place due to a number of causes. In the first place, all oxides of the rare earths do depreciate rather rapidly in light intensity per unit of surface at any given temperature. This is true even when heated by gas or electricity, and a platinum plate coated on one side with rare earths and heated from the rear by an ox-hydrogen flame behaves similarly. It is an inherent property of these oxides and a depreciation of ten or twenty per cent may occur during the first hour. There is then a slow diminuation of intensity of light, also inherent, and seemingly accompanying the tendency of the glower to change from an amorphous to a crystalline structure. A rise of potential difference across the glower terminals is usual, though it is possible to counteract this tendency, at least in part. The effect

Digitized by Google

of a rise in potential difference, obviously, is to diminish the intensity of light by permitting less current to traverse the glower, running on a constant potential circuit.

With carbon incandescent lamps, the useful life or smashing point is considered to be that number of lamp-hours during which the candle-power decreases twenty per cent from the initial candle-power. Nernst lamps are similarly rated, counting as initial candle-power that measured after the initial decrease above mentioned.

Other causes of depreciation in candle-power are blackening of the enclosing glassware and reflecting surfaces. In this connection, the blackening is due largely to platinum which has been vaporized and deposited upon these surfaces. It has been found that the purest platinum is far better than that containing iridium or other of the platinum group, since pure platinum vaporizes much more slowly than alloys with these other metals.

It is to produce uniform chemicals and glowers in which the tendency to depreciate in light intensity and increase in potential difference shall be a minimum, that makes the problem so intricate and so fascinating, and still capable of much improvement.

Curiously enough, not the least of the problems to be solved in the development of the Nernst lamp was to overcome the tendency of porcelains to conduct electricity, the very property which in the case of the rare earths made such a lamp as the Nernst possible. A heater is necessary to start the glower. The heater is made by winding fine platinum wire upon a porcelain tube. It was necessary to produce a suitable porcelain which would withstand the high temperature necessary, and at the same time not conduct electricity. A porcelain composed of kaolin, alumina and silica is sufficiently refractory and porous to withstand the heat, and is an almost perfect non-conductor at high temperatures. The porcelain piece upon which the glowers and heaters are mounted is also of the same composition.

Another form of heater used more abroad than in this country is helical in shape and the glower is mounted in its axis. This is made of pure kaolin and after squirting into tubes about a millimetre in diameter and winding with fine platinum wire and covering over the wire with a paste, the small tube is bent into a helix upon a mandrel, a pointed blow-pipe flame playing upon the kaolin tube at the point where it bends onto the mandrel.

POSSIBILITIES OF SELF-STARTING FILAMENTS.

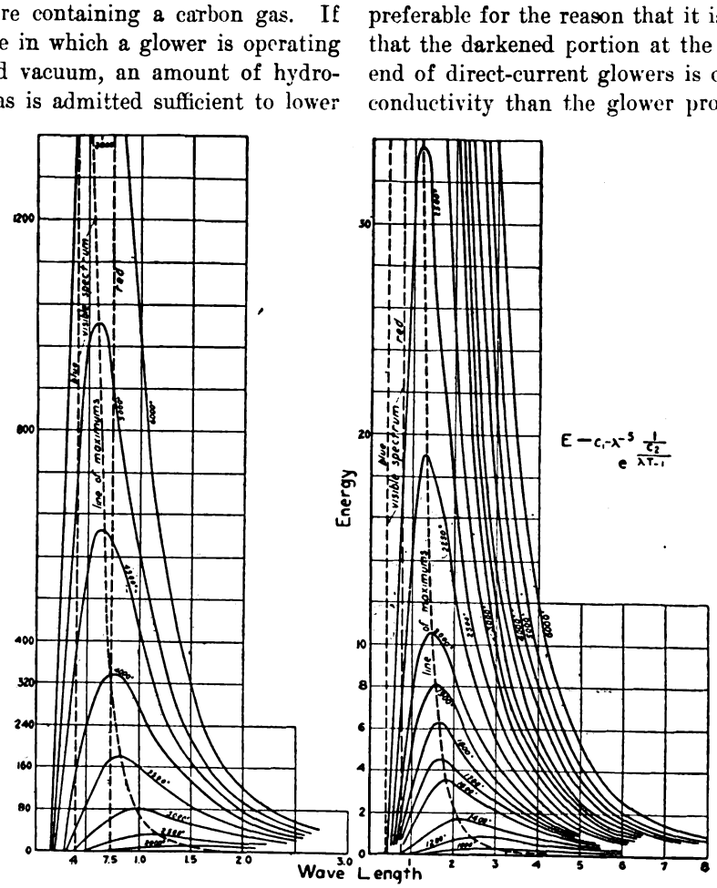
Many oxides will conduct at room temperature. A mixture of iron and tin oxides, about seventy iron to thirty tin, will start without preliminary heating and withstands rather a high temperature. There are many other similar combinations, likewise other possibilities exist; such as carbides, silicides and borides, operated either in vacuum or gases.

A Nernst glower may be made to conduct current at low temperatures by running it for a short time in a rarefied atmosphere containing a carbon gas. If to a globe in which a glower is operating in a good vacuum, an amount of hydrocarbon gas is admitted sufficient to lower the vacuum even less than a millimetre, the potential difference across the terminals of the glower will decrease rather rapidly and in the space of a few minutes, or even seconds, the glower will have become a conductor when cold; or, in other words, self-starting.

The following experiment was tried:

A glower was mounted in a glass bulb and in the axis of a carbon filament of a helical shape. The bulb was exhausted well and sealed off. The carbon filament was used four or five times to start the glower, alternating current being employed. After the glower had run a few hours, it was noted that it was changing color at its terminals. The discoloration gradually crept toward the centre and after about twenty-four hours the glower could then be started without preliminary heating. Apparently enough of the carbon filament was oxidized during the short time it was in use to give a slight quantity of free carbon monoxide in the bulb, the source of oxygen being the glower itself.

It is uncertain whether this gas was effective in reducing some of the glower material to its metallic form, or whether a conducting carbide was formed by the action of the carbon gas upon the glower materials. The former explanation seems preferable for the reason that it is noticed that the darkened portion at the negative end of direct-current glowers is of higher conductivity than the glower proper, and it seems quite likely that this deposit is a metal separated out by electrolytic action. Metallic zirconium, for example, withstands very high temperatures in the open air without oxidizing and its melting and vaporizing points where air is excluded must be very high.



RELATION BETWEEN TEMPERATURE AND ENERGY RADIATED ON VARIOUS WAVE-LENGTHS.

Many possibilities exist, such as are suggested by the above experiments, and many of them have been tried. Boron carbide, for example, withstands very high temperatures and is a conductor while cold, though it seems to vaporize somewhat too rapidly; at least this was the case with samples tried which probably were not very pure.

A Nernst glower, as well as those composed of thoria, magnesia and almost any

Digitized by Google

of the refractory oxides, may be made conducting by treatment with a hydrocarbon gas. Sodium and potassium vapor also effect a reduction to the self-starting condition, though not generally so readily as carbon.

There is a broad field still open and much that is not known of the properties of the rare metals. Oftener than not the supposedly pure metal is very impure, and the properties generally ascribed to it are in reality those of its carbide or other little known combination. Note the difference in properties of pure iron and iron containing even less than one per cent of carbon. Is it not a fact that almost nothing is known of the physical properties of the rare metals? A good example of this point, and one bearing directly on our subject, is the recently developed tantalum lamp, the filament of which is a fine thread of tantalum metal. Tantalum metal until recently was not known to possess properties which now make it a promising addition to electric illuminants.

More or less experimental work has been done, particularly in Europe, in using the rare earths in electric arcs with the idea of obtaining better efficiency and more pleasing light. Lamps have even been tried with electrodes composed entirely of the rare earth oxides, though at the present time the greatest advances in arc lighting are being made along the lines of introducing such elements as boron and tantalum into the electrodes.

In conclusion, attention is directed to a curve which has been plotted to show the relation between the temperature and the energy radiated in the various wavelengths of light for incandescent bodies. We are apparently at the present time just on the border of the possibilities.

BOOK REVIEWS.

"Mechanical Engineer's Reference Book." Henry Harrison Suplee. Philadelphia. J. B. Lippincott Company. Flexible leather. 859 pages. 4½ by 6¾ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $5.

This is the second edition of this engineer's reference book. It has been revised and enlarged, and such typographical errors as have been discovered in the first edition have been corrected. An appendix has been added, containing new matter, and the index has also been enlarged.

"Elements of Mechanics." Forty lessons for beginners in engineering, by Mansfield Merriman, professor of Civil Engineering, Lehigh University. New York. John Wiley & Sons. 12mo. 172 pages. Supplied by the ELECTRICAL REVIEW at $1.

The scope and purpose of this book is shown in the following extract from the preface: "the field of rational mechanics is so vast that no book can present more than a part of the same. Even the limited course usually given in engineering colleges is so difficult and appeals so little to the students' experience that few acquire a complete mastery of it. In the opinion of the author there should be given in every engineering college two courses in rational mechanics, an elementary one during the freshman year in which only as much mathematics is employed as is indispensably necessary, and an advanced one after the completion of the course in calculus. It is the principles and fundamental methods which are of the greatest value and importance, and if no course in mechanics is given until calculus has been completed, as is now generally the case, the student is introduced to a wilderness of algebraic matter in which these principles are largely obscured. Fortunately the fundamental elements can be presented without such advanced mathematics, and this book is an attempt in that direction. To read this volume with interest and profit, only a knowledge of plane geometry, elementary algebra, and plane trigonometry is required. It is intended for manual training schools, freshman classes in engineering colleges, and for young men in general who have the preparation just indicated." We heartily concur with the author's idea that the study of elementary mechanics should be begun in the freshman year. A large portion of the elementary course in mechanics requires only a knowledge of a few simple rules in arithmetic, the method of transposing simple algebraic equations and a few principles of plane geometry. With these as a foundation the young student of mechanics not only is put in possession of most of the important generalizations of the subject, but is also taught in the best manner to exercise his reasoning powers, including in addition to the mathematics his plain common-sense reasoning. We are gratified to notice that Professor Merriman begins the book with a discussion of force, and treats of such questions as the parallelogram of forces, couples, centre of gravity, friction and simple machines before he begins to treat of motion and velocity. This we think is the proper way to begin the study of mechanics and much easier to the student than the plan followed by many modern writers of beginning with motion and later treating of forces as something derived from the study of motion and acceleration. The subject of mass is not mentioned until the last chapter is reached and then it is defined not as the quantity of matter in a body but as the ratio W/G. "This ratio," says the author, "depends only upon the quantity of matter in a body and it is generally called 'mass' in higher works on theoretical mechanics, and is designated by M. The system of units used in this book is called the 'gravitation system' and is the one generally employed by civil, mechanical and mining engineers. The other system of units is of special value in celestial mechanics where bodies have no weight in the sense here employed." The author defines weight W to be the force with which gravity acts upon a body as determined by a spring balance. It would have been well also to have given a definition which is universally employed by engineers in practical work and which is used in common language, namely, that weight is the quantity of matter as determined by weighing it on an even balance or platform scale and thus comparing it with the quantity of matter in the standard pound. It is best to recognize the fact that the word weight in the English language and the corresponding word in all other modern languages is generally employed by the people at large in two senses; one as a measure of quantity of matter and the other as a measure of force, and the context always shows which meaning is used. The book is divided into forty lessons, of which six are comprised under the heading "Concurrent Forces;" six under "Parallel Forces;" five under "Centre of Gravity;" five under "Resistance and Work;" six under "Simple Machines;" six under "Gravity and Motion;" six under "Inertia and Rotation." Each of the forty articles has appended to it ten examples or practical problems, making 400 problems in all. The style of the author is in general clear and simple, but there are a few places in which the text is somewhat obscure. For instance, on page 8 the statement is made that "the 'component' of a force in a given direction is defined as a force represented on the given line of direction by the intercept included between normals drawn to it from the ends of the force-line." This is not clear and not true unless the two components are at right angles to each other. Some of the so-called axioms on page 11 are really not axioms and their truths should be demonstrated. Some of them appear to be true only under certain conditions.

Digitized by Google

The Legislative Enquiry on New York City Lighting.

For several weeks a legislative enquiry has been going on in the city of New York, looking into the production and cost of gas and electricity for public service. The Consolidated Gas Company and the New York Edison Company have been under fire for some time. A number of very interesting points were made when the investigating commission renewed its sessions on Thursday, April 6. Upon questioning Henry M. Edwards, auditor of the New York Edison Company, in an attempt to fix the actual values of all the properties employed in the business, it was developed that $7,500,000 of the power company's bonds was issued to acquire the eight small companies in the electric light business in Manhattan, the Bronx and Yonkers before the merger, and $21,000,000 for the Edison Illuminating Company, whose shares were paid for at the rate of 220. Mr. Edwards said that the illuminating company has earned sixteen per cent in 1899, 19.8 per cent in 1900, and for the first four months of 1901, or just prior to the consolidation, 10.6 per cent. In the twenty-eight months enumerated, a surplus has been accumulated amounting to $2,800,000.

In answer to a question as to the cost to the company of production and distribution, the witness said that, for 1900, it was 5.32 cents per kilowatt-hour, and for the first four months of 1901 it was 4.62 cents per kilowatt-hour. This was the operating cost, no allowances being made for depreciation, bad debts or interest on investment.

Mr. Edwards said that, in computing the cost of production and distribution, two calculations were made—one on the amount of current generated, and the other on the amount actually sold. He said that the difference was thirty per cent. In other words, the company was paid for about seventy per cent of the current produced at the stations. The cost of production in 1904, exclusive of depreciation, interest charges and the like, was, in Manhattan, 3.69 cents for current sold; in the Bronx, 2.98 cents, and in Yonkers, 5.10 cents. The average cost of production for current sold in the two boroughs was 3.66 cents per kilowatt-hour.

On Friday, April 7, Mr. Edwards stated that the corporation had earned some $10,000,000 in the last five years, after interest and expenses of all kinds had been paid, and that it had a surplus of $6,400,000 at the end of 1904. The other $4,000,000 was written off for depreciation.

On Saturday, April 8, Mr. Arthur Williams, general inspector of the Edison company, stated that thirty-four and one-half per cent of the Edison company's customers paid the highest rate—fifteen cents per kilowatt-hour, and that these consumers contributed forty-nine per cent of the total income. The average price was 12.27 cents per kilowatt-hour.

The sessions were resumed on Monday, April 10, when public lighting was taken up. Mr. Williams stated that the amount of current supplied to the city at the rate of twelve cents per kilowatt-hour during the year was 937,180.5 kilowatt-hours. Of this, 670,138 kilowatt-hours were paid for at the rate of twelve cents, making a total of $80,416.55. Four buildings had an exceptional rate. These were the Seventh Regiment Armory, which pays ten cents per kilowatt-hour; police headquarters, which pays 7.2 cents; the county clerk's office, which pays 6.7 cents, and fire headquarters, which pays 7.2 cents. The total receipts from these four buildings last year were $13,302.40. The number of incandescent lamps in the city's buildings aggregates 37,804. Mr. Williams stated that the company had private consumers who were using as much current in a single building.

Mr. John W. Lieb, Jr., vice-president and general manager of the New York Edison Company, testified that the company had in service about 45,000 meters. He said that the service for the city, taking into consideration the scattered condition of the plants, the additional cost for inspection and the valuation placed upon an equivalent power capacity for the maximum number of lamps installed, justified a charge of 11.36 cents per kilowatt-hour.

Concerning street lighting, the city has 3,995 arc lights. Of these, 1,127 are in the Bronx, and are fed from overhead wires, requiring 2,000 kilowatt-hours each per year. Those in Manhattan borough number 2,868. These are fed from underground circuits, and require 2,700 kilowatt-hours each per year.

On Wednesday, April 12, Mr. Edwards, auditor of the New York Edison Company, made a detailed statement showing the properties included in the company's capitalization when it was formed in 1901. The figures are as follows:

Property of Edison Electric Illuminating Company ($15,259,162.77) less 91,680 shares turned in and cancelled...	$6,091,162.77
Property of New York Gas and Electric Light, Heat and Power Company.....	66,545,100.77
Capital stock of power company taken in.....	9,040,000.00
406 shares Edison Illuminating stock, at $120,000, exchanged for bonds, which sold for.....	32,986.06
Total.....	$81,709,249.60
Now in treasury, 171.7 shares Edison Illuminating stock, which was exchanged for bonds, causing a deduction from the capital account of	20,604.00
Total.....	$81,688,645.60

Mr. John W. Lieb, Jr., stated that on Monday he had made an error in his estimate of the company's profit from the street lamps in Manhattan and the Bronx. Including all expenses, interest charges and depreciation, this profit should have been $95,000. A mistake was made when he said $115,000.

In reply to a question concerning the amount paid to the Consolidated Telegraph and Electrical Subway Company in 1904, Mr. Edwards stated that $210,000 was paid at the rate of $1,000 a mile for rental of a three-inch duct. He testified that the Edison company received from the Consolidated Telegraph and Electrical Subway Company for interest on securities owned in 1904 the sum of $268,650. The bonds guaranteed by the other duct corporation, the Empire City Subway Company, amounted to $250,000.

On Friday, April 14, the committee took up the examination of the acquirement of the United Electric Light, Heat and Power Company. This is usually spoken of as the power company in connection with the Consolidated Gas Company. The number of kilowatt-hours sold in 1904 was reckoned as 14,349,707. The average rate received from consumers was 9.44 cents per kilowatt-hour. The total amount realized was $1,355,774.01. The expenses were $1,232,530.83.

On Monday, April 17, the legislative commission continued its investigation. Charles E. Hughes, counsel for the committee, called upon Mr. Arthur W. Middleton, auditor of the Consolidated Telegraph and Electrical Subway Company, concerning the operating charges of the company. Mr. Middleton said that from 1894 to 1904, inclusive, the operating charges were $258,386.71. The franchise tax for 1904 was $68,754.66.

The week previous, upon the recommendation of several civic organizations in the borough of Brooklyn, an investigation was started concerning the operations of the public service corporations in that borough. Continuing the investigation, Mr. Hughes called upon W. W. Freeman, secretary and treasurer of the Kings County Electric Light and Power Company. Mr. Freeman testified that the surplus of the two allied Brooklyn electric light companies—the Kings County Electric Light, Heat and Power Company and the Brooklyn Edison Company—since 1898 was $1,071,834. He stated that the companies lived up to their contract with the city as to free lights in its entirety. The rate for service in Brooklyn until recently was higher than that for the service of the New York Edison Company in the borough of Manhattan. Prior to January 1, 1905, the gross charge was twenty cents per kilowatt-hour, with proportional discounts allowed. Since that date a schedule has been inaugurated, charging fifteen cents per kilowatt-hour for the first two hours, ten cents per kilowatt-hour for the third and fourth hours, seven and one-half cents per kilowatt-hour for the fifth and sixth hours, and five cents per kilowatt-hour for excess of that service. Under the new schedule, the income was twenty per cent less than the old. The company is producing more current, and at a less cost, than in 1904. The increase in the demand for current has been about six per cent. The average cost of arc lamps in the borough of Brooklyn is $115.32. In all, the Brooklyn companies serve 4,260 arc lamps, of which 3,100 are served from overhead lines.

Digitized by Google

THE MAGNETIC CLUB.

DINNER AT THE HOTEL ASTOR IN HONOR OF THOMAS A. EDISON.

One of the most interesting and entertaining events in the life of the Magnetic Club, now some seventeen years of age, was the one that occurred at the Hotel Astor on Thursday evening of last week. Thomas A. Edison was the guest of honor, and Colonel A. B. Chandler presided. In addition at the head table were F. P. Fish, president American Telephone and Telegraph Company; Colonel R. C. Clowry, president Western Union Telegraph Company; Clarence H. Mackay, president Postal Telegraph-Cable Company; U. N. Bethell, vice-president and general manager New York Telephone Company; the Hon. P. V. DeGraw, assistant postmaster-general; Walter P. Phillips, J. Merrihew, H. D. Estabrook, P. F. Murphy, W. D. Baldwin, Gardiner C. Sims, J. A. Van Wormer and E. C. Platt. The other tables were filled with guests to the number of three hundred, representative of the telephone, telegraph and electrical interests in general. Among others present were W. H. Baker, J. C. Barclay, C. P. Bruch, George T. Manson, James Kempster, Wm. Maver, Jr., W. L. Candee, M. R. Cockey, Frank Harrington, Theodore L. Cuyler, Jr., T. E. Fleming, G. H. Usher, W. H. Hawley (of Albany), Colonel C. A. Benton, E. B. Baker, Chas. W. Price, Captain Richmond P. Davis and George F. Porter.

The very excellent repast was followed by a number of interesting addresses by Mr. Fish, Mr. Estabrook, Mr. DeGraw, Mr. Murphy and Mr. Van Wormer. Colonel Chandler, as presiding officer, paid high tribute to Mr. Edison, and enumerated his inventions.

As he mentioned them one by one—the quadruplex telegraph, the telephone, the phonograph, the incandescent electric lamp—singers struck up appropriate tunes, the reference to the telephone, for example, serving to start them on "Hello, my baby; hello, my honey; hello, my ragtime girl." And as he was speaking of the electric lights every lamp in the room suddenly went out, leaving the table dimly lit by red-shaded candles, while the tenor sang the melody from the "Yankee Consul":

It was just like this in the olden days,
Which have passed beyond recall;
In the rare old, fair old, golden days,
It was just like this, that's all:
Then we studied hard by the candle light,
With our visions of future gold—
And some have realized all right
Since the days of old.

In his address, Mr. Fish gave Mr. Edison the credit for the invention of the word "hello" which he stated had been universally adopted and which was not covered by patent or copyright. A toast in silence was given in honor of Mr. E. C. Cockey, for several years president of the association, whose death occurred in this city a few weeks ago.

Mr. Edison appeared in the best of spirits and enjoyed most heartily the interesting way in which several of his leading inventions were honored in the proceedings. A reception was held at the close of the dinner, and Mr. Edison shook the hands of the great majority of those present, a number of the telegraph men being former associates of his.

The officers of the Magnetic Club are president, Colonel Albert B. Chandler; first vice-president, Marston R. Cockey; second vice-president, George H. Usher; third vice-president, David W. McAneeny; secretary, Frank J. Scherrer, and treasurer, Richard J. Murphy. Mr. T. A. Brooks is chairman of the entertainment committee, and Theo. L. Cuyler, Jr., is chairman of the reception committee.

National Electric Light Association.

Mr. Frank L. Perry, Marquette Building, Chicago, Ill., has been appointed assistant master of transportation for Chicago and adjacent territory, with the particular duty of working up a special train from Chicago to Denver-Colorado Springs, which will be run with a special train from New York for delegates to the convention of the National Electric Light Association, to be held at Denver and Colorado Springs, Col., June 6 to 11. Mr. George F. Porter is master of transportation.

As a result of the active campaign being carried on by Mr. Henry L. Doherty, committee on membership for the National Electric Light Association, several hundred names have already been added to the list of members since January 1.

The Franklin Institute.

The Franklin Institute, Philadelphia, Pa., announces the following section meetings: Thursday, April 27, 8 P. M., mechanical and engineering section, discussion, "Internal-Combustion Engines," opened by Professor H. W. Spangler; Thursday, May 4, 8 P. M., section of photography and microscopy, "Notes on Ultra-Violet Light in Photography and Microscopy," Dr. Henry Leffman, Philadelphia; Thursday, May 11, 8 P. M., section of physics and chemistry, "Some New Methods in Clinical Chemistry," by Dr. G. H. Meeker, Medico-Chirurgical College, Philadelphia, Pa.

THE INTERNATIONAL RAILWAY CONGRESS.

TO BE HELD AT WASHINGTON, D. C., MAY 3 TO 14, 1905.

The seventh session of the International Railway Congress will be held at Washington, D. C., May 3 to 14, 1905. The following programme has been announced:

April 29 to May 2, arrival of delegates.

Wednesday, May 3, from 11 A. M. to 2 P. M., registration of members of the congress. The office of the general secretary of the permanent commission will be at the New Willard Hotel, Washington.

Thursday, May 4, 11 A. M., formal opening of the congress. This will be held in the large banquet hall of the New Willard Hotel. Election of president and officers.

On Friday and Saturday, May 5 and 6, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Sunday, May 7, will be given up to resting.

On Monday and Tuesday, May 8 and 9, at 9.30 A. M. and 2 P. M., there will be meetings of the sections. At 7.30 P. M. Tuesday, May 9, there will be a banquet given by the American Railway Association.

Wednesday, May 10, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Thursday, May 11, there will be a meeting of the sections at 9.30 A. M. At 2 P. M. there will be a general meeting followed by a banquet.

Friday, May 12, 9.30 A. M., meeting of the sections. At 2 P. M., general meeting.

Saturday, May 13, at 9.30 A. M., meeting of the sections. At 2 P. M., general meeting and formal closing of the session.

Sunday, May 14, departure on tours of inspection which will be tendered to the foreign delegates. The exact itinerary of these tours and the hour of departure from Washington on the special trains will be announced later. The itinerary will be about as follows:

The Short Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cleveland, Ohio, Buffalo, N. Y., Niagara Falls, Schenectady, N. Y., and Boston, Mass. This tour will occupy the time from the evening of Sunday, May 14, to the morning of Tuesday, May 23. The party will arrive on the return at New York. The total length of this trip is about 1,500 miles.

The Long Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cincinnati, Ohio, St. Louis, Mo., Chicago, Ill., Buffalo, N. Y., including Niagara Falls, Montreal, Canada, and Schenectady and Saratoga, N. Y. This tour will occupy the time from the evening of Sunday, May 14, to the evening of Saturday, May 27, when the party will arrive on the return at New York. The total length of the trip is about 2,700 miles.

Digitized by Google

The Motor Drive for Machine Tools.

At the convention of the National Machine Tool Builders' Association, held in Washington, D. C., April 11 and 12, a discussion of the application of individual variable-speed motors for the driving of machine tools was taken up under the following headings: 1—advantages of the motor drive and the greater power necessary in the belt drive for machine tools; 2—relative cost of power for belt-driven and motor-driven machine shops; 3—standardization of motor drives.

Mr. G. Herbert Condict, vice-president of the Electro-Dynamic Company, Bayonne, N. Y., was invited to address the association on the above subjects, making the following points:

As to the advantage of the motor-driven tool over the belt drive, it was pointed out that, in the case of equipping a new shop, a saving could be made in the initial cost of the power plant. There will be less loss in the transmission of power from the engine to the shaft of the tool; therefore a smaller power plant would be required. It has been practically demonstrated that the average loss in the shafting and belting amounted to at least fifty per cent of the total power developed by the engine.

In the electrical transmission, assuming that the shop is to be operated at seventy-five per cent of the generator capacity, so that good efficiency can be obtained from the generator itself, the loss between the engine shaft and the line will be about six per cent; the line loss, two per cent, and the average loss in the motor itself, seventeen per cent. This is the provisional loss estimated in the adaptation of the "Interpole" motor. There will be a loss between the motor shaft and the shaft of the tool itself, where a single pair of gears or a chain drive is used, of five per cent, or a total loss between the engine shaft and the tool shaft of about twenty-eight per cent.

Attention was called to the fact that the loss in the shafting and belting is practically a constant loss, no matter whether the shop is operated at its full capacity or not. The loss in the case of the electrical transmission varies practically with the power used. Instances were given of a plant which had been entirely equipped with individual motor-driving, in which only one-half of the power capacity had been installed that had been calculated would be necessary in the case of the shop being designed for belt drive. This power plant had been operated on an average of only one-half of its capacity, thus showing that, in this particular case, only twenty-five per cent of the power was required for running the shop with electrical transmission that had been estimated on for belt transmission. Another case was given, in which it was desired to operate only a few tools in the shop, for which about twenty-five horse-power would be required; and a spare engine of about thirty-five horse-power capacity was started up to do the work. It was found that this engine would not turn over the shafting, and upon careful investigation of the entire power plant it was discovered that over fifty per cent of the power was consumed in the shafting alone.

As to the relative cost of the equipment of tools with individual motors and of their equipment with shafting and belting, it was impossible to arrive at any exact figures; but, provided the two-wire system should be adopted—as is the case with the "Interpole" motor—it was believed that the cost of electrical transmission would be much less than that of the belt and shafting transmission.

There would be no question that the motor drive would show a great saving over the belt and shaft driving in maintenance. Assuming that the electrical apparatus is made according to the most advanced methods of design, this will be particularly the case.

Replying to a statement made by one of the members of the association, that he had been unable to secure a variable-speed motor which would operate on a 500-volt circuit, Mr. Condict stated that the "Interpole" motor would operate on a 500-volt circuit as well as on a 110-volt circuit with high efficiency, and run sparkless even at a speed ratio of four to one.

Attention was called to the celerity with which speed changes could be made, and also to the fact that with these greater variations of speed the tool could be run at the most advantageous rate for any given work. There is also less opportunity for accident to operator or equipment, owing to the fact that there are no belts to throw on or off.

Reference was made to a case in which a department of a machine shop was being examined, where the bulk of the tools were driven from a line shaft. But one lathe was equipped with a variable-speed motor. A hot bearing occurred on the line shaft, and shut down all tools run by the shaft, and for twenty minutes twenty-three machinists were idle. On the other hand, the machinist on the motor-driven tool continued his work. As these shutdowns are liable to occur in the best regulated shop, from various defects and troubles of shafting and belts, this item of saving is quite an important one.

The statement was made that, in all probability, the equipment of a shop by shafting and belting will not be considered by future conventions of the Machine Tool Builders' Association, as there seems to be a desire on the part of both the machine shop men and the builders of machine tools to equip all tools, no matter of what capacity, with the individual motor drive. Incidentally, reference was made to the absence of dirt and non-interference with the lighting, which are features of the motor-driven shop.

The Automobile Parade.

The runs and tours committee of the Automobile Club of America has decided upon April 29 as the date for the annual run of the club in New York city.

The parade will form on lower Fifth avenue at 1.30 P. M., on the side streets, as follows:

Guest Division—Fifth avenue, east side, between Eighth and Ninth streets, Captain Homer W. Hedge, marshal. Pennant color: white and blue.

American Gasoline Touring Cars—Washington Square, east, Robert Lee Morrell, marshal. Pennant color: blue.

American Gasoline Runabouts—Ninth street, east, C. H. Gillette, marshal. Pennant color: red.

Foreign Gasoline Cars—Tenth street, east, E. T. Birdsall, marshal. Pennant color: yellow.

Steam Cars—Eleventh street, east, Augustus Post, marshal. Pennant color: white.

Electric Cars—Twelfth street, east, A. H. Whiting, marshal. Pennant color: green.

Automobile Clubs—Thirteenth street, east, A. R. Pardington, marshal. Pennant color: white and red.

The parade will start at 2.20 o'clock, promptly, from Washington square. The run will be up Fifth avenue to 110th street, thence across to Grant's tomb and Riverside drive, down Riverside drive to Seventy-second street and Broadway, where the parade will be disbanded between Sixty-fifth and Seventy-second streets. It is expected that fully 500 cars will be in line. The parade will not be confined exclusively to members of the Automobile Club of America.

Panama Directors.

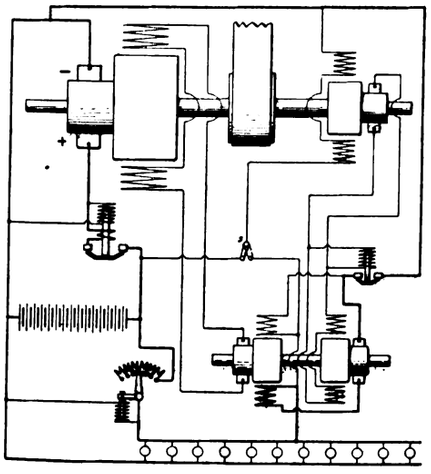
The United States government formally took over the property of the Panama Railroad Company on Monday, April 17, at the annual meeting of the stockholders, and the following directors were elected: Theodore P. Shonts, John F. Wallace, Charles J. Magoon, Mordecai T. Endicott, Peter C. Haines, B. H. Harrod, Oswald H. Ernst, William Nelson Cromwell, William Barclay Parsons, Clarence R. Edwards, J. R. De Obaldia, Rodger L. Farnham and Edward A. Drake.

Mr. Edwards is chief of the Bureau of Insular Affairs. Mr. De Obaldia is the Panama minister to Washington.

Digitized by Google

Electrical Patents.

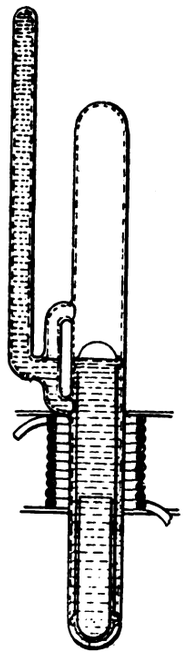
A system of electrical distribution is the invention of William A. Turbayne, of Lancaster, N. Y., and the patent obtained thereon (787,012, April 11, 1905) has been assigned to the Gould Coupler Company, of New York, N. Y. The invention relates to electric lighting systems in which the generating dynamo is subject to wide variations of speed and is liable to have its direction of rotation reversed —as, for instance, in railway-car lighting systems in which the dynamo is driven from one of the car axles. One object of the invention is to improve the self-regulating system of distribution with a view of producing the desired regulating effect for a given output by smaller and lighter machines and over a greatly wider range of speed variations. It is also the object to automatically reduce the generator output during the progress of the charge of the battery for preventing waste of energy and needless evaporation of the electrolyte after the battery has attained the charged condition. A battery is connected with a main generator, and an auxiliary dynamo has its field connected across the battery and varying in speed like the main generator. The auxiliary dynamo



System of Electrical Distribution.

controls a motor, which motor drives an exciter-dynamo, all arranged to vary the speed of the exciter-dynamo in an inverse sense to the speed of the main generator and to vary the excitation of the exciter-dynamo in an inverse sense to the speed of the main generator and to changes in the electromotive force of the battery.

David J. Steele and Charles Kratt, of Glasgow, Scotland, have patented in this country an improvement in electric recording instruments (787,005, April 11, 1905). The invention relates to electrical recording instruments of the type designed to record the maximum electric current which has passed through a circuit during an interval of time without being affected by those variations of current which are momentary or of short duration. It is the object of the invention to provide a convenient and reliable form of instrument which will be free from these defects and which can be so arranged that the maximum current is only registered after it has passed for a predetermined interval of time. In carrying out the invention the inventors employ a tube comprising a main arm containing a liquid, a secondary arm adapted to receive the overflow of liquid therefrom, and a restricted tubular communication between the main and secondary arm. An electromagnetic device surrounds a portion of the main arm, and a float in this main arm is adapted to be attracted by the electromagnetic device.



Electric Recording Instrument.

An invention relating to improvements in resistances, especially such as are heated by electric currents in apparatus, as rheostats, electric heaters, etc., has recently been patented by H. Ward Leonard, of Bronxville, N. Y. (787,047, April 11, 1905). In carrying out the invention, Mr. Leonard provides in a rheostat or electric heater a resistive conductor composed of an alloy containing nickel and copper, and having a relatively high coefficient of expansion, a relatively high-specific resistance and a relatively low-temperature coefficient. A support of insulating material for the conductor has a relatively low coefficient of expansion. An exposed terminal forms an electric joint with the resistive conductor. A coating of insulating heat-resisting material covers and surrounds the resistive conductor and the joint, the

Electric Resistance.

conductor being reflexed, whereby destructive strains in the coating is prevented when the resistive conductor is heated by the current.

New York Electrical Society.

The 250th meeting of the New York Electrical Society will be held at 19 West Forty-fourth street, Wednesday, April 26, at 8 P. M. Mr. N. J. Neall will lecture on "Lightning Protection for High-Voltage Circuits." The lecture will be a résumé of the development of lightning protection apparatus in America and abroad. A description will be given of the problems, their scientific character and bearing on the important question of lightning protection for high-voltage circuits, with a presentation of the favorable way in which these problems may be solved.

American Institute of Electrical Engineers.

The 196th meeting of the American Institute of Electrical Engineers will be held in the Chapter Room, Carnegie Hall, No. 154 West Fifty-seventh street, New York city, on Friday, April 28, 1905, at 8.15 P. M. The following papers will be presented and discussed:

"Polyphase Metering," by J. D. Nies, associate; instructor in Lewis Institute, Chicago, Ill.

"Notes on the Use of Instruments on Switchboards," by F. P. Cox, member; electrical engineer, General Electric Company, Lynn, Mass.

"The Oscillograph and Its Uses," by Lewis T. Robinson, associate; electrical engineer, General Electric Company, Schenectady, N. Y.

"Maintenance of Meters," by W. J. Mowbray, associate; electrical engineer, Brooklyn Edison Company, Brooklyn, N. Y.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Small Electrical Generating Units Considered from the Point of View of the Economical Production of Electrical Energy.

A comparison is here made by M. R. Friederich of the different methods of driving small generators. The methods considered are gasoline engines, oil engines, producer-gas engines, gas engines using city gas, and steam engines using superheated or saturated steam. The conclusions are reached that the use of the gas engine or the oil engine becomes advantageous after the annual output reaches 2,700 kilowatt-hours. Above this point the advantage of the gas or oil engine increases rapidly. In any case, it is exceedingly important so to plan the plant as to reduce, as much as possible, the attention required. Frequently, the use of accumulators is not necessary, and when they can be avoided, the additional expense for the cost of maintenance and depreciation of the plant is greatly reduced.—*Translated and abstracted from La Revue Technique (Paris), March 25.*

Starting and Braking of Direct-Current Electric Motors by a Compound Rheostat.

The usual method of starting a direct-current motor by means of a rheostat inserted in series with the armature is criticised here by M. Emile Dubois. As usually installed, the series rheostat does not give a uniform acceleration, and when used for braking, the retardation is apt to be too sudden just before stopping. To avoid this, the compound rheostat has been devised. This is a rheostat somewhat larger than usual, and, when in use, is connected in parallel across the supply circuits. One end of the motor is connected to one side of the circuit, and the other is connected to points along the starting rheostat, so that the latter acts somewhat as a potentiometer resistance. When the rheostat is properly designed, the operator not only has control of the speed of his motor, but the current through the latter is limited to a definite value. The method of computing the resistances is given in full, and applied to an example. In this example the normal current of the motor is twenty amperes. The maximum current which is allowed to flow through at any time is about thirty amperes. The voltage of the supply is 110, and the normal speed of the motor is 1,500 revolutions per minute. The rheostat is designed so that the maximum current which will flow through it is one and one-half times the normal current taken by the motor. The first step in starting gives the motor a speed of seventy-two turns per minute. The second brings it up to 290 turns per minute. There are four additional steps before the motor attains full speed. When it is desired to stop the motor, the rheostat arm is thrown back to the next to the last notch. The speed at once drops to seventy-two revolutions per minute, and upon the last notch the armature is immediately arrested, since it is short-circuited, and the field strength is full.—*Translated and abstracted from L'Industrie Electrique (Paris), March 25.*

The Electrical Manufacture of Light and the Lamp of the Future.

In this article Dr. J. A. Fleming discusses the different electrical devices which are employed for producing light. He points out the imperfect state of our knowledge with regard to the production of light, and lays emphasis upon the necessity of a reform in the nomenclature and modes of reckoning the efficiency of electric lamps, as well as some more precise and scientific method of defining what it is we produce. The author describes some of the recent work in measuring the output of electric lamps, refers briefly to the amount of illumination found to be satisfactory, and gives the following picture of what the lamp of the future will be: in a highly exhausted bulb will be placed a small sphere of some substance—he knows not what—which phosphoresces intensely under electronic bombardment. On each side, and slightly above this ball, will be a metal saucer-shaped disc, which will be connected by sealed-in platinum wires to the terminals of the lamp. To these will be supplied, in some way, a high-frequency alternating current, which will create a storm of bombarding electrons, and the phosphorescent mass will glow intensely with a brilliant white, but perfectly cold light. The lamp will give what is called sixteen candle-power, with an energy absorption of five or ten watts, instead of fifty or sixty as at present. It will emit no radiation, except that which can affect the eye. The author is not able to provide details or to say how the high-frequency currents will be generated, or the form of wiring which will be utilized. He says that he is merely giving rein to the imagination in looking forward to discover the ideal form of illumination. He adds that invention has necessarily to move slowly when once large capital is invested in one particular form of manufacture. Long before the state of phosphorescent lighting is reached, we shall, no doubt, pass through other stages of thermo-lighting, by which is meant the process of producing light by heating some material.—*Abstracted from the Electrical Magazine (London), March 25.*

Electricity from Water Power versus Gas.

That gas is falling behind in competition with electrical energy generated from waterfalls is the belief of Mr. Alton D. Adams, and he here deduces figures which show why this should be so. At the greatest American centres of transmitted energy—San Francisco, Buffalo and Montreal—the net price of illuminating gas is about one dollar per 1,000 cubic feet, which is as low as such gas is usually sold anywhere in America. In spite of this low rate for gas, the sale of electrical energy from distant waterfalls has risen, during five years, to about 10,000 horsepower in San Francisco, more than 20,000 in Buffalo, and nearly 30,000 in Montreal. These figures do not merely represent the results of substituting water power for steam power at electric generating stations, but correspond, in large part, to increased loads on the electric supply systems. Whatever have been the changes in the volumes of gas distributed in these three cities, it is safe to assume that they can show no such increase as that just indicated for electricity from water power—a conclusion which is supported by the fact that at Montreal the gas output increased only six per cent during the twelve months ending with April 30, 1904. Comparing the gas light with the electric lamp, Mr. Adams finds that the cost of a sixteen-candle-power flame, with gas at one dollar per 1,000 cubic feet, is one-half cent per hour. In many places supplied from hydraulic electric plants, the rates for energy used in lighting are less than ten cents per kilowatt-hour, but even at this rate the cost of operating a standard fifty-watt sixteen-candle-power incandescent lamp is only one-half cent per hour. Thus, the electric light costs the same as gas, but gives, in addition, all its peculiar advantages. The use of mantle burners considerably increases the efficiency of the gas light, but, in spite of this, it has not made much headway against the electric

Digitized by Google

lamp. Comparing the two kinds of energy for heating, Mr. Adams finds that, at the rate of one dollar per 1,000 cubic feet of gas, 325 heat units are obtained for one-tenth of a cent. This figure allows for a loss of fifty per cent, due principally to the heat carried away by the products of combustion. With an electric heater, there is no loss. A kilowatt-hour corresponds to 3,438 heat units. For various reasons, electrical energy is not infrequently supplied for heating purposes at a rate as low as one cent per kilowatt-hour, which gives 343 heat units for one-tenth of a cent. In some cases the rate for electrical energy for heating is as low as one-half cent per kilowatt-hour, which gives twice as many heat units as gas at the same cost. Returning to the question of power production, Mr. Adams finds that a good gas engine, at nearly full load, will develop one horse-power-hour for two cents at the regular rate for gas of one dollar per 1,000 cubic feet. At partial loads the efficiency of the gas engine falls rapidly, and the cost of its power rises. As electrical energy from water power is frequently sold as low as one cent per kilowatt-hour for motive purposes, it is no wonder that successful competition of gas engines is difficult under such conditions.—*Abstracted from Cassier's Magazine (New York), April.*

An Electrostatic Voltmeter for High Potentials.

Various methods have been used for measuring high voltages. These may be satisfactory if the potential be not too high, but when it goes above 20,000 volts or so, difficulty is encountered in many of the types of apparatus employed. A transformer inserted in the high-voltage circuit is satisfactory if one can be sure that no leakage occurs. Non-inductive resistances used as multipliers are also good if there is no doubt of their non-inductiveness. Condensers connected in series across the circuit, used as multipliers, have been successful, but difficulty is encountered in adapting the instrument to different frequencies, because it is not easy to construct an instrument having the same dielectric coefficient as the condensers. None of these methods seemed to Herr A. Grau satisfactory, and he has therefore constructed an instrument of a different type, which enables him to measure, with fair accuracy, voltages up to 90,000. This is an electrostatic instrument constructed in the following way: a glass jar forms the case, and is filled with a good quality of oil, to serve as the dielectric. At the bottom of the jar is a glass plate resting on three legs. This plate supports a metallic cylinder which forms one plate of the voltmeter. Connection to this cylinder is made by means of a fine wire carried down through the oil in a long porcelain tube. Concentric with this cylinder is a smaller cylinder suspended by means of a copper wire surrounded by a glass tube. To the bottom of this small cylinder is attached first a thin plate, and below this plate a lead weight. Projecting from the weight is a glass rod, which holds the movable system concentric with the large fixed cylinder. This whole system is suspended by means of a fine wire running over a pulley, with a counterweight on the other end. A pointer is attached to the pulley, which multiplies the motion of the movable cylinder, indicating it on a suitable scale. To the pulley is attached a small weight, adjustable so as to vary the sensitiveness of the device. The movable system is, of course, connected to the other side of the high-voltage circuit, the wire being led to the pulley through a porcelain tube. The plate attached to the lower part of the small movable cylinder serves to damp the motion of the latter. The glass rod which holds this system concentric is kept in place by means of three friction rolls attached to the glass plate mentioned above, the rod passing through a hole in the plate. This instrument does not give a uniform scale, as the latter is a little more open at the centre than near the ends. The particular instrument here illustrated is suitable for 90,000 volts only, as above this voltage a discharge passes from plate to plate through the oil. The following are the principal dimensions of this instrument: the large cylinder is twenty centimetres in diameter and fourteen centimetres high. The small movable cylinder placed in the centre is three centimetres in diameter and eleven centimetres long. The lead weight attached to it weighs 200 grammes. The capacity of this instrument was about one-ten-thousandth of a microfarad.—*Translated and abstracted from the Electrotechnische Zeitschrift (Berlin), March 23.*

Electrolytic Detectors of Electric Waves.

A study has been made by M. R. de Valbreuze of the different investigations into the action of the electrolytic detectors employed in wireless telegraphy. In principle, the apparatus consists of an electrolyzer in which an extremely fine platinum wire serves as the anode, and a larger platinum wire as the cathode. Any solution seems to serve, although certain investigators prefer an alkaline solution. Schloemilch gives the following generalization: all electrolyzers with electrodes of gold or silver, immersed in dilute sulphuric acid and submitted to a difference of potential slightly greater than the counter-electromotive force of the cell, so that a small current traverses it, producing at the electrodes a slight disengagement of gas, show a very clear increase in the current when submitted to the action of electric waves of high frequency. This conclusion has been verified by Dieckmann, but he used for his electrodes two metals somewhat separated in the electrochemical series—a construction which made the use of an auxiliary battery unnecessary. His apparatus consisted of a glass vessel containing at the bottom a concentrated solution of copper sulphate, and at the top a dilute solution of sodium chloride. The cathode was formed of a strip of zinc-foil, and was placed in the solution of sodium chloride. The anode was a fine copper wire, the lower portion of which only came in contact with the liquid. The electric circuit contained this detector, a high resistance and a galvanometer. The electrodes were connected together through condensers to the secondary of a small induction coil. When the anode was inserted into the solution of sodium chloride, the galvanometer indicated the passage of 0.000022 ampere. When the induction coil was set in action, the current was increased to 0.00048 ampere. On the contrary, when the anode was plunged into the solution of copper sulphate, where no polarization was possible, the current passing without the coil in action was 0.000613 ampere, and this fell slowly to 0.0004 ampere when the coil was put into operation. According to the position of the anode, the element acts either as a coherer or an anti-coherer. It has been stated by some investigators that there is nothing gained by earthing the receiver. On the other hand, Rothmund and Lessing have found that there is a decided advantage in earthing the receiver and the transmitter. These investigators have also studied the action of the device above the point of decomposition, and they have found a relatively considerable increase of the current in that region. They find that for voltages above four it is necessary for the anode to be the small electrode. For lower voltages the phenomena are identical, whether the small electrode is anode or cathode, though in the latter case the action is more feeble. Neither the chemical nature of the products of decomposition nor the constitution of the electrodes has any effect on the phenomena. The general results of these investigations seem to show that the action depends upon the phenomena of polarization. The author believes that investigations have not yet been sufficiently complete to determine this point finally.—*Translated and abstracted from L'Éclairage Électrique (Paris), March 25.*

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

An Apparatus for Automatically Transcribing Morse Signals.

The accompanying illustrations show a recently developed type of apparatus for printing Morse messages in English or other characters on a strip of tape, in a manner similar to that of the familiar stock ticker. No special apparatus is required for sending the messages other than the regular Morse key in the hands of an ordinary skilled Morse operator. In the present instrument it is necessary to use a synchronizing device to keep the sending and the receiving apparatus in unison. There are no vibrating rods or other sensitive parts, and the mechanism is comparatively simple. The instrument operates on the principle of analysis and synthesis, the analytical portion measuring the length of the impulses, as well as their respective positions in the character being sent over the line. The synthetic portion turns the type wheel to the position corresponding to the value of the combination of impulses representing each character. Should one character be missent, it will have no influence over the following character, as the mechanism starts from zero for each character.

The inventor, Charles R. Underhill, New York city, states that this apparatus may be almost instantly attached to any Morse telegraph line, and the messages will then be printed in English on the tape, instead of being recorded in the

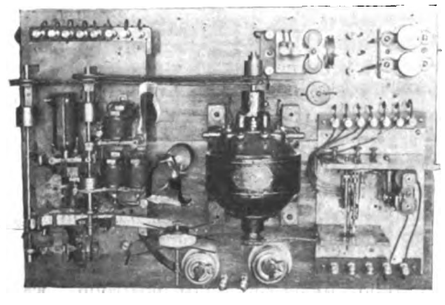


FIG. 1.—APPARATUS FOR TRANSCRIBING MORSE SIGNALS, CONNECTED TO WIRELESS TELEGRAPH APPARATUS.

form of dots and dashes, or being received by ear and translated by the operator. At the same time, the regular Morse instrument will operate as usual, since the line conditions have not been disturbed.

The instrument shown in Fig. 1, when connected in the local circuit of a wireless telegraphic outfit, recorded the wireless messages in printed English. The instrument shown in Fig. 2 is a more recent type, and is more rapid in operation. This machine would give excellent results when

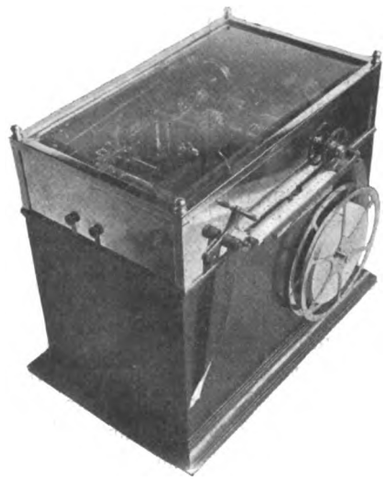


FIG. 2.—RECENT TYPE OF APPARATUS FOR TRANSCRIBING MORSE SIGNALS.

connected on a line with the well-known Morse transmitting typewriter.

Construction of Telephone Systems.

The telephone construction season has opened auspiciously for the Automatic Electric Company, Chicago, Ill., which closed four contracts for new automatic telephone plants during the month of March, besides several contracts for additional equipment for exchanges already built.

The latest contract is for a complete system of 1,500 lines for the Southern Independent Telephone Company, of El Paso, Tex. For this company the Automatic Electric Company is to build and install a complete central office equipment having an immediate capacity of 1,500 lines and an ultimate capacity of 10,000 lines.

The switchboard will be the regular standard type consisting of fifteen units, each unit carrying the necessary switches for handling 100 lines. Five additional units will be installed partially in blank so that the plant may be increased to 2,000 subscribers by simply adding the additional shelves. The cross-connecting frame will be F. B. Cook's latest type with self-soldering heat coils.

The power plant will consist of duplicate sets of storage batteries of the American Battery Company's manufacture. Two charging outfits will be furnished, one of which will be a Holtzer-Cabot motor-generator, the motor being designed to be run by the commercial power circuit; the other charging outfit will consist of a Fairbanks-Morse vertical gasoline engine belted to a charging generator. Two ringing machines will be included, one of these will be a motor-generator outfit designed to be run on the commercial power circuit; the other will be a dynamotor wound to be run on the exchange storage battery. Both machines will be Holtzer-Cabot make and will have the customary busy and howler attachments.

The power board will be of pink Tennessee marble bolted to an iron framework. On it will be mounted switches and fuses for regulating and protecting the circuits of the power plant, an overload and underload circuit-breaker for the charging circuit, a Weston ammeter and voltmeter, field regulators for the charging machines, etc.

The entire automatic equipment and power plant is to be installed in one large commodious room, and, in addition to this, the Automatic Electric Company will put in this same room a two-position wire chief's and trouble clerk's desk. In the offices of the company will be installed a two-position information and toll operator's desk. The trouble clerk's position of the wire chief's desk will be arranged so that all of the toll and information trunks and lines can be switched to it at night.

The Automatic Electric Company is now building or installing public exchanges for Los Angeles, Cal. (3,000 lines in addition to the 6,700-line automatic exchange already completed, making 9,700 lines in all); San Diego, Cal.; Columbus, Ohio (8,000 lines); Sioux City, Iowa; Hastings, Nebraska; South Bend, Ind.; Wausau, Wis., and El Paso, Tex., and private exchanges for the Milwaukee Electric Railway and Light Company, Milwaukee, Wis.; the New York Manufacturing Company, Saco, Me.; Frankford Arsenal (Ordnance Department, U. S. A.), Bridesburg, Pa.; and Springfield Arsenal (Ordnance Department, U. S. A.), Springfield, Mass.

These last will make five automatic telephone exchanges that the United States government has purchased of the Automatic Electric Company, four for the Ordnance Department of the Army (at the arsenals named and at Rock Island Arsenal, Rock Island, Ill., and Watervliet Arsenal, Syracuse, N. Y.); and one by the Navy Department for the United States naval station at New Orleans, La.

Digitized by Google

Alternating-Current Ceiling Fans.

The Hunter Fan and Motor Company, Fulton, N. Y., in presenting its line of alternating-current ceiling fans for 1905, has added two types to its already popular list.

Fig. 1 shows the "Tuerk" alternating-current ceiling fan. This is the same fan that the company has been making for years, and it has given great satisfaction. It is so arranged that the blades can be set at any angle while running, and is furnished for all cycles and voltages, and with either two or four blades. If desired, the "Tuerk" fan may be furnished without the blade adjuster. These fans have the same sweep of blades as the regular fan, the same speed, and consume the same amount of current.

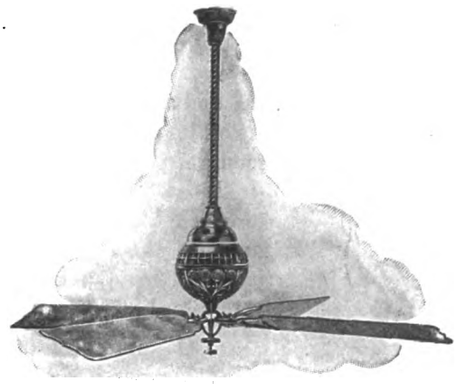


FIG. 1.—"TUERK" ALTERNATING-CURRENT CEILING FAN.

Fig. 2 shows the "Hunter" fan for 1905. Several new features have been added, improving the design, efficiency and operation. The "Hunter" fan has a speed of 175 revolutions per minute, carrying two or four blades of sixty-inch spread and width of eight inches at a maximum current consumption of 110 watts. It is equipped with a two-speed regulator and starting switch placed at the bottom and so arranged that any fan can be made into an electrolier. The "Hunter" fan is supplied for forty, fifty and sixty cycles only, and voltages from 50 to 220.

Fig. 3 shows the "Hunter" fan so constructed that the electrolier attachment can be made by simply removing the plugs at the side of the switch case, and replacing them with curved electric fixture nipples for holding the sockets and shades. They are wired with an independent lighting circuit, so that the lights and fan are independent of each other. They are made so that two or four lights can be used. The company will furnish the necessary angles, sockets, etc., when required.

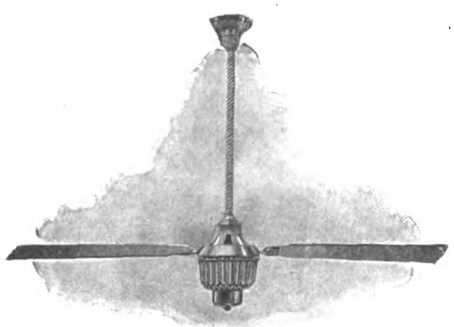


FIG. 2.—"HUNTER" CEILING FAN.

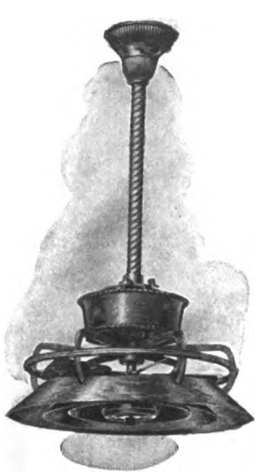


FIG. 4.—"FULTON" DEFLECTOR CEILING FAN.

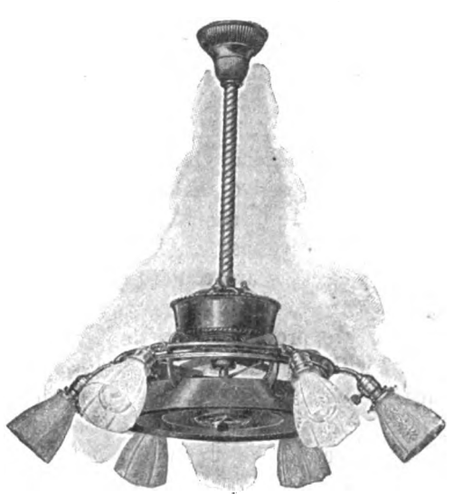


FIG. 5.—"FULTON" DEFLECTOR FAN WITH ELECTROLIER.

Fig. 4 shows the "Fulton" deflector ceiling fan. The motor is of the well-known induction type, and the fan is equipped with special blades of fourteen-inch sweep, set at an angle of twenty-eight degrees, and running at two speeds —1,050 and 800 revolutions per minute —with a maximum current consumption of 125 watts. The air is delivered on to three discs or stationary deflectors which distribute it equally over a large area. It is said to be practically noiseless, and is well suited for use in private dining-rooms, over billiard tables, or any place where fans with wooden blades can be used, or where long blades are objectionable. This fan will be supplied for voltages from 50 to 220, and on systems of from 40 to 140 cycles. The fan is also made up as an electrolier fan, an illustration of which is shown in Fig. 5.

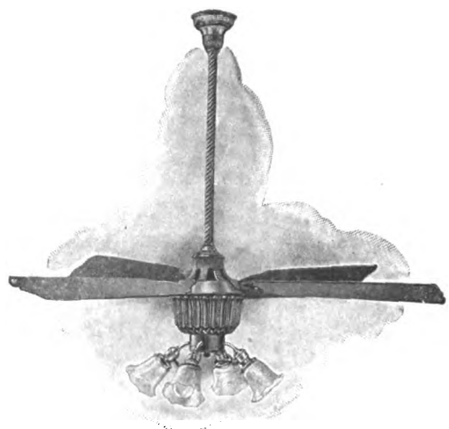


FIG. 3.—"HUNTER" FAN WITH ELECTROLIER.

The eastern agents for the Hunter Fan and Motor Company are E. B. Latham & Company, 39 Vesey street, New York city.

Extensive Additions to the Allis-Chalmers Milwaukee Works.

The Allis-Chalmers Company, Milwaukee, Wis., on April 8 decided to begin immediately a $3,000,000 extension to its Milwaukee works, for the manufacture of electrical machinery of all kinds, of the largest types, and for construction of steam turbines, hydraulic turbines and gas engines. Three large buildings will be erected, and two of the existing buildings extended.

The electrical department at Milwaukee will be operated in connection with the plant of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, which is owned by the Allis-Chalmers Company.

The importance of this project in connection with the great development of electrical engineering which is taking place everywhere is a matter of unusual interest. This will provide in the West one of the largest engineering establishments in the world, centering under one organization the design and construction of all classes of prime movers and auxiliary power apparatus.

Digitized by Google

Westinghouse Choke Coils.

Lightning arresters are employed to relieve the line of abnormal rises of potential due chiefly to static disturbances, while it is the function of choke coils to prevent such disturbances from entering the apparatus which they protect. The choke coil operates on the principle that a coiled conductor presents a greater resistance to the passage of an electric current of high frequency than to one of relatively low frequency; therefore, though a coil may have a very slight resistance to direct current or to alternating current of from 3,000 to 7,200

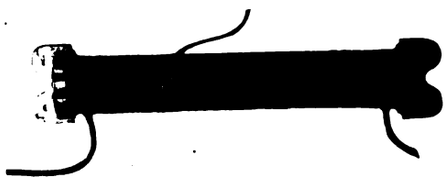


FIG. 1.—LOW-VOLTAGE CHOKE COIL FOR RAILWAY WORK.

alternations, its resistance to lightning discharges or other static disturbances, which always occur very suddenly, may be very great.

In order that the choke coil may perform its duty successfully, very great care must be exercised both in its construction and in its installation. The Westinghouse Electric and Manufacturing Company has for the past twelve years been engaged in the manufacture of choke coils and the development of protective appli-

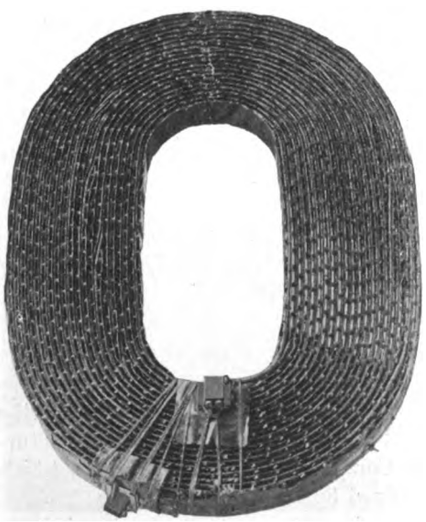


FIG. 2.—DISC FORM OF CHOKE COIL FOR ALTERNATING CURRENTS.

ances for circuits of both high and low potential.

For low voltage circuits, such as railway work, the form illustrated in Fig. 1 has been developed. The conductor is coiled in the form of a cylinder and is mounted on a wooden spool, each turn being insulated from its neighbor and the completed coil skillfully protected from moisture and dampness. The lightning arrester is connected to a terminal plate laid across a few turns of the line end to provide a selective path to earth.

In alternating-current work, a disc form of coil has been found to give the best

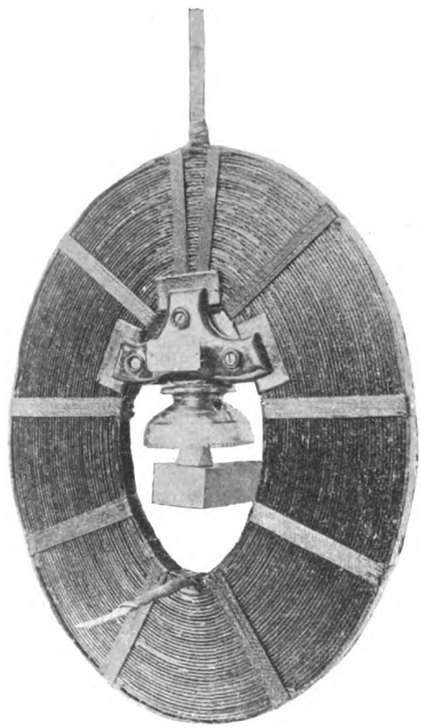


FIG. 3.—ALTERNATING-CURRENT CHOKE COIL MOUNTED ON INSULATOR.

protection. A form of this coil is shown in Fig. 2. The insulation of these disc-form choke coils, which are known as the Westinghouse type 7, has great dielectric strength and extends beyond the sides of the conductor, so that there is little likelihood of the discharge jumping from terminal to terminal or from layer to layer. The coils are constructed with a large factor of safety. Very large cooling surfaces are provided. As the coils are wound with but one turn per layer, every turn is exposed on two sides and offers a maximum radiating surface to the cooling influence of the surrounding air.

As these coils are connected in the line, it is desirable to mount them on insulators capable of withstanding the line voltage. The coils must also be held securely against the side pull due to magnetic action. To meet these conditions the support illustrated in Fig. 4 has been developed. It is very strong and the insulator which accompanies it has given excellent service at the voltages for which choke coils of this type are designed.

Coils of this type vary in the size of the conductor and in the number of turns, depending upon the current and voltage of the apparatus which they are intended to protect. They are manufactured in a great many different capacities, ranging from 7 to 200 amperes and from 2,500 to 25,000 volts, inclusive. Coils of the same type have been successfully used for the protection of apparatus with a potential lower than 2,500 volts, where the conditions are such as to require protective devices of this form.

For apparatus with potentials higher than 25,000 volts, two forms of choke coils have been developed, *viz.*, the oil-immersed choke coil and the static interrupter. Oil immersion improves the insulation, while the addition of a condenser such as is used in the static interrupter makes it possible to reduce the relative size of the coil, at the same time providing increased protection. Either of these devices can be made to afford effective pro-

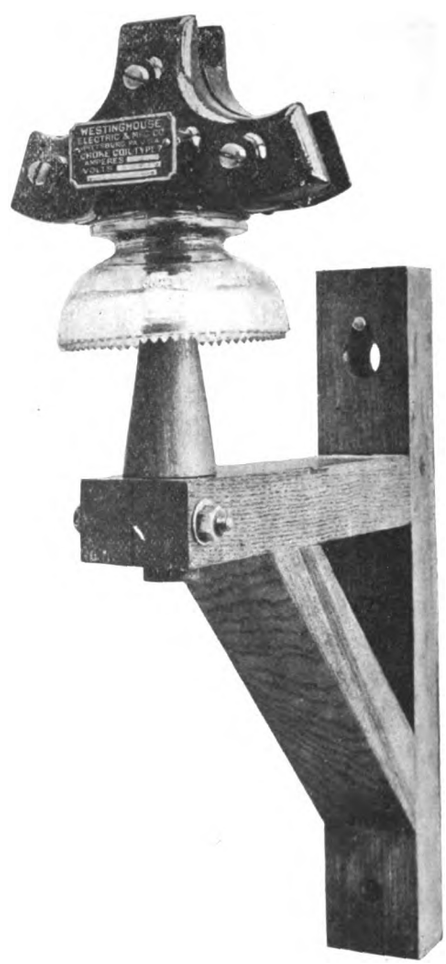


FIG. 4.—INSULATOR AND SUPPORT FOR ALTERNATING-CURRENT CHOKE COIL.

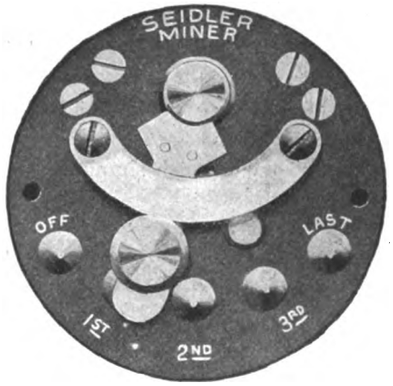
tection against powerful disturbances. Both are immersed in oil and can be either of the self-cooling or water-cooled type. The oil-immersed choke coil is mounted on a wooden frame and is ventilated in such a way as to maintain a temperature uniform in every part. The ventilating ducts when filled with oil add

Digitized by Google

greatly to the insulation between layers, and are so arranged as to promote a natural circulation of oil around the coil. The cases in which these coils are mounted in general resemble those standard for Westinghouse transformers. They are constructed with the greatest care and include fibre tubes designed to protect and insulate the leads.

The "Economy" Switch.

The accompanying illustration shows the "Economy" switch, manufactured by the Seidler-Miner Electric Company, 207-211 Jefferson avenue, Detroit, Mich. The "Economy" switch is designed to increase



THE "ECONOMY" SWITCH.

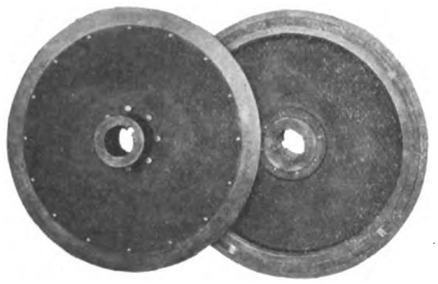
the life and use of primary batteries. It is substantially constructed, and the company states that if used according to its directions, it will more than double the life of the batteries. In operation, the first point switches on one set of batteries. The second point switches a second set of batteries. The third point switches both sets in multiple series, and the fourth or last point switches the two sets of batteries in series. By using the third point, or multiple connection, on a new set of batteries, it is stated that one-third more capacity will be secured than by using the cells singly, or first one set and then the other. When the engine starts to miss on the third, or multiple, connection, the batteries have dropped from 1.4 volts to 0.75 volt per cell. By moving the lever on the last, or series, connection, the operation of the engine may be continued, getting from one-third to one-quarter more capacity out of the batteries than when operating them in single sets.

Motor Omnibuses and Tram Cars in England.

At a recent meeting of the highways committee of the London County Council, the chairman stated that the cost of running motor omnibuses carrying thirty-four passengers was from twenty-two to twenty-four cents per car-mile, while that for electric tram cars carrying from fifty to seventy passengers was but ten to twelve cents per car-mile.

Magnetic Couplings and Accelerators.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has been carrying on experiments for several years in the development of magnetic couplings and accelerators. The Cutler-Hammer



PARTS OF MAGNETIC COUPLING.

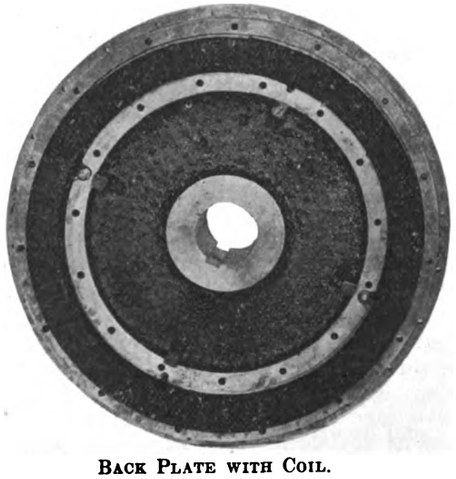
Clutch Company has now been organized for the manufacture and sale of this apparatus, and it announces that it has designs and equipment for the manufacture

FIELD IN THE ROUGH.

FIELD BABBITTED.

of a complete line of these couplings and accelerators.

The magnetic couplings are of the simplest possible form for a device of this



BACK PLATE WITH COIL.

BACK OF FIELD.

nature. They consist of two cast-steel rings mounted concentric with the shafts to be coupled. One of these rings has an annular groove, in which the magnetizing coil is securely fastened, the other ring acting as the armature or keeper. A cross-section of the two members shows the well-known form of a horseshoe magnet and its keeper.

This device is applicable wherever the shafts to be coupled are at rest or both running at the same speed when the coupling takes place. They can also be used to cut out a machine or section of shaft when in rotation, giving a prompt and absolute release regardless of load.

The magnetic speed accelerators are used for the same purpose as the ordinary friction clutch, except that they have a much wider range of application. The torque in these clutches is the sum of two components, one due to friction and one due to eddy currents induced in the armature plates by the magnetism of the field, which is specially constructed to secure this result. At the moment of starting the induction component of torque is a maximum, dropping off as the driven member attains speed.

In starting up a load with the ordinary friction clutch it is a noticeable fact that the pressure on the operating lever is eased the moment the load begins to move, in order to obtain a smooth start. In the

Digitized by Google

accelerator this is accomplished automatically by the dropping off of one component of the torque, the result being a remarkably smooth acceleration, which can be controlled, if desired, by means of a rheostat.

In practice these accelerators find their readiest application to that class of service where it is desired to control moderate or large sized units by some form of automatic device, such as a float switch, relay or electrical contact of any kind. For most work they can be thrown directly across the line without danger from shock or jar, as it is practically impossible to produce a sudden jerk with them.

The simplicity of their construction renders them easily balanced for speeds much higher than that for which the ordinary clutch is available. The small currents used in the magnetizing coil result in a simple and cheap controlling apparatus, two amperes being sufficient to control a 100-horse-power unit at the ordinary speed.

They are designed and built for heavy service, and ample wearing surface is provided so that no adjustment for wear is necessary. One of these clutches now in operation in the steel plate mill of the Riter Conley Company, at Leetsdale, Pa., has been starting a 100-horse-power load 200 to 250 times a day for the past three months, not having had any adjustment whatever, and is still operating as satisfactorily as when first installed.

In connection with gear trains this device is also used to operate a machine at different speeds, and this arrangement has proven very satisfactory in practice.

The principles of design and construction, as well as many applications of these accelerators, are well protected by patents, a number of patents having been issued on April 4 to the Cutler-Hammer Manufacturing Company, covering several inventions of Mr. H. H. Cutler, chief engineer of the company. These patents cover three distinct inventions which are radically new to the electrical art.

No. 761,411 discloses the magnetic-speed accelerator, to which allusion has already been made.

The patent shows the accelerator running in a bath of oil, and provided with large composite surfaces for resisting the frictional wear between the two members of the accelerator.

No. 786,425 discloses a magnetic-speed accelerator which utilizes solely the principle of induction for creating a torque during acceleration, this being supplemented by friction only when desiring to operate the load at full speed. This device will not be placed on the market at present.

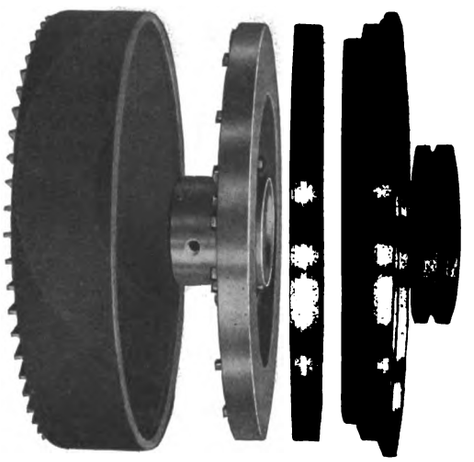
No. 786,420. This illustrates another form of accelerator similar to that described in the preceding patent, but differing in construction.

No. 786,412 discloses a modified form of the type of accelerator described in patent No. 786,411.

No. 786,413 covers a method of control for the types covered by patents Nos. 786,425 and 786,420.

No. 786,414 covers a method of power transmission using a magnetic-speed accelerator which possesses the inherent property of gradual acceleration.

No. 786,415 discloses means for starting single or polyphase motors under load without disturbing the power-factor on the lines, and covers means for producing a suitable current for energizing the accelerators.



CLUTCH BEFORE ASSEMBLING.

No. 786,416 discloses a modification of the above, using small direct-current generators for producing magnetizing current for the accelerators.

No. 786,417 illustrates and covers a method of starting synchronous motors under load.

No. 786,418 covers a method of improving the power-factor on the line in starting alternating-current motors under load, utilizing the controllable, joint inductive and frictional slip of a magnetic accelerator mounted between the motor and its driven load.

No. 787,419 discloses a method of operating trains of cars driven by alternating-current motors, arranged on the multiple unit plan, so that all the motors may be started, stopped and reversed from any car on the train. The preferred system shows single-phase induction motors, provided with accelerators.

Patent No. 786,421 illustrates a system of apparatus for motor control especially adapted for the operation of large newspaper presses. The system utilizes a large motor and a small motor designed to operate the press at full speed and at slow speed, respectively. The magnetic clutch connects either motor to the driving shaft at will, and the speed of both motors is varied by one controller.

Nos. 786,422, 786,423 and 786,424 illustrate modified forms of a multiple unit system of controlling trains of cars using direct-current generators. The basic patents covering this system of control have been issued and were described a few months ago, these patents being numbered 776,220 and 777,778. The detail patents covering the practical application of this system have not as yet been issued, but show a much simpler form of control.

A Prize Contest for the Design and Finish of Motor Cars.

A prize competition of interest to artists and designers, as well as to owners and users of motor cars, has been arranged by the George N. Pierce Company, Buffalo, N. Y., manufacturer of the Pierce motor cars.

There is an offer of three sets of first and second prizes: first, for the best design of a body for an enclosed car; second, for the best design of a body for a touring car; third, for the best color scheme for any motor car. The first prize for each of the first two competitions will be $250, and the second prize, $100. For the last competition the first prize is $200, and the second prize, $100. The contest closes June 1, and prizes will be awarded as soon as a decision can be reached. Any one wishing to compete in this contest can secure full information and scale drawings by writing to the George N. Pierce Company, Buffalo, N. Y.

A One-Cent Telephone Call.

On Saturday, April 1, the Sandusky Telephone Company, Sandusky, Ohio, inaugurated a telephone system at a rate of one cent per call. A great many slot machines have been in use in Sandusky heretofore, and contracts are now being signed up by almost every one who has, in any way, any use for the system. The company reports that the new one-cent rate has met with a hearty response, and promises to become very popular.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

TO MODERNIZE THE POWER PLANTS OF RIO DE JANEIRO—The Rio de Janeiro Tramway, Light and Power Company, which has been incorporated with a capital stock of $25,000,000 by American and Canadian capitalists, has perfected plans to install a modern electric railway and lighting system in Rio de Janeiro, Brazil. The power-generating plants will be forty-five miles from the city.

LARGE MORTGAGE FOR SPEIR'S FALLS COMPANY—The Hudson River Power Company, Glens Falls, N. Y., has given to the Knickerbocker Trust Company, New York, two mortgages—one of $5,000,000, and another of $2,000,000. These mortgages cover property of the power company at Speir's Falls, and are to secure the payment of $5,000,000 in bonds and $2,000,000 in cash lent to the power company by the trust company.

NEW POWER PLANT IN MEXICO—A new electric power plant will probably be established on the Pamico and Tamesi rivers, in Tamaulipas, Mexico. An investigation has been conducted for St. Louis parties by W. H. Marsden, to find a suitable site. He has reported that places have been found where the velocity of the water in the two rivers is nine and twelve miles per hour, respectively. Concessions are to be asked from the Mexican government for the construction of the plant.

PLANS FOR EXTENSIVE POWER PLANT IN INDIANA—Plans are under way for the formation of the Indiana & Michigan Electric Company, with headquarters at Mishawaka, Ind. The concern will have a capital of $2,000,000, and will control about 60,000 horse-power generated by plants located along the St. Joseph river in Indiana and Michigan. The energy will be distributed throughout Indiana and Michigan for lighting and railway work. Current will also be sold to manufacturing establishments.

TRACTION COMBINE IN OHIO—A certificate has been filed with the secretary of state, at Columbus, Ohio, combining the Ft. Wayne, Van Wert & Lima Traction Company and the Lima, Delphos, Van Wert & Ft. Wayne Traction Company, under the name of the Ft. Wayne, Van Wert & Lima Traction Company. The capital is $2,000,000, half of which is five per cent preferred. James Murdock, Lafayette, Ind.; D. J. Cable, Lima; John D. S. Neely, Lima; John B. Chapman, Pittsburg; H. C. Paul, Ft. Wayne; Chas. Murdock, Lafayette, Ind., and A. L. Kitselman, Muncie, Ind., are the directors.

MEXICAN ELECTRICAL NOTES—The manager of the San Ildefonso Hydraulic Power and Exploration Company, Mr. Emilio Penzon, has applied to the secretary of state for a concession to utilize 1,000 litres of water per second from the Tachos river. This is in addition to the company's power station already equipped, near the Veronica Calzada, on the line of the National railway. A new telephone system is proposed for Mexico City. The system will be almost entirely underground, the duct construction being of a specially designed form of cement blocks. The system will have a capacity for serving 40,000 subscribers if required.

COMPANY TO CONTROL ELECTRIC PLANTS IN RHODE ISLAND—The Blackstone Valley Company has been incorporated in Rhode Island by Charles H. Darling, Charles E. Ballou and Howard T. Metcalf. A bill has been introduced in the Rhode Island legislature, which if passed will give the incorporation power to lease and acquire the property, rights, contracts, powers and privileges of any gas, electric light, power, street railway or other railway company that may operate its road by electricity in Rhode Island, and with the power to acquire, hold and dispose of the stocks, bonds, securities and obligations of such corporations. The capital stock is not to exceed $3,000,000, of which $1,000,000 is to be preferred stock.

LARGE ELECTRIC RAILWAY SYSTEM IN COLORADO PLANNED—A company has been organized, with a capital of $2,700,000, to build an electric railroad, which will connect Pueblo, Colorado Springs, Florence and Cripple Creek. President Thomas Robinson, of the Florence Electric Street Railway, states that ground will be broken at once for the road. The first section, between Florence and Canon City, is to be completed before October 1. The road is to reach all the important points in the Arkansas valley between Florence and Colorado Springs, a distance of seventy-five miles. Both freight and passengers are to be carried. H. H. Cook and Harry Robinson, both of Florence, are vice-president and secretary, respectively, of the road.

KANSAS CITY & LEAVENWORTH ELECTRIC RAILROAD CHANGES HANDS—The Kansas City & Leavenworth Electric Railroad has been sold to the company which is to build the viaducts between Kansas City, Mo., and Kansas City, Kan. The purchaser bought $1,450,000 worth of bonds, and $1,500,000 in stocks. The new company will apply for franchises in both Kansas Citys, and proposes to build a system of urban and interurban lines reaching all cities within 100 miles of Kansas City. The road is to be extended from its present terminus in Leavenworth to Atchinson and to St. Joseph. A line will run to Lawrence, and Topeka ultimately, while another line will run to Olathe and Paola. It is probable the company will run a line later to Liberty and from that city to Excelsior Springs. The plans call for an ultimate expenditure of from $5,000,000 to $8,000,000 within the next five years.

FOR A NEW TELEPHONE COMPANY IN NEW YORK—A franchise application for a new telephone company in Greater New York was introduced at a session of the board of aldermen, New York city, last week. Under the resolution which was presented and referred to the committee on water supply, gas and electricity, a twenty-five-year franchise is asked for the New Amsterdam Telephone Company, with a renewal privilege at the end of the first period of twenty-five years. The company seeks to be empowered to place and operate telephone, telegraph and telautograph wires in the five boroughs, and to erect necessary poles and lay the necessary ducts in the various boroughs. The compensation to the city in return for the franchise is fixed at three per cent of the gross receipts of the company for the first twenty-five years. At the end of that period renewal terms are to be fixed by a commission of three, one of the members to be named by the board of estimate and apportionment, one by the company, and the third by the two members so chosen. In addition to the compensation provided in the resolution the New Amsterdam Telephone Company agrees to install free telephones in the various city departments, the number not to exceed 500.

NEW COMPANIES.

MARION, IND.—The H. F. Reynolds Electric Company has been incorporated with a capital of $20,000. The directors are H. F. Reynolds, B. F. Burke, Louise Reynolds and Roy Grunell.

ATLANTA, GA.—The Empire Electric Company has been organized by E. C. Peters, J. G. Clements and L. E. Moncrief, to manufacture electrical supplies. The company has a capital of $8,000.

NEW YORK, N. Y.—The Long Island Consolidated Electrical Company has been formed with a capital of $25,000. The incorporators are: D. Clarke, W. Y. Oakman, both of New York city; T. DeW. Cuyler, of Philadelphia, Pa.

JERSEY CITY, N. J.—Streator Independent Telephone and Telegraph Company has been formed with a capital of $200,000. The incorporators are Charles N. King, Le Grand Bouker and John J. Reilly. The company is to make and deal in telephonic and telegraphic apparatus.

BUFFALO, N. Y.—A certificate of incorporation of the Buffalo Pole Line Construction Company has been filed in the office of the county clerk. The company is capitalized at $10,000. It purposes to do a general business in building power plants, telegraph and telephone lines, etc. The directors are William E. Robertson, Clarion S. Saunders, Adolph G. Greenberg, Raymond D. Johnson and George B. Barrel.

Digitized by Google

TELEPHONE AND TELEGRAPH.

COUNCIL BLUFFS, IOWA—The city has voted to grant a franchise for an independent telephone exchange.

KOSCIUSKO, MISS.—The Kosciusko Telephone Company has begun extensive improvements on its lines throughout the city. New instruments are being installed, and new pole lines and cables erected.

LEONARDSVILLE, N. Y.—The Leonardsville Telephone Company will extend its line to Unadilla Forks this spring. Arrangements are well under way, and the line will probably be built on the Plainfield or east side of the Unadilla road.

HERKIMER, N. Y.—A franchise has been granted the County Telephone Company, of Herkimer, to extend its system and build a local exchange in Newport. This company is controlled by the Independent Telephone Securities Company.

BENSON, MINN.—The Benson Telephone Company has been reorganized as a stock company, under the name of the Swift County Telephone Company. The old lines will be removed and a cable line installed. About 100 miles of new farmers' lines will be built.

MINNEAPOLIS, MINN.—Telephones will be installed by the Chicago, Milwaukee & St. Paul Railroad between the villages of Millville, Hammond and Zumbro Falls, Wabasha County, to take the place of the telegraph system which was removed a few months ago.

WINONA, MINN.—The Winona Telephone Company has elected James A. Tawney, John Dietze, Edward Lees, S. L. Wright and J. R. Mitchell as directors, and the directors have elected the following officers: president, James A. Tawney; vice-president, John Dietze; secretary and treasurer, John Dietze.

CANASERAGA, N. Y.—A new telephone company has been organized in this vicinity for the purpose of running a line from Arkport to Canaseraga, *via* Bishopville. The officers are William Ellis, president; Dennis Karns, vice-president; John Bacon, treasurer, and Fred Howes, secretary. The line will probably connect with the Inter-Ocean.

PECATONICA, ILL.—The Winnebago County Telephone Company will build at once from Durand to Pecatonica, doubling the capacity of its exchange in the last-named town. Better service will be established with Freeport, by way of Durand. Shirland and Rockton will also be connected and extensions in other towns near Rockford will be undertaken.

LIVONIA, N. Y.—The Bell Telephone Company, of Buffalo, has purchased the system and exchange of the Livonia Home Telephone Company. The property consists of more than twenty miles of telephone right of way with wiring, an exchange at Livonia, and pay stations at Conesus, South Livonia, Hemlock, Livonia Center, South Lima and Lakeville.

OWINGSVILLE, KY.—A new telephone line will at once be built from Owingsville, Ky., to the eastern part of the county, connecting at Salt Lick with W. J. Fill's line, which runs to West Liberty, Morgan County. From there the lines will be extended to the remote sections of the mountains, which have now neither telephone nor telegraph facilities. The new line will connect with long-distance lines at Owingsville.

ELM HILL, W. VA.—The National Telephone Company has completed a survey and secured the greater part of the right of way for the construction of a new telephone line from Elm Grove to the Sand Hill region. The line when constructed will be on private right of way for the greater part of the distance and will be about six miles in length. Arrangements have been made for the starting of active work on the construction of the line.

PORT DEPOSIT, MD.—At a meeting for the reorganizing of the Cecil Farmers' Telephone Company it was decided to amend the charter by raising the capital stock from $5,000 to $25,000. Officers for the ensuing year were elected, as follows: R. E. M. Clenahan, of Port Deposit, president; Elwood Balderston and E. T. Dorens, vice-presidents. Nine directors were also elected, as follows: R. K. Rawlings, E. H. W. Holden, E. L. Duyekinck, Cecil E. Emory, Joseph Grove, Elwood Balderston, Carlton Kimble, R. E. McClenahan and E. T. Dorens.

CLEARFIELD, PA.—The Huntingdon & Clearfield Telephone Company has effected the purchase of the system owned by the Indiana Telephone Company in Indiana County, and the system in Northern Cambria County, known as the Cambria County Telephone and Telegraph Company. The latter system is an important one, connecting the towns of Carrolltown, Ebensburg, Hastings, Barnesboro, Spangler, Cresson, Gallitzin, Lilly and other prosperous towns and villages, and gives the Huntingdon & Clearfield line direct communication with Pittsburg.

GRAND RAPIDS, MICH.—The Western Union Telegraph Company will begin to place its downtown wires underground about the middle of April. It is now considered certain that the committee will report favorably upon the company's request for right to use the streets. The only change which is likely to be made is that the council's action may not specify the side of the street which the company may use, as was at first desired. The reason for this modification is that some of the streets are already pretty well filled up with wires on one side or the other.

CAMDEN, N. J.—The Eastern Telephone and Telegraph Company has completed a direct line to Bridgeton, Vineland, Millville, Salem, Tuckahoe, Bivalve and intermediate points. Heretofore communication with these towns was by way of Newfield. A large force of men is employed on the Cape May branch, and it is confidently expected that this line will be in operation by July 1. The Atlantic City service of this company has been thoroughly tested since its completion, and subscribers state that conversation between Camden and Atlantic City can be carried on as easily as if one was in his own home.

LEGAL NOTES.

GROSS RECEIPTS NOT THE VALUE OF A FRANCHISE—The Western Union Telegraph Company brought action against the city of Omaha, Neb., to enjoin the collection of a city tax levied upon the gross receipts representing a franchise which the company held in the city. The supreme court has held that the gross receipts in a given year of a telephone and telegraph company are not the value of a franchise of a corporation, and therefore can not be taxed as a franchise, though the amount of the gross receipts may be taken into consideration in determining the value of the franchise.

DECISION IN WIRELESS TELEGRAPH LITIGATION—In the United States Circuit Court for the District of New York Judge Townsend, on April 12, handed down an opinion in the suit brought by the Marconi Wireless Telegraph Company *vs.* the De Forest Wireless Telegraph Company, for alleged infringement of patents. The opinion is very much involved, and both litigants say that the decision is in their favor. The Marconi company bases its suit upon six claims, two of which Judge Townsend upholds. The other four are dismissed. Upon the two claims sustained the court allows an injunction and an accounting, holding that, so far as these two separate claims are concerned, the defendant has infringed.

PERSONAL MENTION.

MR. E. J. DOSS, county clerk of Shelbyville, Ky., has been elected secretary and treasurer of the Shelby Water and Light Company.

MR. H. T. SANDS, superintendent of the Lewiston & Auburn (Me.) Electric Light Company, has accepted the position of superintendent of the electric light plant at Haverhill, Mass.

MR. R. A. WALKER has accepted the position of general manager of the Central Iowa Telephone Company, with headquarters at Iowa Falls. He assumed his new duties April 1.

MR. A. L. TETU, general manager of the Home Telephone Company, Louisville, Ky., has resigned to accept charge of the Independent Telephone Company's plant in Nashville, Tenn.

PROFESSOR R. W. WOOD, of the department of physics of Johns Hopkins University, Baltimore, Md., has been elected an

Digitized by Google

honorary fellow of the Royal Microscopical Society, of Great Britain.

MR. JOHN D. TWIGGS, JR., city engineer of Augusta, Ga., has been appointed chief engineer of the work of surveying and building the electric railway line between Raleigh and Durham, in North Carolina.

MR. H. N. PEDRICK, superintendent of the Bristol County Electric Railway system, now the Taunton & Pawtucket, has resigned. He will be succeeded by Mr. E. H. Richards, of Framingham.

MR. H. C. ADAMS, JR., representing R. B. Corey, New York city, is about to make an extended trip throughout the country, in the interest of the various specialties for which R. B. Corey is eastern agent.

MR. CHARLES DAVIS has accepted the position of auditor of the Olean (N. Y.) Electric Railroad. This includes the electric lines to Bolivar, Shingle House, Allegheny, Salamanca and the Olean street railway.

MR. FRED GORDON has been appointed superintendent of the Lewiston and Auburn (Me.) Electric Light Company to succeed Mr. H. T. Sands resigned. Mr. Gordon was formerly assistant superintendent at the same plant.

MR. PAUL MILBURN, of Miles City, Mont., has been appointed assistant manager of the Helena office of the Rocky Mountain Bell Telephone Company. For more than a year Mr. Milburn has had charge of the telephone exchange at Billings.

MR. R. E. SPENCER GEARE, M. E., formerly consulting engineer to Colgate & Company, Newark, N. J., has severed his connection with the company, and will hereafter be identified with Walter S. Timmis, consulting engineer, 150 Nassau street, New York city.

MR. ROBERT J. CHAMBERS, Montgomery, Ala., has been appointed local executive head of the Montgomery Light and Water Power Company as vice-president and general manager. Mr. George A. Montgomery, consulting engineer, becomes, under the new management, general superintendent in charge of the execution of all the work of the company.

PROFESSOR HENRY S. CARHART AND PROFESSOR W. B. SCOTT have been invited to join the official party to attend the South African meeting of the British Association for the Advancement of Science, which will be held this summer. Professor Carhart holds the chair of physics at the University of Michigan, and Professor Scott, the chair of geology at Princeton.

MR. J. S. BELLAMY, for some years manager of the Mutual Telephone Company at Des Moines, Iowa, has resigned and will go to Hutchinson, Kan., to take charge of a line which he has established at that place. It is said that he will retain his interest in the company, remaining as president. Mr. C. H. Judson, the engineer in charge of construction, will take Mr. Bellamy's place temporarily.

MR. ARTHUR WILLIAMS has received for his report on municipal ownership, which is to be presented at the Denver-Colorado Springs convention of the National Electric Light Association, June 6 to 11, some fifty or more reports from foreign cities and towns, as well as a great quantity of information regarding municipal plants in this country. This report will be voluminous, and will, no doubt, be welcomed by all interests engaged in public service.

PROFESSOR WILHELM OSTWALD, of the University of Leipsic, has been invited by Harvard University to serve as lecturer during the first half of the coming academic year. This is under the arrangement for an exchange of professors which has recently been agreed upon by Harvard University and the German government. With J. H. van't Hoff Professor Ostwald founded in 1887 the *Zeitschrift fur Physikalische Chemie*, and in 1901 the *Annalen de Naturphilosophie*. Professor Ostwald is regarded as one of the founders of the modern science of physical chemistry. He has been a prolific investigator and writer. No definite announcement has yet been made regarding the course that he will give at Harvard.

OBITUARY NOTICE.

MR. THOMAS P. ESPY, superintendent of the Consolidated Gas and Light Company in Tiffin, Ohio, died suddenly of heart disease on March 31, at his home in Tiffin. He was sixty-eight years old. The body was taken to Kenton for burial.

ELECTRICAL SECURITIES.

Continuing the revival of bullish speculation inaugurated two weeks ago the market for the past week was considerably animated, and in every direction confidence appeared to dictate the appetite for investment and possibility of profit-making. Crop deposits will play an important part in the development of movements of great moment, and the initial government report on winter wheat bids fair to encourage the prophecy that the farmer will be in the market with money to spend. The prosperity of the iron and steel trade, the expanding railroad earnings, and reports of increased building operations all over the country assure a brisk season, extending even through the summer months.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 15.

New York:	*Closing.*
Brooklyn Rapid Transit	70⅛
Consolidated Gas	204¼
General Electric	184⅛
Interborough Rapid Transit	207
Kings County Electric	200
Manhattan Elevated	166½
Metropolitan Street Railway	122⅝
New York & New Jersey Telephone	170
Westinghouse Manufacturing Company	192

Boston:	*Closing.*
American Telephone and Telegraph	144⅝
Edison Electric Illuminating	255
Massachusetts Electric	68
New England Telephone	139
Western Telephone and Telegraph preferred	100

The $7,500,000 4 per cent bonds of the Boston Elevated Railway authorized by the railroad commissioners will be used for the following purposes: $130,000 for engineering and miscellaneous expenses in connection with proposed extension of railway; $900,000 for construction and equipment of proposed extensions of elevated structure, including foundation, tracks and electric system; $850,000 for construction and equipment of power stations; $170,000 for construction and equipment of terminal and other stations in connection with proposed extension; $1,300,000 for purchase and equipment of rolling stock; $3,700,000 for payment of necessary cost of real estate and the payment of damages caused by construction of the railway; $50,000 for purchase of machinery, tools and miscellaneous equipment; $300,000 for necessary cost of equipment of tunnels. These bonds have been awarded to Kidder, Peabody & Company, for a syndicate.

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	85½
Electric Storage Battery preferred	85½
Philadelphia Electric	11¼
Philadelphia Rapid Transit	35
United Gas Improvement	116¾

The annual report of the Philadelphia Electric Company for the year ended December 31, 1904, shows a gain in surplus over the previous year of $300,000. The income account also shows a gain of about $95,000. The gross income and expense charges, etc., increased in about the same proportion. The report is as follows: gross income, $3,873,911; expenses, charges, etc., $3,167,128; net income, $706,783; previous surplus, $800,134, giving a balance of $1,506,917; dividends, $406,261, making the total surplus $1,100,656, as compared with $800,134 for 1903. J. R. McAllister has been elected a director of the Philadelphia Electric Company, succeeding the late Charles M. Swain. Other directors have been reelected.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61½
National Carbon common	62
National Carbon preferred	114½
Union Traction common	8½
Union Traction preferred	37

H. G. Hetzler has been elected president of the Metropolitan West Side Elevated Railroad Company, and F. A. Delano, chairman of directors.

The city of Chicago has granted permission to the Northwestern Elevated Company to begin its Ravenswood extension.

The directors of the Chicago Edison Company have declared the regular quarterly dividend of 2 per cent, payable May 1.

Digitized by Google

ELECTRIC RAILWAYS.

LYNN, MASS.—The Nahant & Lynn Street Railway Company has been granted a charter.

COUNCIL BLUFFS, IOWA—The City Railway Company will expend about $20,000 in new car barns.

HATTIESBURG, MISS.—G. L. Hawkins, president of the First National Bank of Hattiesburg, will soon begin to build an electric railway in the town.

SYRACUSE, N. Y.—The State Board of Railroad Commissioners has authorized the Ithaca-Cortlandt Traction Company to increase its capital from $200,000 to $1,000,000.

SHARON, PA.—Sharon council has granted a franchise to the Shenango Street Railway Company, giving it the right to construct its lines over the various streets of the town.

WILMINGTON, DEL.—A franchise has been granted the South Wilmington Railway Company, permitting it to build a street railway from Front and Market streets to the city line.

NEWARK, N. J.—An electric railway line is contemplated from Orange to the South Mountain reservation, and it may possibly extend over the Orange mountains to Caldwell.

JAMESTOWN, N. Y.—The Warren & Jamestown Railway Company will complete this spring its new line from Jamestown to Warren, Pa., a city of over 8,000 inhabitants, twenty-one miles south of Jamestown.

NORRISTOWN, PA.—The extension of the line of the Schuylkill Valley Traction Company from Sanatoga to the centre of Pottstown will necessitate the installation of additional machinery at the power plant in Collegeville.

OCONOMOWOC, WIS.—The common council has granted the Milwaukee Light, Heat and Traction Company a franchise to construct its electric railway lines over certain streets. The road will be extended from Waukesha beach to Oconomowoc.

EL PASO, TEX.—George A. Nicholas, of Baltimore, and others have secured a franchise to build and operate an electric railway in El Paso. Two miles of road must be constructed within a year. The franchise also allows the company to supply light and power to the town.

LONG BRANCH, N. J.—The Atlantic Coast Electric Company is extending its lines from Spring Lake to Sea Girt. It is expected that cars will be run on the extension before the opening of the season. The extension will be double tracked and nearly three miles in length.

RALEIGH, N. C.—A charter has been issued to the Chapel Hill Construction and Supply Company for the construction of an electric road between Chapel Hill and Durham. The incorporators are Joseph Hyde Pratt, R. A. McLeod and Chas. S. Mangum. The capital is $25,000.

WASHINGTON, D. C.—The Maryland Construction Company has begun to take up options on a right of way for a railway connecting Baltimore and Frederick, Md. The company recently purchased sixty acres of land north of Frederick, which, it is understood, is to be the site of a power-house.

SEATTLE, WASH.—Two franchises have been granted for an electric railroad from Kirkland to North Bend. The commissioner has reserved the right to revoke one of the franchises when work is commenced under the other. One franchise was secured by Otto Stendahl and the other by John Cort.

BOSTON, MASS.—The Plymouth County Street Railway Company has been granted a charter by the Massachusetts secretary of state. It will operate a road from Rockland, through Hanover, Pepperell, Duxbury and Marshfield, to Kingston. The road will be 26.86 miles long, and the capital stock, $125,000.

ELMIRA, N. Y.—The Waverly board of trustees has voted to give the Chemung Valley Traction Company the requested franchises. The Chemung Valley Traction Company was recently incorporated. It is composed chiefly of Elmira and Waverly men, who propose to construct a trolley line from Elmira to Waverly.

OBERLIN, OHIO—The Oberlin & Lorain Railway Company has secured three-fourths of the consents needed to build an electric line from Oberlin to Lorain. The road will run in an almost direct line from Oberlin to the steel plant at Lorain and then into that town. At Lorain the new road will connect with the Lake Shore Electric.

COHOES, N. Y.—The Schenectady Railway Company will construct another interurban line this summer, in addition to its Saratoga and Cohoes extensions. The new line will extend from Rexford's Flats to a point near Latham's Corners, crossing the river at Dunsbach's Ferry, where it will connect with the proposed Cohoes extension.

GRASS VALLEY, CAL.—It is stated that John Martin intends to build an electric road from Grass Valley to Marysville, a distance of nearly fifty miles, according to the route just surveyed. He and his company already own the electric road between Grass Valley and Nevada City, and the line to Marysville will be an extension.

GOSHEN, IND.—Construction work on the proposed interurban electric railway between Goshen and Warsaw has been started, and will be pushed to completion as soon as possible. This (Elkhart) township has voted a subsidy of $25,000 to the line, which is to be constructed by the Winona Assembly Company, contingent upon the road's being in operation by July 4.

WHEELING, W. VA.—A franchise has been granted to the Steubenville-Wellsburg trolley line, and work upon the project will be actively pushed. The company is the Tri-State Traction Company, and the franchise granted authorizes construction along the county road from the north end of Wellsburg to Follansbee. Beyond the last named point the right of way is on private property.

HARRISBURG, PA.—The Cumberland Valley Railroad has purchased the rights and franchise of the Chambersburg & Gettysburg Electric Railway Company, and will complete the line to Gettysburg, the state forestry reservation at Graffensburg and other points. The railroad company will run electric cars to and from Waynesboro, using the tracks over which the steam cars now run.

EVANSVILLE, IND.—A subsidy of $30,000 has been voted in Montgomery township, Gibson County, for the extension of the Evansville & Princeton traction line from a point near King's Station, through Owensville, to the Posey County line. Work on the extension must begin within thirty days, and the subsidy is not to be paid until the work is completed. The subsidy was carried by 333 majority.

BLOOMDALE, OHIO—The Bloomdale council has been requested to grant a franchise to the promoters of the Bloomdale, Fostoria & North Baltimore Electric Railroad to construct a street car line through Bloomdale. This road will be built from Fostoria to Deshler, passing through the towns of Bloomdale, Bairdstown, North Baltimore and Hoytsville. Work will commence on the line as soon as all the right of way is secured. S. P. Douglas, of Toledo, is the promoter of this line.

KALAMAZOO, MICH.—A high-speed electric road, known as the Grand Rapids & Kalamazoo Valley Railway, is to be built from Kalamazoo to Grand Rapids. W. H. Patterson, the promoter, has announced the signing of contracts with the Westinghouse company for the equipment. The road will be sixty miles long and double tracked. Single-phase alternating current, at 3,000 volts, will be used. It is expected to have the road in operation by December 1. The directors of the company are W. H. Patterson, Frank Henry, E. J. Anderson, C. B. Kelsey and George Hefferan.

STAUNTON, VA.—It is understood that the Middlebrook & Newport Railway and Electric Company will begin work with a large number of hands, in the southwestern part of this county, on an electric car line. The line will begin at a point near Staunton, and will run in a southwesterly direction to a point at or near Newport, Augusta County. Later on the company proposes to extend the line to a point at or near the village of Rockbridge Baths, in the county of Rockbridge. The following are the incorporators and directors: W. W. Sproul, J. Frank Clemmer, John H. Bowman, T. M. Smiley, W. C. Bosserman, Edward Echols, Richard Hogshead, and L. L. Bowman. Edward Echols is president of the company.

Digitized by Google

ELECTRIC LIGHTING.

RICHLAND CENTRE, WIS.—A new electric light plant has been completed at a cost of $20,000.

MONTREAL, CANADA—The town of Westmount is preparing to install a 600-horse-power electric plant.

BROOKHAVEN, MISS.—The Brookhaven city council has placed an order for fifty new arc lamps for the city streets.

LEOMINSTER, MASS.—The town of Leominster has voted against the installation of a municipal electric light plant.

WICHITA, KAN.—H. G. Landis, of Wichita, has secured a franchise for furnishing electric lights in the city of El Dorado.

LAUREL, MISS.—The city of Laurel is figuring with the Laurel Improvement Company for the purchase of the electric light and power plant.

ST. AUGUSTINE, FLA.—The St. Augustine Gas and Electric Company, which owns an electric light franchise in St. Augustine, will install a plant immediately.

EASTHAMPTON, MASS.—At a meeting of the directors of the Easthampton Gas Company it was voted to discard the electric plant now used for lighting the streets and to install an entirely new plant.

LIVONIA, N. Y.—A stock company, consisting of prominent business men of Livonia, has purchased the plant of the Stedman Electric Company. The new company will make several improvements in the plant.

ABERDEEN, WASH.—Plans are being drawn for an extensive addition to the plant of the Grays Harbor Lighting Company in East Aberdeen. The new building will be 45 by 96 feet, and twenty-two feet high.

MEDINA, N. Y.—The Niagara Falls Power Company, which is extending its power lines toward the east, through Medina, has applied to the board of trustees for a franchise to furnish light, heat and power in Medina.

BALTIMORE, MD.—Jacob Peters has secured the contract to build the large addition to the power-house at Herring Run for the Baltimore County Water and Electric Company. The addition will be one story high and will cover a space of 42 by 74 feet.

WINNIPEG, MANITOBA—At a meeting of the Calgary city council it was decided to go ahead with the installing of a civic electric plant for domestic and street light, at a cost of $60,000. Mr. R. S. Keish, of Montreal, has been selected as consulting engineer.

LYONS, N. Y.—The Wayne County Electric Company will expend $5,000 this spring in improvements to the plant and in replacing its feed wires throughout the village. About fifteen miles of copper wire will be used. Additional machinery will also be installed at the plant.

MISSOURI VALLEY, IOWA—C. H. Deur, A. Edgecomb, H. M. Cramer and George A. Kellogg, the owners of the Missouri Valley Electric Light, Power and Telephone Company, have sold their business and plant, located at Missouri Valley, to L A. Little, of Buffalo Lake, Minn. The consideration was $70,000.

RITZVILLE, WASH.—The electric light plant has changed hands, C. O. Greene disposing of the same to N. H. and O. H. Greene, president and cashier, respectively, of the Pioneer State Bank, who plan to spend considerable money on the plant in the near future, rewiring Ritzville, and putting in new machinery.

COLUMBUS, IND.—The Ryan Construction Company, of Indianapolis, has been awarded the contract to build and equip an electric light plant in Hope. A sufficient number of arc lamps will be put up to light the streets of the town, and commercial lights will also be furnished. George S. Cook is the owner of the new plant.

STILLWATER, MINN.—The Stillwater Gas and Electric Light Company has accepted a ten-year contract from the city of Stillwater for lighting the streets with electricity. Private consumers of both gas and electricity will reap a substantial gain, the company having agreed to reduce the price of gas about twenty per cent, and the price of electricity one-third.

CANAAN, CT.—The work on the dam for the Berkshire Power Company is completed. Other work connected with the plant has been delayed on account of high water. A brick power-house sixty feet long is to be erected. The Berkshire Power Company has recently purchased the Sharon plant, which is to be run in connection with the plant on the Housatonic river.

CHARLESTOWN, N. H.—The Charlestown Water and Power Company incorporators have chosen Frank W. Hamlin, William H. Tinker, Fred H. Perry, John E. Allen and W. L. Mason directors. The directors chose Frank W. Hamlin, president; Fred H. Perry, clerk, and W. H. Tinker, treasurer. It is expected that work on the final survey will commence at an early date.

POST FALLS, IDA.—Work is being pushed rapidly on the electric plant being constructed at Post Falls, and it is expected that the plant will be completed and ready for operation next fall. It is being built by the Washington Water and Power Company, and is to be one of the largest power plants in the Northwest. The capacity will be 25,000 horse-power, and the cost of the completed enterprise will be between $500,000 and $600,000.

NELSON, BRITISH COLUMBIA—L. A. Campbell, manager of the West Kootenay Power and Light Company, whose extensive works at Bonnington Falls are now undergoing improvement, has announced that his company has entered into contracts to supply the Granby Mining and Smelting Company and the British Columbia Copper Company in the boundary with 4,500 horse-power. The new installation now in process will cost $1,000,000.

CHICAGO, ILL.—The Calumet Lighting Company, formerly the Calumet Gas and Electric Company, has conveyed to the North Shore Electric Company for the nominal consideration of one dollar property in Harvey and Chicago Heights. The conveyance includes all property, real, personal and mixed, lands, waterworks and electrical plants. The deal is subject to a lien of a trust deed dated July, 1902, given by the United Water and Light Company to the American Trust and Savings Bank, as trustee, for bonds amounting to $200,000.

NEW HAVEN, CT.—New Haven interests, which already control the Springfield, Mass., Gas Light Company; the Malden Electric Company, of Malden, Mass.; the Suburban Electric Company, of Revere, Mass., and the Haverhill Electric Company, of Massachusetts, have acquired the Concord, N. H., Electric Company. The new concern is the only company supplying electricity to the city of Concord, and has a perpetual franchise. The population of the city is about 20,000. The capital stock is $350,000 and there is a bond issue of $350,000 authorized.

GAINESVILLE, GA.—Preparations are being made to begin active work at an early date upon the new dam at Wilson's Shoals, about six miles from Gainsville and about ten miles down the river from the Dunlap dam. The North Georgia Electric Company is constructing the plant. The new development will be approximately the size of the dam and power plant at Chattahoochee Park, Dunlap Shoals. The height of the dam will be about thirty feet, the length of the spillway 400 feet, the production of power about 3,000 to 3,500 horse-power.

OMAHA, NEB.—A second mortgage upon the plant of the Citizens' Gas and Electric Company has been filed for record. It is given to secure an issue of $300,000 second mortgage bonds held by the American Loan and Trust Company, of Boston. The Omaha Electric Light and Power Company guarantees the payment of the principal and interest of the bonds. The new issue is stated to be for the purpose of taking up the former bonded indebtedness, as well as to secure funds with which to pay floating indebtedness, for improvements made during the last year and for improvements to the amount of $50,000 or more contemplated during the present season.

NYACK, N. Y.—A meeting of the stockholders of the Orange & Rockland Electric Company was held recently. Charles R. Bull, of Oxford Depot, was elected chairman, and Gilbert Carpenter, of Monroe, was made secretary. After discussion it was voted to organize with a capital stock of $50,000. These directors were elected: Zael Paddleford, Luther Terwilliger, Monroe; Frank Durland, George M. Roe, Chester; A. Creelman, Fred W. Snow, R. J. Davidson, Hillburn. A central generating plant will be established in Monroe, and current will be furnished for lighting Monroe, Chester and surrounding villages. The directors hope to have the plant in operation early in July.

Digitized by Google

INDUSTRIAL ITEMS.

THE McGUIRE-CUMMINGS MANUFACTURING COMPANY, Chicago, Ill., announces that the Chicago City Railway Company has placed an order with it for 424 of its standard Master Car Builders' trucks, to be placed under new cars recently purchased.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has issued a catalogue describing the "Simplicity" theatre dimmer. The catalogue is handsomely got up. and contains descriptions and illustrations of a large variety of theatre dimmers, and also a list of the dimmers installed.

THE STANDARD VARNISH WORKS, New York city, is mailing a large folder calling attention to quick-drying "Voltalac," "Gutta-Percha Black Finishing" and "Gutta-Percha Light Finishing." In order to prove its words in regard to its goods, the company makes a proposition to ship a gallon of each of these varnishes as a trial order.

THE BATES MACHINE COMPANY, 346 Broadway, New York city, has established a branch office in Chicago, Ill., in the Manhattan Building, 315 Dearborn street. The office will be in charge of C. K. Eberts, formerly with Barnhart Brothers & Spindler. This office will carry a full stock of standard models of hand and typographic numbering and dating machines. So that orders for such goods may be filled with great promptness.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, Chicago, Ill., has shipped an additional increase of capacity, consisting of one section of multiple switchboard for the Independent exchange at Springfield, Mo. This is the second increase made by the Springfield company since the original installation. The Springfield company reports a very brisk demand for telephones, and it became necessary to increase the capacity of the switchboard a full section.

THE DEAN ELECTRIC COMPANY, Elyria, Ohio, is distributing folder No. 1, illustrative and descriptive of its compact type telephones. This literature is attractive and instructive. Diagrams are given, showing the connections of series telephones, bridging telephones, ring-through telephones, non-interfering telephones, divided-circuit telephones, four-party selective telephones, and central checking telephones. The company is prepared to furnish special telephones upon request.

THE ELMER P. MORRIS COMPANY, 15 Cortlandt street, New York city, manufacturer and exporter of electric lighting and railway supplies, will be pleased to send its general catalogue, No. 6, to any one interested in wrought-iron and steel tubular poles and pole brackets for electric railways, electric lighting and telephone and telegraph service. This book gives diagrams and illustrations of various forms of service apparatus and tables of standard weight tubing, in both English and metric systems.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., will be pleased to send their literature concerning P. & S. porcelain fixture sockets and P. & S. temporary sockets or receptacles for decorative wiring. This latter apparatus saves time and labor, it being unnecessary to use solder, tape or compound. The socket can be installed without opening it, and is placed on the line after the wires are set up. It is to be used with standard stranded wire, without removing or injuring the insulation.

THE AMERICAN CIRCULAR LOOM COMPANY, Chelsea, Mass., announces that the National Board of Fire Underwriters, after careful consideration at an open meeting held by the special committee, has cancelled all the specifications of rule 50-C of the electrical code, referring to the construction of flexible tubing, and has directed that circular loom of the type made by the company during the past twelve years be put back upon the list of approved fittings, and that this change be noted in the April supplement to the electrical code to be issued shortly.

THE SWITCHBOARD EQUIPMENT COMPANY, Pittsburg, Pa., in its bulletin No. 1, describes direct-current circuit-breakers with overload relays. In its introductory note the company states that it does not make switchboards, but that it does make circuit-breakers. The endeavor has been made to outline clearly and concisely the essential features of these breakers. Designs are based upon broad engineering experiences in circuit-breaker work, and a careful consideration of the requirements. The illustrations show the circuit-breakers both in diagram and perspective.

S. H. COUCH COMPANY, INCORPORATED, Boston, Mass., will be pleased to send bulletin No. 10, describing single-speaking circuit battery call telephones. The company also manufactures automatic reset intercommunicating telephones, rotary switch intercommunicating telephones, plug switch intercommunicating telephones, either in battery or magneto call. Catalogues will also be sent upon application descriptive of magneto call exchange telephones, central energy battery telephones, drop shutter switchboards, target signal switchboards, telephone annunciators and telephone parts.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is sending to its telephone customers a new catalogue and price list (No. 23), in which are listed telephones, appliances and construction material. On the first page of the book is a partial view of the Central Electric Company's new headquarters at 207-211 East Jackson Boulevard. A complete line of telephones, parts and materials is listed, and the company states that the prices quoted are the lowest in force. The catalogue is attractive, and the company requests that all users of this material who have not received a copy should write for one at once.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of new publications. One of these is entitled "Fan Motors." It contains about fifty pages, and describes alternating and direct-current fan motors. The fans illustrated are desk, wall and ceiling fans, together with their accessories. A second pamphlet deals with the Curtis steam turbine. This pamphlet contains twenty-five pages, and consists principally of photographs of existing installations. Accompanying this is a partial list of Curtis turbines already installed and under construction. "Motor-Generator Sets" is the title of a third pamphlet which describes various motor-generator and booster sets built by this company and installed in various electric stations. The company has also issued bulletin No. 4403, describing the separate adjustable shunt field coil for the Thomson recording wattmeter.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Coal City, Iowa; Rochester, N. Y.; Yorkshire, Ohio; Round Knob, Ill.; Jefferson City, Tenn.; Rockford, Ill.; Ossian, Ind.; Castalia, Iowa; Minot, N. D.; Hemlock Lake, N. Y.; Ames, Iowa; Kimball, Minn.; Birmingham, Ala., and Des Moines, Iowa. A contract has recently been closed with the United States Telephone Company, of Cleveland, Ohio, for one of the largest toll boards ever built for a telephone company. The equipment is to consist of the following apparatus: eleven toll sections of two operators' positions each, to be arranged in one line Two recording sections of two operators' positions, arranged in one line. One rural section. One paystation and heavy users' toll section; both of these sections will be arranged in one line. One test board. One chief operator's desk; this is to be a flat-top desk with a turret in the centre, so equipped that the chief operator can use one side, and the assistant operator use the other side. One switching section. One messenger call box; this arrangement consists of an annunciator box running to each operator's position, who can, by pressing a key, light a lamp in the call box. The lamp is covered with a lamp cap about one inch in diameter, with a numbered opal. The cabinets are to be built of solid mahogany.

AUTOMOBILE NOTE.

AUTOMOBILE CLUB OF AMERICA—A club smoker will be given at the club-house of the Automobile Club of America, 753 Fifth avenue, New York city, on Tuesday evening, April 25, at 9 P. M. This will be the concluding event of the season's house entertainments. Through the courtesy of Mr. Emerson Brooks the house committee has arranged an enjoyable programme. Supper will be served at 10.30 P. M.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 17. NEW YORK, SATURDAY, APRIL 29, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Electric Porch Lights . . . 679
Electric Railway Problems . . . 679
Self-Propelled Fire Engines . . . 680
A Simple Experimental Furnace . . . 681
The Incandescent Lamp as a Foot-Warmer . . . 681
The International Railway Congress . . . 682
The Annual Convention of the Iowa Electrical Association . . . 682
The Efficiency of the Incandescent Lamp . . . 683
Meeting of the National Conference on Standard Electrical Rules . . . 683
New Apparatus for Mechanically Checking Recording Wattmeters . . . 683
Electrical Mining Notes, by Sydney F. Walker . . . 684
Rural Electric Roads, by Dr. Louis Bell . . . 685
International Association of Municipal Electricians . . . 685
High-Pressure Line Construction for Alternating-Current Railways, by Theodore Varney . . . 686
Application of Electricity to Heavy Freight and Trunk Line Railways . . . 691
The Faraday Society . . . 692
The *Century* "Great Inventions" Series . . . 693
The Application of Electricity in the New York Hippodrome . . . 694
The Practical Management of Maintenance and Operation of a Telephone Exchange, by C. E. Stinson . . . 697
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 700
INDUSTRIAL SECTION:
The Electric Launch . . . 702
A Demonstration of Heating and Cooking by Electricity . . . 703
Orders for Allen-Bradley Controllers . . . 703
To Manufacture Field and Armature Coils . . . 703
Westinghouse New York Changes . . . 704
Electric Plants for the Supplying of Electricity to London . . . 704
Publicity . . . 704
A New Battery Fan-Motor Outfit . . . 704
The "Bijur" High-Duty Storage Battery . . . 705
New Form of Ceiling Board . . . 706
Electric Power for Spinning Mills . . . 706
CURRENT ELECTRICAL NEWS . . . 707

ELECTRIC PORCH LIGHTS.

The development of the porch light field deserves the consideration of every central station desiring to increase its business. One has only to walk after dark down a residence street of the city in which he lives to realize the opportunity that awaits the electric light companies in the direction of clearing up the mysteries of illegible house-numbers, which ought to be regarded as relics of barbarism by every residential user of the incandescent lamp.

In some localities the use of the porch light in a numbered globe has been taken up with enthusiasm. The cost of an eight-candle-power service for three and one-half hours each evening may be quoted as half a cent in some cases and yet be made profitable by the central station. The use of sixteen-candle-power lamps is worth encouraging, but in any event it is important to sell current at a small profit rather than not to sell it at all. The annoyance of needless calls to the door is often great in cities where the residence numbers are indistinguishable, and the safety and convenience of such a light may easily outweigh its low cost, from the consumer's standpoint.

ELECTRIC RAILWAY PROBLEMS.

The field of electrical application which seems to attract the most general interest is the introduction of the electric motor in place of other methods of propulsion. This, no doubt, is because of the character of the work which is being done by the electric car. It has revolutionized city transportation, has brought outlying districts within easy reach of business centres, and has spread out our city population and greatly reduced the cost of riding. These things appeal to the average man. He appreciates more fully what has been done by the electric railway than by other applications such as the electric light, and therefore possibly thinks that changes equally as great are imminent in larger railway work—larger in the sense of hauling greater loads and heavier trains. He does not realize that the problems presented in the two cases are entirely different.

This lack of appreciation of the true situation is only natural—in fact, the first electric railway work was done, not by railway engineers, but by so-called electricians, who attempted to substitute the motor for the horse, and hence built up a system from old horse-car practice. Had these pioneers known more about railway work, it might have saved much time; but, on the other hand, had they known what demands would be made upon the motors, they would probably have hesitated before submitting them to such service. They rather naturally assumed that if two horses were sufficient to move a car, a five or, at the most, a seven-horse-power motor would meet all demands. This belief was the cause of many unsuccessful electric cars, but resulted in the production of a motor truly wonderful for the work which it performs and for its suitability to the work required.

Now, in other lines of railway work, there are many problems to be solved before the motor can have universal sway. There are, in fact, several different kinds of service, each presenting peculiar conditions, and calling for a peculiar equipment. We have the city service, high-speed interurban service, long-distance passenger and heavy freight service, and possibly in the not distant future what we may call extra high-speed lines between important cities. To these we might add a fifth class—rural lines: light roads cheaply constructed, and intended to serve districts where a standard trolley service could not pay.

For the first of these classes we have what we may consider a practically perfected system. The overhead or underground trolley using direct-current series motors will probably remain unchanged for some time, unless the necessity of meeting conditions outside of cities makes a compromise desirable. The high-

Digitized by Google

speed interurban lines have until recently been equipped with direct-current motors, and have, on the whole, been successful; but the high cost of such a system has been the lever which has forced electric railway engineers to develop alternating-current, single-phase systems, designed to reduce the cost by saving in copper transmission lines and in substation machinery. The direct-current motor itself performs the service required of it satisfactorily, and the aim has been to obtain an alternating-current motor having the same characteristics.

Coming now to steam railway systems, we find several classes of work, each of which requires special treatment. There is the suburban traffic, which the road can not afford to give up to competing trolleys. This is best handled by an extension of the system found suitable for heavy city work, in which two or more large cars are coupled to form a train of the desired length, controlled from one point. It differs only from the surface car system in having a larger equipment on each car and in the method of controlling the motors. The motors themselves are simply large motors of the usual type.

The through passenger and heavy freight traffic, on the other hand, can not be handled in the same way. The express train makes long runs with few stops, calling for heavy trains and high speeds, hence rapid starting is not as important as in city work. The problem, principally, is to supply power at irregular times to a long stretch of track. To do this by extending the system found so satisfactory for city work is hardly possible on account of the expense. For the present, at least, this service can only be given by a locomotive, because our express trains of to-day are made up of cars running between widely separated cities; and until such route has been electrified throughout, it will be out of the question to equip the cars with motors. The problem in hauling freight is pretty much the same, except that the trains are heavier; but there is no need to make the same speed, and in freight haulage there is less possibility of equipping the individual cars with motors. It is evident that the problem presented in these two cases is widely different from that of urban and interurban work, and, from the magnitude of the work itself, that progress must be slow. Up to the present time, where changes from steam operation to electric have been made, or are in process of making, other and special considerations have entered and have forced the change.

There is no necessity to-day of providing extra high-speed service, though possibly the demand will arise in the near future. Already some important experimental work has been done in this field, and it has been shown that such service can be rendered by an electric system. It is now practically a commercial question. When sufficient demand arises, and it appears that the traffic will pay for the necessarily great expense, the high-speed road will come.

A different situation exists in the rural districts. While there are large sections of the country amply supplied with transportation facilities—either steam or electric, or both—there are still large districts where there is little or no railroad service. It has been suggested a number of times that a light electric road would meet the demands of these districts, and, if properly constructed, it would pay well. On another page of this issue this proposal is considered again by Dr. Louis Bell, who points out the needs of the rural districts and indicates how these should be met. The first thing that should be recognized is that a light road is needed. The builders must resist the temptation to make a standard road.

We have indicated above briefly the principal traction problems which are now confronting the electrical engineers. As has been shown, they differ considerably, a system admirably adapted for one being not at all suited for another. There is, however, no question about the possibility of doing all this work electrically. The main question to-day is merely, will it pay, and it is to answer this question and devise a system which will be profitable that the electrical engineer is directing his efforts. He is confident that, in the end, success will be his, but he does not anticipate overthrowing present railway practice in a night.

SELF-PROPELLED FIRE ENGINES.

It is reported that the municipal authorities of Vienna, Austria, have decided to reequip the city's professional fire-brigade, together with the auxiliary suburban volunteer fire-brigades, entirely with self-propelled vehicles. The city has already ordered fifty-three motor chemical engines, to replace the horse chemical engines of the professional service and of the volunteer brigades, which own their own horses. The Vienna fire service has long been held up as a model on the Continent, and the present step is thought to be one of the most important which it has taken, if not the most important in the history of fire-protection service. Although the equipment will be expensive, it is said that it will effect an annual saving of over $15,000. The cost of the change will be in the neighborhood of $180,000.

Attention has been called several times to the use of automobile fire engines, and the hope expressed that a city in this country would try them. They would seem to have some important advantages. It is most essential to get to a fire as soon as possible, and no effort is spared in training men and horses to obtain this end. In large cities, where there are many engines, there is pretty sure to be one in every important locality, so that the scene of trouble is reached quickly; but it would be reached still more quickly by means of a self-propelled vehicle, which is always ready to start, and which can make much better time on the streets because of its greater speed and the ease with which it can worm its way through a crowd of vehicles. If the steam pump is to be retained, it would be natural to propel the engine by means of steam, but much may be said in favor of an electric machine. The battery equipment of such a machine need not be large, since in no case would the distance to be covered be great. The supply for operating the motors would, of course, be drawn from suitable stations, which should be located at each fire-hydrant. Each machine would naturally be fully equipped with smoke helmets, a telephone, portable lights, and all the other modern appliances which greatly aid the fireman in his work.

Digitized by Google

A SIMPLE EXPERIMENTAL FURNACE.

In a paper read recently before the Faraday Society, of England, Messrs. R. S. Hutton and W. H. Patterson described a simple form of experimental furnace which has been devised by themselves. This is simply a tube of carbon which forms, at one time, the containing-chamber and the conductor. Heating is effected by passing current through the tube, the substance to be experimented with being placed in the tube.

It was found that this type of furnace gave a uniform temperature throughout, its only disadvantage being the presence of the carbon. The first tubes were formed of graphite, machined to the shape desired, but these being rather expensive, later tubes were made of agglomerated carbon pressed into proper form and baked. As this carbon becomes incandescent when heated, it must be protected from contact with the air. The best protection found was fine carborundum, which is packed around the outside of the tube. Carborundum, being not only a non-conductor of heat, but a reducing agent, retains the heat and excludes air and thus prevents combustion of the carbon tube. The inner layers of the material become fritted together, forming a non-conducting tube.

When a research is to be carried out in a pure gas, a double furnace is constructed, a second tube of carbon being placed around the outer, which allows the inner tube to be filled and surrounded completely by the pure gas. One of the problems to be solved in the development of this furnace was that of obtaining a good contact between the carbon tubes and the metallic conductors. This was finally accomplished by copper-plating the ends of the tube and soldering to these ends water-jacketed terminals. The circulation of water through the terminals keeps them cool, and the electric contact is excellent.

A convenient feature of this furnace is the rapidity with which high temperatures may be obtained. For example, with an agglomerated carbon tube one and one-half centimetres internal diameter, two centimetres external diameter, and twenty centimetres long, surrounded outside with a second carbon tube, and outside of the latter by carborundum, a current of 200 amperes at twenty-one volts melted nickel wire in three minutes. Increasing the current to 240 amperes at twenty-five volts melted platinum in two and one-half minutes more. A tube sixty centimetres long and 8.2 centimetres external diameter, 6.7 centimetres internal diameter, supported 600 amperes at 8.6 volts, and gave a temperature of 1,200 degrees centigrade in thirty minutes, with the temperature still rising seven degrees per minute. When the voltage was raised to thirteen, the current increased to 850 amperes. This furnace melted nickel in twelve minutes, and platinum in twenty.

This ingenious type of furnace should be acceptable for experimental researches in which the presence of carbon is not deleterious. Its advantages are, of course, its simplicity and the rapidity with which the desired temperature may be reached. While in the particular experiments mentioned above direct currents were used, alternating currents will be just as satisfactory, and probably, in most laboratories, more easily obtained. The electric furnace is becoming an exceedingly important instrument in chemical research. Happily, the best work can be done by simple and inexpensive devices.

THE INCANDESCENT LAMP AS A FOOT-WARMER.

One of the New York daily papers described recently a use of the incandescent lamp for which it is not intended. It is said that an ingenious salesman, by means of a thirty-two-candle-power lamp and an extension cord, constructed a foot-warmer by means of which he managed to sleep comfortably during the coldest weather in a miserably heated hotel. There is no question that this could be done, for the incandescent lamp is, unfortunately, a much better heater than lamp; but we must vigorously condemn any such use of it. We are glad to see that our contemporary, in a humorous way, throws cold water on the scheme, although it does not point out the real danger. It is not impossible that, as suggested, a restless sleeper might break a lamp placed under the bed covers, and should he do this, he might cut his foot on the broken glass; but there would be little danger of fire arising from the accident. The real danger of fire exists before the lamp is broken.

A thirty-two-candle-power incandescent lamp absorbs about 100 watts. Placed under the bed covers, all of this energy is converted into heat, and as the lamp is comparatively small, and the covers good heat insulators, it does not take long for a high temperature to be attained. This supply of energy at the rate of 100 watts is equivalent to 5.7 British thermal units per minute, which would be sufficient to raise one pint of water about fifty-seven degrees in ten minutes. When the lamp is closely surrounded by a non-conductive material, it does not take long for the latter to be heated to a dangerous point. One can test this easily for himself by wrapping a thick cloth about an incandescent lamp when it is lighted. In a few minutes the cloth will be smouldering, and possibly break into flame. When such a condition is not merely likely, but almost certain to occur, there is no necessity of dwelling upon the inadvisability of obtaining a comfortable night's rest by the means suggested.

It is a fact that possibly the greatest danger of fire from an incandescent lamp arises from this cause, because many persons who should know better seem to forget that it gives off heat, and therefore provision should be made for dissipating this. In other words, the lamp should not be placed in an enclosed position, unless it is surrounded by fireproof material, and it should not come in contact with anything combustible. This is one of the requirements of the fire underwriters, and it is something that should be known by every one.

The salesman referred to might very properly have made use of his incandescent lamp in place of the old-time warming-pan for taking the chill from his bed; or he might have wrapped it in some fireproof material, and then used it safely as a foot-warmer. But one may ask why he did not use an electrically heated mat, which is not only safe, but much more comfortable than a hot lamp.

Digitized by Google

THE INTERNATIONAL RAILWAY CONGRESS.

TO BE HELD AT WASHINGTON, D. C., MAY 3 TO 14, 1905.

The seventh session of the International Railway Congress will be held at Washington, D. C., May 3 to 14, 1905. The following programme has been announced:

April 29 to May 2, arrival of delegates.

Wednesday, May 3, from 11 A. M. to 2 P. M., registration of members of the congress. The office of the general secretary of the permanent commission will be at the New Willard Hotel, Washington.

Thursday, May 4, 11 A. M., formal opening of the congress. This will be held in the large banquet hall of the New Willard Hotel. Election of president and officers.

The sections will meet as follows:

First Section—Ebbitt House.

Second Section—New Willard Hotel, north end.

Third Section—New Willard Hotel, south end.

Fourth Section—Raleigh Hotel.

Fifth Section—Hearing room of the Interstate Commerce Commission.

On Friday and Saturday, May 5 and 6, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Sunday, May 7, will be given up to resting.

On Monday and Tuesday, May 8 and 9, at 9.30 A. M. and 2 P. M., there will be meetings of the sections. At 7.30 P. M. Tuesday, May 9, there will be a banquet given by the American Railway Association.

Wednesday, May 10, at 9.30 A. M. and 2 P. M., there will be meetings of the sections.

Thursday, May 11, there will be a meeting of the sections at 9.30 A. M. At 2 P. M. there will be a general meeting followed by a banquet.

Friday, May 12, 9.30 A. M., meeting of the sections. At 2 P. M., general meeting.

Saturday, May 13, at 9.30 A. M., meeting of the sections. At 2 P. M., general meeting and formal closing of the session.

Sunday, May 14, departure on tours of inspection which will be tendered to the foreign delegates. The exact itinerary of these tours and the hour of departure from Washington on the special trains will be announced later. The itinerary will be about as follows:

The Short Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cleveland, Ohio, Buffalo, N. Y., Niagara Falls, Schenectady, N. Y., and Boston, Mass. This tour will occupy the time from the evening of Sunday, May 14, to the morning of Tuesday, May 23. The party will arrive on the return at New York. The total length of this trip is about 1,500 miles.

The Long Tour—Visits to Altoona, Pa., Pittsburg, Pa., Cincinnati, Ohio, St. Louis, Mo., Chicago, Ill., Buffalo, N. Y., including Niagara Falls, Montreal, Canada, and Schenectady and Saratoga, N. Y. This tour will occupy the time from the evening of Sunday, May 14, to the evening of Saturday, May 27, when the party will arrive on the return at New York. The total length of the trip is about 2,700 miles.

Election traction will be discussed by Section 2, under the general questions of "Progress Made in Electric Traction on Important Lines of Railways," "Continuous Current, Alternating Current, Polyphase Current," and "Experiments Made with High-Tension Currents."

The reporters are as follows:

America—Mr. W. F. D. Young; electrical engineer, Baltimore & Ohio Railroad.

France—Mr. Paul Dubois; engineer of bridges and highways; engineer of the central service motive power, of the Orleans Railroad, Paris.

Great Britain and Belgium—Mr. Ernest Gerard, general inspector; chief of the cabinet of the Belgium minister of railways, Brussels.

Other Countries—Mr. Victor Isemontani, chief inspector of the electrical section of the Mediterranean Railway, Milan.

The lighting, heating, and ventilating of trains will be discussed by Section 2 and Section 3 conjointly.

Automatic block systems will be discussed by Section 3.

The entertainment of the delegates in New York on May 1 will include visits to the power stations of the Interborough Rapid Transit Company and passenger stations and freight terminals of the railroads running into New York and New Jersey.

At Pittsburg the delegates will visit the works of the Westinghouse Electric and Manufacturing Company, where luncheon will be tendered Tuesday, May 16.

At Schenectady, a trip will be made through the works of the General Electric Company's plant, Saturday, May 20.

At Cincinnati, a party will visit the works of the Bullock Electric Manufacturing Company at Norwood. Luncheon will be served after the inspection of the works.

The American Railway Appliance Exhibition, which will be held in Washington from May 1 to 14, in connection with the International Railway Congress, will present, on an elaborate scale, a varied exhibition of still and moving railway apparatus and kindred appliances. Monument Park has been selected as the site for the exhibition grounds. A main exhibit building with a floor space of some 21,000 square feet will contain the larger portion of the set apparatus. In addition, the balance of the nine acres of the park will be utilized by manufacturing companies, which will erect booths of their own, the moving exhibits being relegated exclusively to one section of the park. This is, of course, because of the difficulty of transmitting power too far away from the power-house. It is anticipated that this will be the most notable exhibition of railway appliances that the world has ever seen.

The Annual Convention of the Iowa Electrical Association.

The annual convention of the Iowa Electrical Association was held at Dubuque, April 19, 20 and 21. There were some 100 members in attendance, the visitors being welcomed by Mayor Berg, the response being made by Mr. Bowers, president of the association. Following the executive business of the convention, a paper was read on "Methods of Obtaining New Business," by L. D. Mathes, of Dubuque. This paper was discussed by Messrs. McGee, Bellamy, Zahm and Burt. Mr. W. J. Greene, of Cedar Rapids, introduced a proposal to increase the dues of members in the larger cities.

The afternoon of April 19 was taken up with committee reports and two papers. These were "Boiler-Room Economies," by F. H. Lankashier, of Davenport, and "Methods of Accounting," by A. W. Zahm, of Mason City.

Manufacturers of electrical apparatus were represented at the convention. Among these the National Electric Company, Milwaukee, Wis., made a prominent exhibit. The new universal Lundell motor was shown. The design of this motor has recently been described in the technical press all over the country. The "National Electrical Catechism," a new publication which the National company is distributing, was given away, as were various catalogues, mailing cards and other literature. The National souvenir watch fob, bearing as a charm a bas-relief representation of the company's trademark, was also distributed. The company's interests were represented by Ashley P. Peck, electrical sales agent; J. Frank Perry, sales engineer, and H. M. Klingenfeld, advertising manager.

Digitized by Google

The Efficiency of the Incandescent Lamp.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

The editorial in your issue of the twenty-second instant, on the methods of measuring the radiations of an incandescent lamp filament producing the sensation of light and of separating them from the non-luminous radiations, is most interesting. The problem is, as you say, rendered exceedingly difficult by the fact that of the wave-lengths that produce the sensation of light, all probably do not have an effect on the eye proportional to the actual amount of energy transferred, and it is further practically impossible to make any such determinations, as the eye is unable, for instance, to balance in the photometer the brightness of a red light against that of a green light.

I believe, however, that the explanation of this question can be nicely illustrated by further use of the mechanical analogy cited by Professor Kent. He says: "it takes mechanical energy to cause a steel spring to vibrate, but after it has been brought up to its normal period of vibration, it requires no further expenditure of energy to keep it vibrating except that necessary to overcome the resistance of the air and, possibly, a trifling molecular friction."

It is not quite plain whether by "the resistance of the air" Professor Kent means only the skin friction, shock and minute eddies caused by the spring passing rapidly through the air, or also includes those regular pulses sent out through an elastic medium, such as the air and most liquids and solids; and which, if of sufficient intensity and the right periodicity, affect our auditory organs as sound. These impede and carry energy from the vibrating spring just as surely as internal molecular friction or the external friction against the surrounding medium, and if the vibrating body is of the right shape they carry energy away very rapidly and are the principal means of bringing it to rest, especially if its mass is small in proportion to the surface imparting vibration to the air, as witness the exceedingly brief time of, although powerful, vibration of a drum-head.

This same mechanical illustration may be used to explain several other phases of the subject. If we will choose, rather than a tuning fork or simple thing, a body of some other shape having, when struck, complex vibrations of different periodicities, part of the energy of the blow may be expended in the permanent distortion of the material and heat, some may be used in mechanical friction against the air, another portion may be sent out as air-waves of a periodicity either too high or too low to affect the ear, and a small portion may appear as waves distinguishable by the sense of hearing. If, for instance, we were to determine the comparative efficiencies of two types of bells, it would be first necessary to measure the energy input of each in foot-pounds in the hammer blows when the sounds produced by the respective bells were apparently equal under the same conditions of distance and direction, this would give a rating similar to "watts per candle-power."

If we further wished to determine the actual proportion of the energy appearing in air-waves affecting the ear, or as "sound," we would have a very difficult problem, for, as far as I know, no one has ever perfected a method of sifting out the waves of different periodicity, as can be done with light by means of the prism, the diffraction grating, or medium transparent to some rays and not to others. Furthermore, the same difficulty that is found in balancing lights of different colors would arise in balancing the loudness of a sound of high pitch against that of one of low pitch.

GEORGE H. GIBSON.

New York, April 24.

Meeting of the National Conference on Standard Electrical Rules.

The National Conference on Standard Electrical Rules held its third meeting at Boston, Mass., on Thursday, April 20, to consider the relation of the manufacturing and operative electrical interests with the underwriters' electric rules.

The following organizations were represented by delegates:

American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Association of Edison Illuminating Companies, Associated Factory Mutual Insurance Companies, International Association of Municipal Electricians, International Association of Fire Engineers, National Board of Fire Underwriters, National Electrical Contractors' Association, National Electric Light Association, Underwriters' National Electric Association; and on the part of manufacturers and operating companies there were persons representing the American Telephone and Telegraph Company, Chicago Edison Illuminating Company, Edison Electric Illuminating Company, General Electric Company, Postal Telegraph-Cable Company, Western Union Telegraph Company, Westinghouse Electric and Manufacturing Company, Pacific Coast Transmission Association and the representatives of a large number of operating electric light and power companies.

The principal action of the conference was to approve a change of the notice on the flyleaf of the National Electrical Code from the statement of approval which has been continued ever since the first issue of this code in 1897. This notice was the result of the work of the first meeting of the conference in March, 1896, which prepared, through its code committee, the electric rules adopted by the National Board of Fire Underwriters. It was felt by the conference that the subsequent editions in which these rules had been amended and others added, without action of the conference or the approval of the organizations composing the conference, had altered the relation of the conference to these rules.

In place of this statement, another was adopted containing an historical statement of the formation of these rules of the edition of 1897, and the names of the organizations forming the conference.

In regard to future relations between the electric interests in the conference and the Underwriters an arrangement was entered into by Mr. C. M. Goddard, secretary of the Underwriters' National Electric Association, in which notice of proposed changes in the rules should be submitted to the secretary of the conference for distribution to its members in advance of the annual meeting in December of each year.

The discussion throughout the meeting was active.

New Apparatus for Mechanically Checking Recording Wattmeters.

A description is given by Dr. A. Gradenwitz of an ingenious little device invented by M. F. Biermann for checking recording wattmeters. The device was brought out in order to satisfy that class of consumers which always regards with suspicion the indications of the usual type of meter. The machine is merely a mechanical recorder which is operated by means of a relay. The relay itself is actuated by a little commutator attached to the revolving part of the recording wattmeter. This commutator completes a circuit through the relay once during every revolution. At this moment the relay attracts its armature, and the latter, by means of a ratchet, shifts a light shaft

Digitized by Google

forward one notch. The revolutions of this shaft are recorded by means of a series of discs in the method common in such mechanical counters. The shaft, at the same time, drives the second shaft through gears, and this second shaft, two other sets of recording dials. The first set of dials merely records the number of revolutions of the wattmeter disc. The second set records, by means of a suitably selected gear ratio, the watt-hours or ampere-hours, according to the type of meter employed. The third set of discs indicates the amount of the bill. These gear ratios must, of course, be changed for different meters and for different prices of the supply. These three sets of discs are arranged in line, and opposite them is a small plate which can be forced against them by means of a lever. When a record is to be taken, a blank sheet is placed upon this plate, the lever is turned and the paper forced against the dials. In this way a record is made not only of the number of revolutions of the wattmeter, but of the actual consumption of current or energy, and of the amount of the bill. The record obtained from the first set of discs is continuous, while that from the other two is for the time which has elapsed since the last reading. The latter are set at zero after each record has been taken.—*La Revue Pratique de l'Electricité (Paris), April 5.*

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

CABLES FOR MINING WORK.

Cables are perhaps the most important part of any electrical equipment, because they are so difficult to control. They are more or less hidden, and they are always giving more or less trouble. Two substances have been used in mining work, so far, india-rubber and bitumen. In my experience, up to the present, india-rubber has been the only substance that would stand, and that only if you had plenty of it and protected it well from moisture. My idea of a cable for mining work has been at least one-tenth-inch radial thickness of rubber, made up in the usual way, the different coatings being well vulcanized together so as to form a continuous tube, with the tube well protected by as much jute yarn laid on outside as you could, the yarn to be well impregnated with some waterproof substance, and treated pretty frequently to doses of the same substance. But this makes an expensive cable, and mine owners ask if there is nothing cheaper. And so bitumen has been used very largely. I used bitumen many years ago, but was obliged to abandon it as it was unreliable. It would crack and allow moisture to enter, with the result that the cable was parted, and there was trouble generally. Bitumen softens at low temperature, and is amenable to the action of the salts that are found in the water in coal-pits. Lately, however, a modification of bitumen has been put upon the market, known as "Dialite," which is very much less expensive than rubber and claims to be better even than rubber in many respects. It is made by adding certain substances to the bitumen after it has been refined and before vulcanizing, the result of the addition being the production of a very much harder substance that melts at a much higher temperature than bitumen and, it is claimed, will stand a higher temperature than rubber; that is not attacked by moisture, even when the water from which it is taken is impregnated with salts, as pit-water so often is. It has been upon the market some four years, and apparently promises well. Another interesting development in cables is the bitumen-covered paper cables that Messrs. Glover have brought out some time since. Paper cables have been used to a great extent in street work, in England, rubber having failed, in the opinion of borough electrical engineers. But it has only been used to a small extent in mines, for the reason that it is difficult to ensure immunity from the ingress of moisture to the paper. Lead is attacked by the acids so often found in pit-water, and it is liable to have cracks developed in it, admitting moisture, with the well-known results. Messrs. Glover have prepared paper cables with bitumen tubes in place of lead. The development is an exceedingly interesting one. The question is will the bitumen tube prevent the ingress of moisture more than the lead tube does. Bitumen is not subject to electrolysis, as lead is, and there is a distinct advantage in having an insulator in place of a conductor on the other side of the insulator.

It is perhaps interesting to note that there is rubber and rubber. The best comes from the district known generically as Para, in South America, and the worst from West Africa. The prices range from five shillings a pound down to one shilling a pound. Rubber contains, so experts inform me, a germ that renders it unfit for use alone, outside copper. The addition of sulphur in the vulcanizing process kills the germ, but if too much sulphur is put in the resultant product is bad, while if too little the deterioration which the germ sets up is only delayed. West African rubber contains much more of the germ than Para, and therefore requires more sulphur. It is possible, however, to make a cable insulated with West African, or other inferior, rubber that shall apparently be as good as Para, but which will have a very short life. If either the crude rubber or the crude bitumen is not thoroughly cleaned, if small foreign substances are left in them, the results are very disastrous. The common practice with rubber-insulated cables in England that are to be used for electric light or power is to employ only Para rubber, and to place a thin layer of pure rubber next to the conductor, then a layer of what is termed separator, vulcanized by addition of a salt containing sulphur, such as sulphide of antimony, then a further layer called jacket, well vulcanized, the whole being heated together. The pure rubber takes some sulphur from the separator, the separator takes some sulphur from the jacket. The whole becomes one tube of vulcanized material.

THE HOME OFFICE RULES FOR THE USE OF ELECTRICITY IN COAL MINES.

The rules proposed by the Home Office have been issued. They were sent to every coal mine in the United Kingdom, with an intimation that unless an objection was lodged within twenty days of the receipt of the rules, they would be considered to be established at each mine that had not objected. There are fifty-nine rules in the present set, as against a hundred odd in the previous set. Further, the new rules are to be observed as far as is reasonably practicable. There is no mention of who is to judge as to practicability, but there can hardly be any doubt that his Majesty's inspectors will be the judges, *de facto,* if not *de jure.* The rules themselves are very reasonable, and if they are applied with the usual give and take that is necessary in all industrial matters, and particularly in mining, they should at least not hamper the industry. The requirements demanded by the rules are in themselves fair and reasonable. There is only one point where I should be inclined to differ from the rules, to any appreciable extent, and that is on the vexed question of "earth." Evidently this has been a battle-ground in the negotiations that have taken place. Where a medium pressure supply is used, for power, for arcs in series or for incandescent lamps in series, the wires or connections to the motors, transformers or lamps or otherwise in connection with the supply shall be, as far as is practicable, completely encased in strong armoring or metal casing efficiently connected to "earth." And in the section devoted to cables it is stated that where lead-covered cables are used, the lead covering shall be continuous and connected to "earth." There is a saving clause in the general rules dealing with the matter. The cables, etc., may be fixed sufficiently far apart to prevent fire or shock and they need then not be armored. In the cables section, also, the rules have given in to the concentric cable men. In the original rules concentric cables with the outer earthed were practically forbidden. In the present rules they are allowed, and in addition the middle wire of three-wire systems and the neutral of three-phase are allowed to be earthed at one point. In every generating and transforming station earth or fault detectors are to be kept permanently connected up to show immediately any defects in the insulation of the system. The readings of these instruments are to be entered in a book kept for the purpose, at the generating and transforming stations. My view is that registration of insulation at as frequent intervals as possible is the right thing, but a permanent earth connection, whether to armor or through an instrument, is wrong. Further, the earthing of the outer or the neutral of a system at one point only is inviting trouble. There is always a distinct difference of pressure between the two ends of the outer covering of a cable if it is a conductor.

Digitized by Google

RURAL ELECTRIC ROADS.

BY DR. LOUIS BELL.

It has long been the writer's opinion that there exists a field for profitable electric traction that has been up to the present time almost wholly undeveloped. This is the field of distinctly rural traffic which lacks the density requisite for the support of ordinary interurban enterprises, but yet is quite sufficient to justify roads built on a less ambitious scale. One must realize at the start that there are and must continue to be many communities of limited, but still stable, population not yet in touch with railroad transportation, while furnishing in the aggregate a good amount of traffic. Some few of these communities are already served by electric roads of the ordinary sort, but, save in localities where the roads can find termini capable of supplying a considerable amount of business, commercial success is very problematical, and the list of unsuccessful electric roads, fortunately not a long one, is mainly composed of lines touching only rather small communities.

The cost of a standard electric line, even when most economically constructed, involves considerable fixed charges quite independent of the traffic, and the net receipts after paying operating expenses must be large enough to take care of these fixed charges, which they sometimes fail to do. For example, a road which carries a funded capitalization of $20,000 per mile and operates on fifty per cent of its gross earnings, which is a very low figure, must earn $3,000 to $4,000 per mile at least to take care of its fixed charges and maintain the physical value of its system. If its earnings fall to $2,000 per mile, a reorganization is imminent. Nevertheless, a light electric road can be built at a figure that would make it a profitable and permanent investment on the basis of $2,000 per mile gross earnings or even less. But to succeed such a road must be frankly built as a light railway and must plan for traffic accordingly. It can not maintain the airs and graces of an interurban system upon the prospect that lies before it, but it can do its work, pay dividends, and be of inestimable value to the community in which it operates. It must depend upon its own territory save as it became a useful feeder to some existing railway, as will frequently happen. Its competitor is not the trunk line, but the wagon, and if its locality be well chosen it will become a short cut for both freight and passenger traffic and can gather up a very respectable amount of business.

The recent development of simple alternating motors for electric traction ought to give an impetus to this sort of railway construction, since the new system minimizes the cost of the necessary electrical distribution, reducing it in all ordinary cases to a single trolley wire, for which a cheap and light overhead construction will suffice. For the class of service intended, moderate speed and light rolling stock suffice, so that the actual amount of power can be kept low. Thereby its supply is rendered the more simple, for in many cases it could be readily obtained *via* a frequency changer and a short transmission from some existing electrical supply station. In more ambitious projects one of the many small water powers common in a hilly country could be utilized to advantage, the extreme simplicity of the necessary equipment tending to keep down the first cost and the operating charges to very modest figures. It does not take much of a power station to operate two or three light cars at eight or ten miles per hour upon a road half a dozen miles long, and yet this equipment is amply sufficient to meet the requirements of many a community quite able to furnish traffic enough for good profits upon the modest investment required.

In a country where summer tourists are numerous there is particular need for suitable transportation, which is too frequently absent at present. Inaccessibility is a serious obstacle in developing the summer business and it often happens that regions in themselves most attractive are cut off by lack of the railway facilities which would make them practicable. For such cases the light electric railway has many advantages, since it can be put down at a cost that allows a profitable business even if the bulk of it has to be crowded into the summer months. A very natural question which will be raised is: "why do you talk light railways, what is the matter with an ordinary electric road cheaply installed?" The answer is this: "it is almost impossible to start with the idea of a cheap road using standard equipment and to carry it vigorously through to the end. Some one gets enthusiastic over the chance of an extension, or the possibilities of rapid growth, and weakens to the extent of putting on heavy standard cars. This implies a heavier track if the cars are to run well, strengthening of bridges and trestles, a bigger feeding system, a little more generating capacity, a cut-off to save time over the natural route along the highway, and before the trend of these things is fairly recognized the project has risen to double its proper cost. A cheap, even, narrow-gauge road that pays is worth two standard roads in the hands of receivers, as an investment. "But," some one says, "how can such a road exchange cars with standard roads?" On the other hand, who asked it to do so? These little rural lines should stand strictly on their own merits as practicable enterprises. Most of them should go in where the very absence of connections and the improbability of getting any is the very reason for their being. They should occupy ground where they are needed with the clear understanding that they are just what they claim to be—rural roads to meet rural needs, without any probability of ever being part of a trunk line. They are essentially enterprises to be put through, largely by local interests, forming the capillaries of traffic circulation. How far it is wise to go in the matter of lightness is a proper subject for experiment as the roads go in. In a general way one may safely say that they should be kept down to about half the ordinary cost of electric roads in open country. On this basis they can not do all that an ordinary road can do in speed and capacity, but they can do all that is required to earn dividends, and that is what some standard roads fail to do. If they are intelligently installed in carefully selected districts every light electric road can do admirable work, and that the need of them is real a brief trip with one's eyes open will demonstrate.

International Association of Municipal Electricians.

The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 29, 30 and 31, 1905. At this meeting will be presented the following papers:

"Electrical Induction, Its Effects and the Application of Methods Used to Counteract It."

"Advisability or Inadvisability of Fusing Fire and Police Telegraph Boxes."

"Suggested Improvements in Fire Alarm Telegraphs."

"Underground Construction."

"The Necessity of a Rigid Inspection by the Municipality."

"Electric Light Engineering."

"Electric Light Plants."

These papers have been assigned to men who are thoroughly conversant with the subjects selected, and they are of great importance to the municipal electricians. Frank P. Foster, of Corning, N. Y., is secretary of the association.

Digitized by Google

HIGH-PRESSURE LINE CONSTRUCTION FOR ALTERNATING-CURRENT RAILWAYS.[1]

BY THEODORE VARNEY.

The chief advantage to be derived from the direct application of the alternating current to railway service is in the use of high trolley pressures. Having a successful alternating-current motor, the remaining problem of greatest importance is the method of supplying current to the car. The third rail, which is largely used in heavy railway work, is obviously unsuited for carrying 3,000, 6,000, or 10,000 volts on the score of insulation and of safety. Moreover, the third-rail construction, whatever be the pressure, is not suitable for terminal yards in which there are many tracks and in which derailments are not unusual. A smash-up would be almost certain to result in tying up the system.

Of the various methods of current supply heretofore employed the overhead conductor is believed to be the only one capable of development into safe or permanent operation with trolley pressures running up into thousands of volts. The present paper will describe some preliminary work which has been carried out on a practical scale with overhead conductors. In laying out a suitable overhead high-pressure alternating-current system, it was decided to make a radical departure from the present methods of construction wherein the insulation is made only good enough and the supporting structure only strong enough to keep the cars running by the aid of an efficient repair department. It was rather the aim to obtain a system which would be serviceable and reliable for several thousand volts and which when once in place would at least equal in durability and cost of maintenance the bridges, track, and other portions of a standard railroad. While the exacting conditions and heavy traffic of the present steam roads will require for successful operation by electricity a carefully planned and substantial construction, the lighter interurban roads may frequently be equipped with a less expensive system.

Several classes of construction have been designed; of these the least expensive type employing bracket arms will be described first.

BRACKET-ARM CONSTRUCTION.

This system consists of a single line of wooden poles spaced well apart and fitted with bracket arms and steel catenary sus-

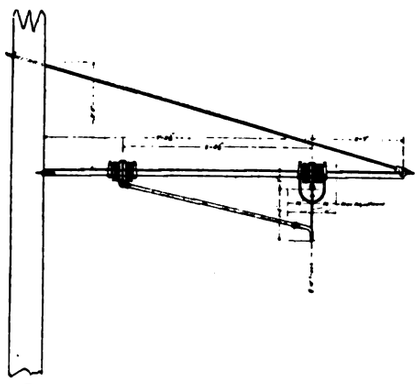


FIG. 1.—T-Iron Bracket with Main Insulator and Steady Strain.

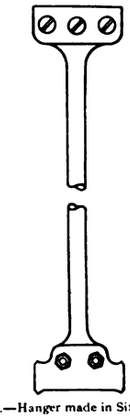


FIG. 3.—Hanger made in Six Lengths.

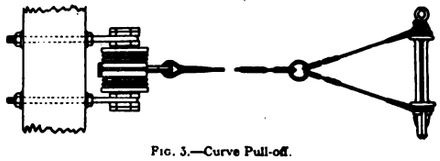
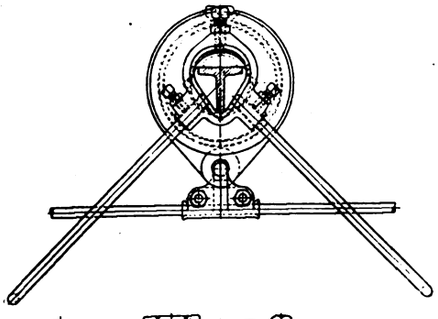


FIG. 5.—Curve Pull-off.

FIG. 6.—Anchor Scheme.

FIG. 7.—Anchor Scheme.



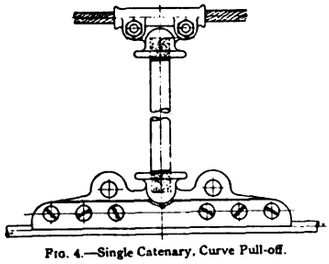


FIG. 4.—Single Catenary, Curve Pull-off.

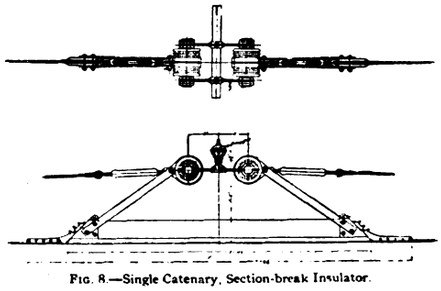


FIG. 8.—Single Catenary, Section-break Insulator.

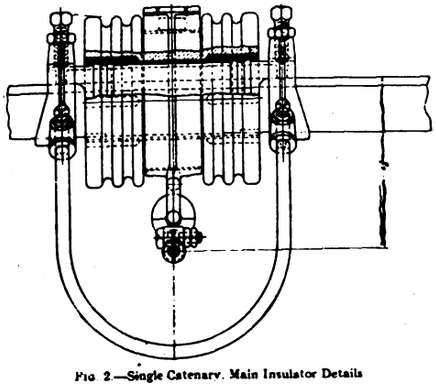


FIG. 2.—Single Catenary, Main Insulator Details.

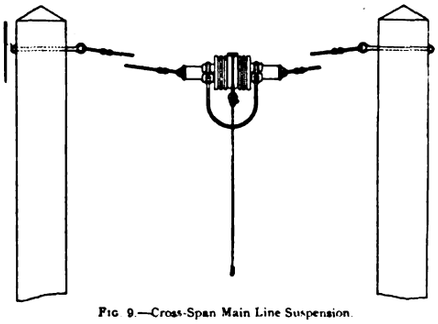


FIG. 9.—Cross-Span Main Line Suspension.

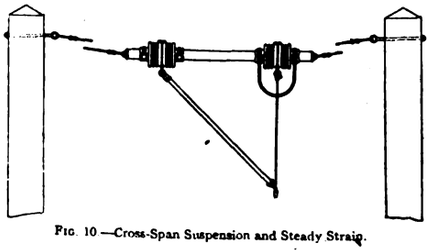


FIG. 10.—Cross-Span Suspension and Steady Strain.

LINE CONSTRUCTION FOR ALTERNATING-CURRENT RAILWAYS.

[1] A paper presented at the 195th meeting of the American Institute of Electrical Engineers, New York, March 24, 1905.

Digitized by Google

pension cable for supporting the trolley wire. The bracket arm is a T-iron supported by a tension rod at its outer end and fitted at the inner end with lugs which partly embrace the pole and to which they are bolted with lag screws. Fig. 1 indicates the construction.

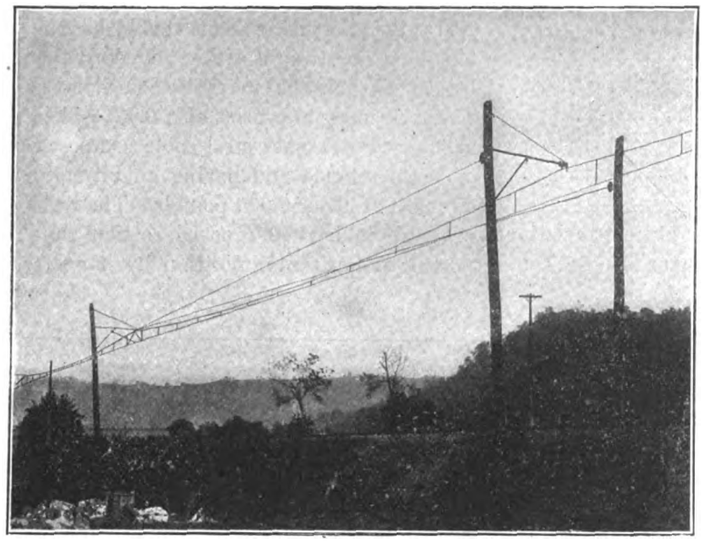


FIG. 11.—SINGLE CATENARY, 120-FOOT SPAN AND ANCHOR.

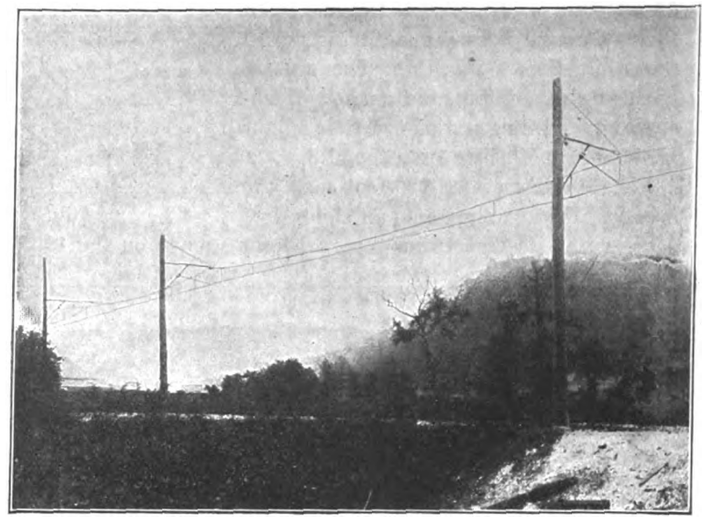


FIG. 12.—SINGLE CATENARY, 80-FOOT SPAN WITH STEADY STRAIN ON CURVE.

The insulator is of corrugated porcelain, cemented to a malleable-iron sleeve which in turn is slipped over the bracket arm and held by clamps and set screws. The porcelain insulator has a groove at its centre surrounded by a malleable-iron collar similar to a pipe clamp. This collar has an eye on the lower side into which the hooks of a clamp which carries the steel supporting cable or messenger are inserted. Wheel trolleys will probably be used to a considerable extent with the lower pressures. Guard loops are provided to prevent breakage of the porcelain, in case the trolley should leave the wire under a bracket. The insulator with its fittings is shown in detail in Fig. 2.

The guard loops are also of service in temporarily supporting the cable while it is being run out and pulled up. The trolley and messenger are run out together, and the former is supported from the messenger at occasional points by temporary tie-wires. The tension in the messenger cable is adjusted to give the proper sag, and the trolley wire is pulled up tight enough to take out all kinks and bends. Both trolley and messenger are then anchored. The messenger is next clamped to the insulators and the trolley is permanently supported from the messenger by means of hangers or clips which are adjusted in length in such a manner as to hold the trolley horizontally. By this means, the tension in the trolley is slightly relieved and allowance is made for expansion and contraction. The hangers are stiff and, being placed only ten feet apart, correct any tendency of the grooved trolley wire to twist. This ensures that the smooth lower surface will always be downward, a feature especially necessary when bow or sliding trolleys are used. The short distance between hangers also prevents the end of a broken trolley wire from coming dangerously near the ground.

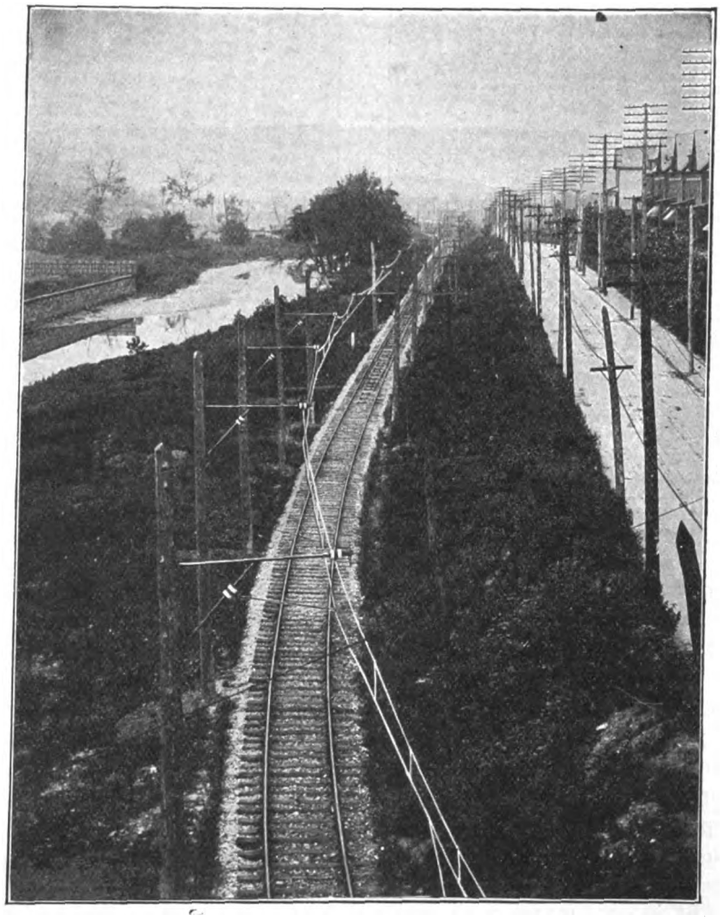


FIG. 13.—SINGLE CATENARY CURVE, SHOWING USE OF STEADY STRAINS.

The method of supporting the messenger below the bracket arm enables a tension rod to be attached to the outer end of the bracket without the necessity of fishing the messenger cable over the arm and under the brace. The cable and trolley may be run out along the track and pulled up in place under the brackets with a minimum amount of labor. Another advantage in this arrangement is the slightly flexible character of the point of support of the messenger; this is not sufficient to permit any considerable vibration of the span as a whole, but will allow any small vibration set up by the trolley to pass on. It has been noticed in rigidly supported spans of considerable length that a tendency exists for waves to be reflected from these fixed points which, when they reach the trolley, lift the wire from it, thereby causing flashing.

The hanger is illustrated in Fig. 3 and consists of a galvanized malleable-

Digitized by Google

iron casting made in ten lengths. It is fitted with a bolted clamp to take the messenger cable and is secured to the trolley with screws. At intervals of about 1,000 feet and upon curves of large radius, a steadying device shown in Fig. 1 is used. The pull-off used on sharp curves, the method of anchoring, and the section-break insulator are shown in Figs. 4, 5, 6, 7, and 8.

Fig. 11 illustrates a 120-foot span and anchor. Fig. 12 represents an eighty-foot span with steady strains on a slight curve. Fig. 13 is a view taken from an overhead bridge, showing the use of steady strains on a moderately sharp curve.

MEASUREMENTS ON SPANS IN SERVICE.

A road five miles in length has been in operation for about five months, and upon this road several forms of construction have been installed. One portion has been equipped with 120-foot spans with sags of twenty-four inches in the messenger cable. Another section has spans of about ninety-six feet and sags of about four inches. In the latter case both messenger and trolley wire are tighter than the former. The effects of temperature upon these two forms of construction are indicated by the following observations during the period of two months:

Date.	Temperature Fahr. Degrees.	Height of Trolley Wire above Rails.	
		Span No. 1.	Span No. 2.
		120-ft. Span.	
12-23-04	33.8	21 ft. 3.4 in.	21 ft. 5.1 in.
12-23-04	52.3	21 " 2.0 "	21 " 3.6 "
1- 4-05	16.0	21 " 4.1 "	21 " 5.5 "
		96 ft. Span.	
12-22-04	34.7	20 ft. 7.0 in.	20 ft. 7.5 in.
12-23-04	52.3	20 " 6.8 "	20 " 7.4 "
1- 4-05	14.7	20 " 7.4 "	20 " 7.9 "

The greatest temperature variation noted on the 120-foot spans was 36.3 degrees Fahrenheit, and the corresponding changes in height at the centres of the spans were 2.1 inches and 1.9 inches respectively. For the ninety-six-foot spans the temperature variation was 37.6 degrees and the corresponding changes in height were 0.6 inch and 0.5 inch respectively.

The combined weight of messenger, 000 trolley wire, and hangers averages one pound per foot which gives a tension in the messenger cable with 120-foot span and twenty-four-inch sag of about 900 pounds. The tension with ninety-six-foot span and four-inch sag is about 3,500 pounds.

BEST ARRANGEMENT.

For best results with this form of construction both as regards cost and operation, the following arrangement is considered satisfactory: the spans should be 120 feet long on straight track, reducing the length as may be necessary on curves. The messenger to consist of a 0.4375-inch galvanized Bessemer steel cable composed of seven strands and having an ultimate strength of about 6,000 pounds. The trolley wire to be 000 grooved section supported in horizontal position by hangers placed ten feet apart. The messenger cable is to be pulled up to a minimum cold weather sag of about eleven inches, corresponding to a tension of about 2,000 pounds.

CROSS-SPAN CONSTRUCTION.

For conditions where bracket arms can not be used, cross-span work may sometimes be employed. For this purpose the arrangement indicated in Figs. 9 and 10 has been designed. The difference between this arrangement and the bracket-arm construction is the substitution of a 0.4375-inch steel span cable for the bracket. Other details are practically the same.

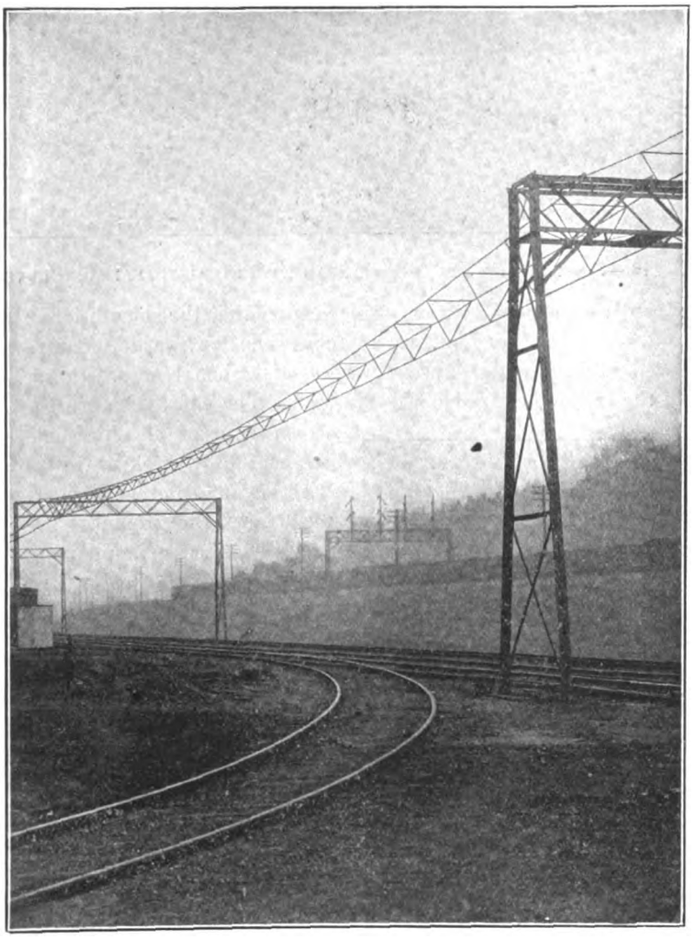


FIG. 14.—DOUBLE CATENARY, BRIDGE CONSTRUCTION.

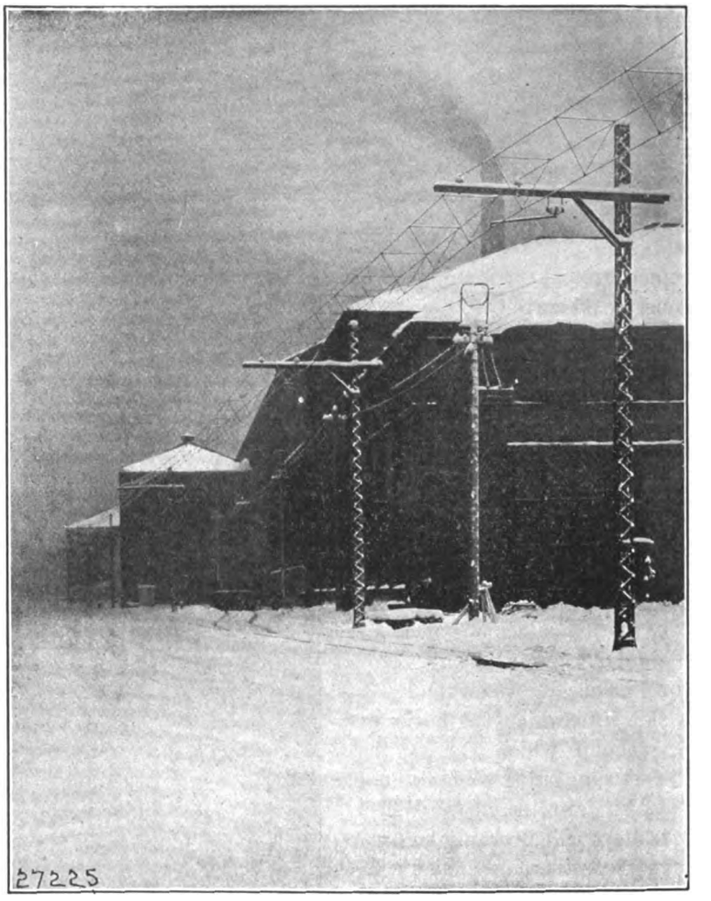


FIG. 15.—DOUBLE CATENARY, LATTICED-POLE CONSTRUCTION.

Digitized by Google

BRIDGE CONSTRUCTION.

For the heavy service requirements of steam roads having from two to four tracks, the construction described above is not adequate; a more substantial equipment and one which will not encroach upon the present standard clearances is necessary. Obviously, the best form of support to accomplish this result is a bridge long enough to span all tracks with ample clearance on the sides and overhead, and stiff enough to carry all of the overhead conductors without undue vibration. Bridges of this character are at present in use on many roads to support semaphores and other signal apparatus.

Fig. 14 illustrates a section 2,500 feet long of a three-track road, one track of which has been equipped with the bridge construction. The double catenary system is used, each messenger being a 0.4375-inch steel stranded cable. The trolley wire is 000 grooved, and the supporting hangers are placed ten feet apart. The average total weight per foot supported by each cable, including its own weight, is 0.91 pound. The vertical sag in the first span, which is 230 feet long, is 2.6 feet, and in the second span, which is 270 feet long, 3.6 feet, both at 26.6 degrees Fahrenheit. The corresponding tension in the messenger cables is 2,300 pounds.

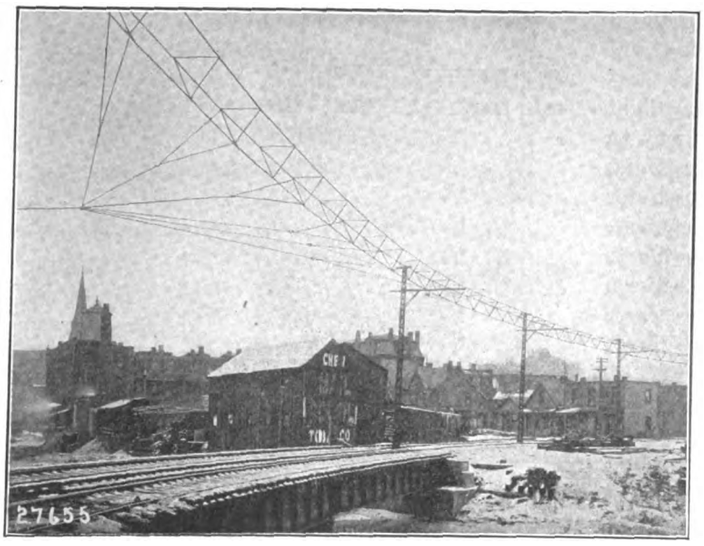


FIG. 16.—DOUBLE CATENARY CURVE WITH PULL-OFF.

The observed variation in height of trolley wire due to temperature change was as follows:

Date.	Temperature Fahr. Degrees.	Height of Trolley Wire above Rails.	
		Span No. 1.	Span No. 2.
1-16-05	26.6	23 ft. 9.1 in.	23 ft. 7.1 in.
1-26-05	6 8	23 " 10.1 "	23 " 9.9 "
2- 9-05	39.2	23 " 7.3 "	23 " 4.3 "

The maximum temperature variation is 32.4 degrees and the corresponding change in height of trolley wire is 2.8 inches for the 230-foot span and 5.6 inches for the 270-foot span.

Fig. 15 shows an extension of the double catenary construction supported upon latticed poles, while Fig. 16 represents a curve of 425-foot radius. In the latter view the use of double catenary curve pull-offs is illustrated.

PROPOSED GENERAL PLAN.

It was first thought advisable to run the messenger cable over the bridges. Fig. 14 shows this construction. It is necessary, however, to provide an unobstructed view of the signal apparatus and it is accordingly considered preferable to make the bridge high enough to permit the semaphores to be suspended below the truss.

Fig. 17 indicates a signal bridge which has been devised for a four-track road carrying besides the semaphores, the four sets of cables and trolley wires suspended below the truss. This construction is a decided advantage in erecting, as the cable and trolley wire can be run out along the track and lifted into place.

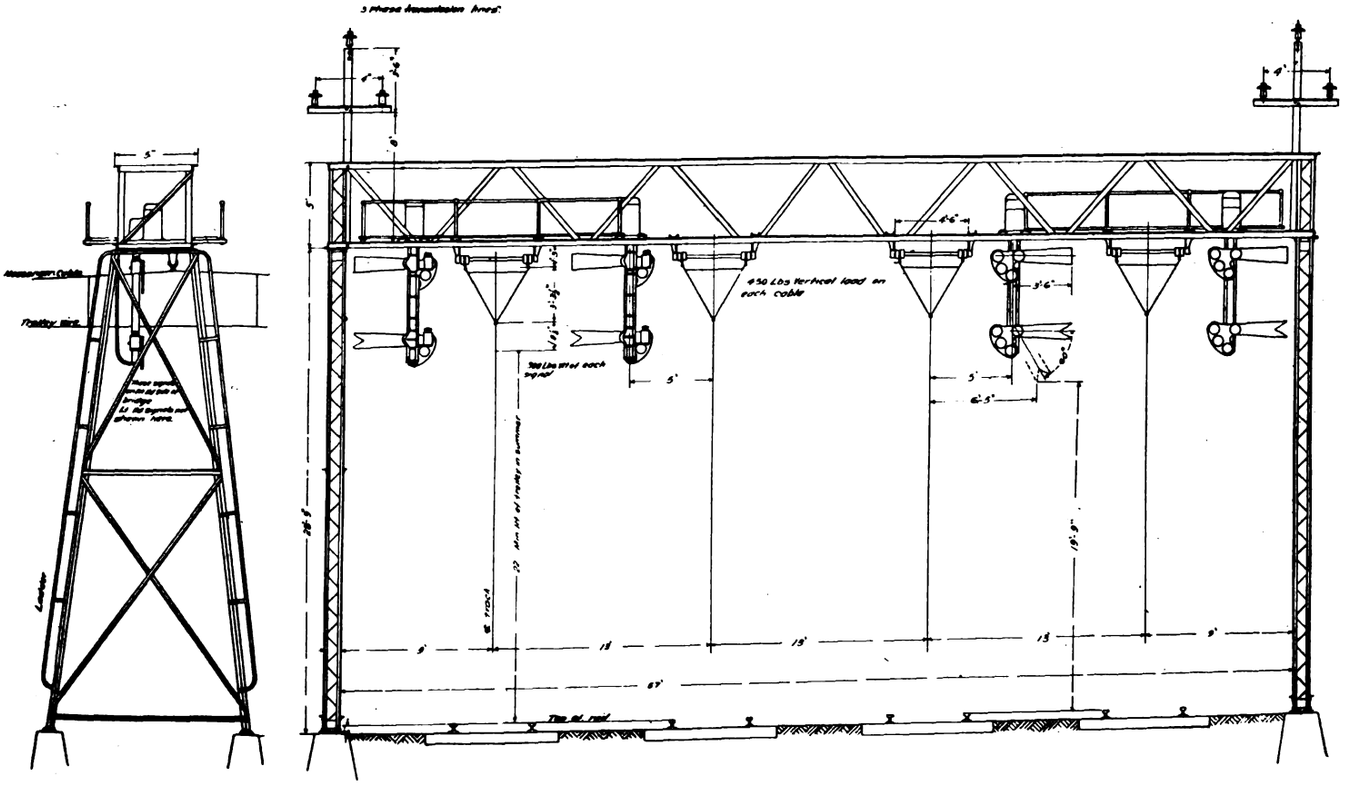


FIG. 17.—SIGNAL BRIDGE FOR FOUR-TRACK ROAD.

Digitized by Google

Massive porcelain insulators will be used mounted on heavy pipe and fitted with collars having soft lead strips under them. From these the cables will be hung by means of bolted clamps. By anchoring all cables to the bridges after being drawn up to a uniform tension, the effect will be to steady the bridges. For roads having wide rights of way comparatively light bridges steadied with guy cables may be used, but for most cases a substantial structure similar to those now used for signal towers will probably be preferable. It will be noted, however, that owing to the comparatively long intervals between signals only a few of the bridges carry semaphores; the others may be made lighter than the one indicated in Fig. 17.

Spans of 300 feet for straight tracks appear to be satisfactory, not being so long as to permit undue vibration in the cables, and not so short as to require a large number of bridges per mile.

For the messenger cables 0.625-inch

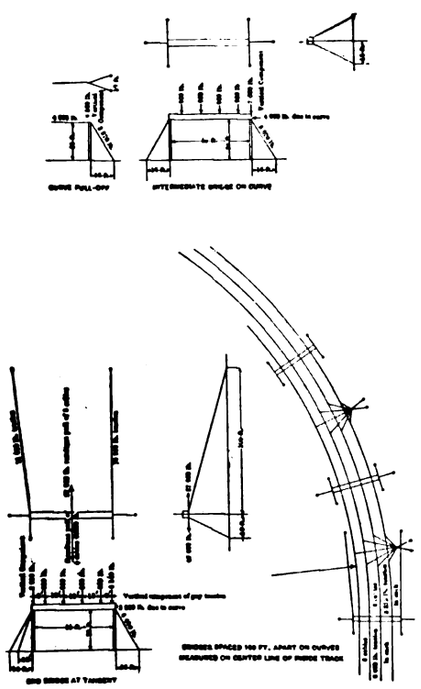


FIG. 18.—CURVE, 500-FOOT RADIUS.

extra high strength steel strands are suitable. With a 0000 grooved trolley wire and hangers spaced ten feet, the average load per foot on each cable is 1.43 pounds, and with a vertical sag of 2.7 feet the tension is 6,000 pounds. In a rough climate, wind and sleet will at times increase this tension; assuming that the tension may be doubled, a factor of safety of about 3.5 will still remain, as the breaking strength of the cable is about 40,000 pounds.

For use in localities where milder weather conditions may be assumed, lower grades of steel may be used having breaking strength for the same weight per foot of 25,000 pounds and 19,000 pounds. These latter cables are somewhat easier to

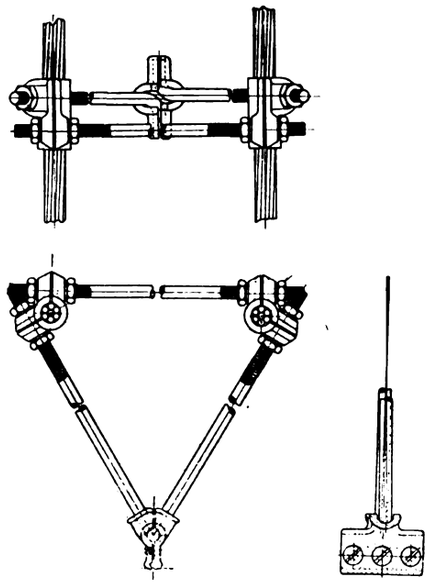


FIG. 19.—DOUBLE CATENARY ADJUSTABLE TROLLEY HANGER.

handle and would be sufficiently strong for most conditions.

The sag given above is taken to be the cold weather condition and for 100 degrees Fahrenheit rise the sag would be about 4.4 feet, or a variation of 1.7 feet. In Fig. 17, this allowance is made in the height of the bridge so that the lowest point of the trolley wire will be twenty-two feet above the track. It is not believed that the variation will be this much on account of the giving of the supports and other causes.

For curves, the length of span will be decreased; and when necessary to hold the wire in the centre of the track radial pull-offs will be used, secured to strain insulators. These will be mounted on latticed poles which in turn will be braced by guy anchors.

For sharp curves, the radial pull of all the messenger cables would be severe, and it is intended to provide at the tangent points anchor bridges which will have trusses stiff enough in the horizontal plane to stand the strain of slacking off the cables about one-half. These anchor bridges will then be held by long guys running out a considerable distance from the bases of the bridges and anchored to cross-ties or channel-irons buried in the ground and concreted. Fig. 18 represents in outline a 500-foot radius curve.

Several details for the double catenary construction are shown in Figs. 19 and 20. All of the metal parts other than the bridges and trolley wire are galvanized, but as a further protection against depreciation from locomotive fumes periodical painting is advisable.

Regarding the efficiency of the insulation employed, it may be stated that under the snow-clad conditions indicated in

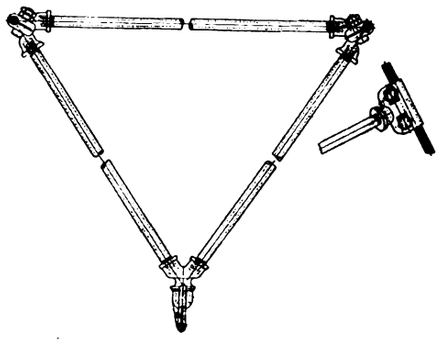


FIG. 20.—DOUBLE CATENARY CURVE PULL-OFF

Fig. 15, the 2,500 feet of iron bridge work and five miles of single catenary construction showed under test a leakage of one ampere at 6,000 volts.

CONCLUSIONS.

The foregoing describes the actual work which has been carried out with a view of

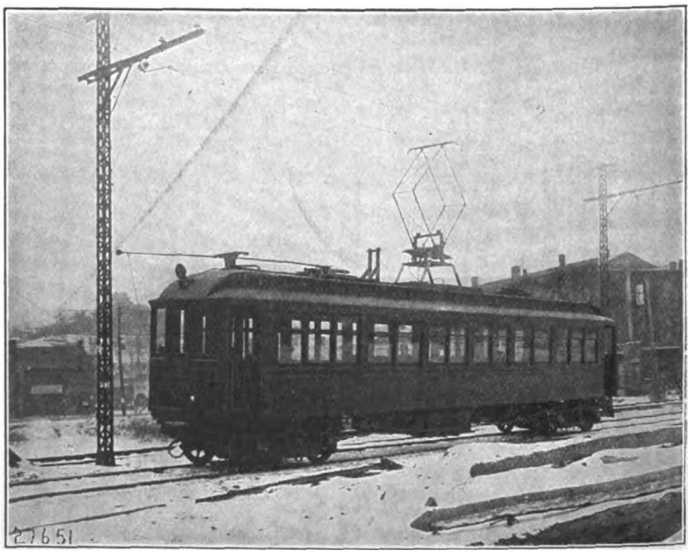


FIG. 21.—HIGH-PRESSURE PANTOGRAPH TROLLEY.

developing a system of overhead conductors for moderate and heavy traction service which will approach in a far greater degree than heretofore the reliability and

Digitized by Google

permanency of present steam railroad equipments.

Aside from the work described above, forty miles of road using the single catenary wood-pole construction have been put in operation in Indiana. This has been in successful running order since the first of this year. The remaining sixty miles of this road will probably be completed in the near future. The pressure is 3,300.

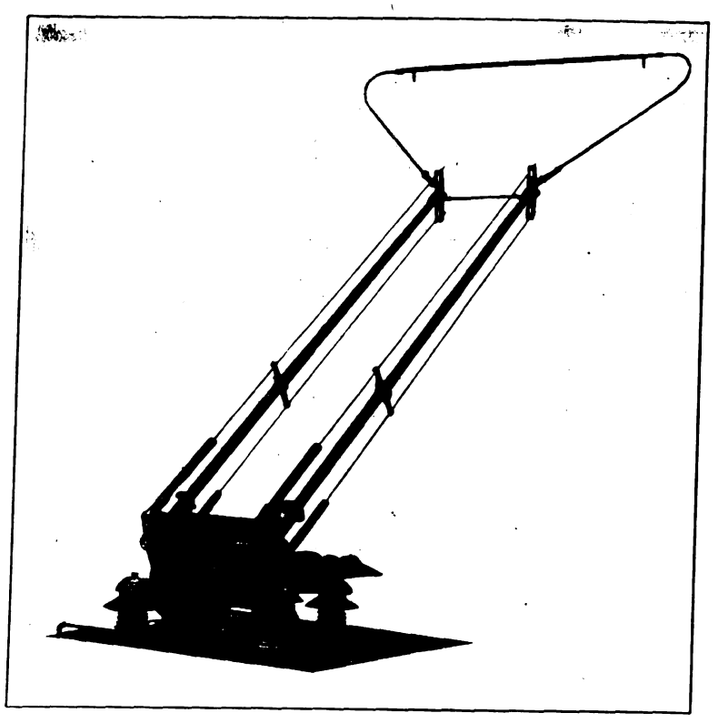


FIG. 22.—SLIDING-BOW TROLLEY.

Fig. 22 is of interest in showing the type of air-operated sliding-bow trolley in use on this road. Another form of trolley with which satisfactory results have been obtained is shown in Fig. 21. It is also air-operated and is insulated for 6,000 volts.

Application of Electricity to Heavy Freight and Trunk Line Railways.

On Tuesday evening, April 18, Mr. J. H. Hallberg delivered an illustrated lecture on the "Application of Electricity to Heavy Freight and Trunk Line Railways" before the Electrical Engineering Society of Columbia, at the Columbia University, New York city.

The lecturer described in detail all electric systems which have been proposed and tried for trunk line service, and a number of lantern slides, illustrating the 15,000-volt single-phase railway developments carried on by the Oerlikon Electric Company, of Zürich, Switzerland, under the direction of Mr. Emil Huber, were the subject of an interesting description and discussion.

The electrical equipment for the New York Central Railroad, now being manufactured by the General Electric Company, was also illustrated by lantern slides, and an enthusiastic discussion followed the description of this system.

Mr. Hallberg also had prepared for the occasion a number of special slides, illustrating the Siemens & Halske locomotive, used for the high-speed electric railway tests between Marienfeld and Zossen, and others, showing in diagrammatic form the power and distribution equipments required for the various systems.

One of the most interesting subjects discussed during the evening was the single-phase to polyphase electric railway system which has recently been invented by Mr. Hallberg, and which has already been described in the electrical press. The important feature of this system is that it is possible to build very powerful locomotives which can be operated with only one contact wire delivering high-voltage single-phase current to the locomotive, on which the current is then converted by means of a motor-generator set into polyphase currents suitable for the polyphase induction motors, which are mounted on the driving axles.

As all generating and transforming apparatus are of the alternating-current type, no commutators will be required, and the use of induction motors on the locomotive eliminates altogether the use of commutators for any of the main generating or driving machines for this system, and which was considered an important feature.

Considerable attention was also given to the various forms of construction for overhead contact wires for high-speed trunk line railway service, and the inverted catenary construction developed by Mr. Huber of the Oerlikon company was favorably commented upon, and the general opinion was that it would be preferable to make contact on the top of the contact wire, as suggested by Mr. Huber, instead of using the ordinary catenary suspension, which makes it necessary to collect current from the underside of the contact wire.

The speaker also agreed with Mr. C. O. Mailloux and Mr. Damon in that nothing less than 15,000 volts should be used for heavy trunk line traction, and it was also thought that the use of more than one wire for each track would be prohibitive. In other words, the straight three-phase system, requiring either two or three trolley wires for each track, would not be considered as a general proposition.

Mr. Hallberg also commented favorably upon Mr. Mailloux's suggestion to generate current at about 15,000 volts, which could be distributed directly to the contact wire wherever necessary, instead of generating current at a low voltage and then stepping up to a very high voltage for the transmission lines and again reducing the pressure at substations for the contact wire. Where large amounts of power are generated, as for a large trunk line railway system, it would perhaps be more economical to generate and distribute directly to the contact wire without the use of high-potential transmission lines and substations.

Professor Fitzhugh Townsend took active part in the discussion, and several interesting references were made by him to the bipolar motors designed by the General Electric Company for the New York Central locomotive, and he explained very clearly why those motors operate under greatly varying loads and other unfavorable conditions without sparking. He also pointed out several advantages of Mr. Hallberg's single-phase to polyphase railway system.

Mr. Karl Wersall, an electrical engineer, until recently in the employ of the Oerlikon company at Zürich, also participated in the discussion, and he pointed out several of the advantages of the Huber inverted catenary contact-wire support, and he also referred to the sucessful operation of the Oerlikon 15,000-volt single-phase locomotive, which is equipped with the Ward-Leonard system of control, and which has been in daily successful operation during the past few months on a section of the state railways in Switzerland.

Digitized by Google

The Faraday Society.

The thirteenth ordinary meeting of the Faraday Society was held on Tuesday, April 4, 1905, at the Institution of Electrical Engineers, London, England, Professor A. K. Huntington being in the chair.

Mr. A. H. Hiorns read a paper entitled "Alloys of Copper and Bismuth." The reading was illustrated by lantern slides of the photomicrographic observations referred to in the paper.

This is further research on copper alloys carried out in a similar manner to that on the copper-arsenic series published in the Transactions of the Society, April, 1904.

Professor Arnold has investigated the effect of bismuth, from 0.1 to 0.5 per cent, on copper, and found that the investing membranes surrounding the grains of copper appeared to be split down the centre, presenting a definite plane of cleavage. Dr. Gautier obtained a freezing-point curve similar to the author's but his temperatures are generally higher.

The microscopic evidence mainly confirms the records of the freezing-point curves, of which there are four branches. We have pure copper and pure bismuth at the extremes, and solid solutions of copper in bismuth or bismuth in copper at intermediate points. The types of pattern on the etched surfaces depend on the position of the freezing points on the curve. The eutectic points occur at 243 degrees centigrade and 1,020 degrees centigrade, with a transition point at 858 degrees centigrade. From this point with increase of bismuth in alloys containing thirty to forty-three per cent of copper, the curve is practically a horizontal line showing little differences in the freezing points. In the region two possible chemical compounds may be present, *viz.*, Cu_3Bi_2, and Cu_2Bi, but there are no well marked indications of such, either in the freezing-point curve or in the microsections. Such compounds can therefore only exist in contact with solutions containing excess of bismuth.

The above mentioned transition point is the transition point between solutions of copper in bismuth and bismuth in copper, and at this point the two solutions have probably the same freezing points, each being lowered by the addition of the other, thus forming a conglomerate of the two mixed crystals, which here exist in equilibrium.

Copper, with small percentages of bismuth, consists of polygonal grains, the boundaries of which contain a thin line of bismuthide. When such copper is broken the line of fracture follows this line. With two per cent bismuth the surface shows a characteristic eutectic structure. With increase of bismuth gradually widening boundaries to the grains appear and the interior is of a eutectic nature, which also increases with the addition of bismuth. With seventy-five per cent bismuth the whole surface is composed of grains of the two solid solutions, one of a light gray and the other of a light red color. With sixty to sixty-seven per cent bismuth the alloys are composed of the two solid solutions mentioned above, with the addition of dark blue grains, probably the compound Cu_2Bi. With seventy to ninety per cent of bismuth there are two main constituents, consisting of the red solid solution in a eutectic mixture. With 97.2 per cent of bismuth the whole is decidedly a eutectic mixture. The structure of alloys containing ninety-eight per cent bismuth and upward resembles pure bismuth.

The chairman drew attention to the fact that previous observers had not noted the eutectic point of pure copper and copper bismuth solution at 1,020 degrees centigrade, shown at D on the author's cooling curve. He hoped Mr. Hiorns would make his study more complete by systematically examining chilled alloys as Heycock and Neville had done in the case of the copper-tin series.

Dr. C. H. Desch remarked that the photograph of the 0.4 per cent bismuth alloy was the best that had yet been published.

Professor E. Wilson thought that a further study of the 0.4 per cent alloy might throw some light on the well-known influence excited by bismuth in the conductivity of copper.

Mr. Hiorns, in reply to the chairman, said that repeated experiments justified his belief in the existence of the eutectic at 1,020 degrees centigrade.

The discussion was taken on the paper by Mr. E. Kilburn Scott, entitled, "Refractory Materials for Furnace Linings," which was read on January 31 last.

The requirements of a good refractory material are as follows:

1. It should be a poor conductor of heat.

2. It must be mechanically strong over a wide range of temperatures.

3. It must stand the reducing action of the charge; particularly of carbon.

4. If used in an electric furnace, it must be a non-conductor, even at high temperatures.

Refractory materials are classified as follows into four groups. The paper deals with the second and third groups, and particularly with the use of electric furnace products as furnace washes over ordinary linings.

1. Carbon; for the highest temperatures.

2. Silicon carbides.

(*a*) Carborundum (Crystallized Silicon Carbide, SiC)—This has established an excellent reputation as a furnace wash. The binding material mixed with the finely ground carborundum is silicate of soda, for washing ordinary firebrick, or for coating iron, and fire clay in the case of basic materials. Nothing but carbon —preferably charcoal—is known at present for use at temperatures above the decomposition point of carborundum.

(*b*) Siloxicon (SiCO)—This is to a certain extent self-binding, but it is best to add alumina, and in certain cases non-alkaline clay, if desired to make up articles that can be baked before use, and if used for linings, either silicate of soda or coal tar as binding materials; it is then baked in position. Siloxicon is very refractory, and inert in its chemical action. It decomposes at 3,000 degrees centigrade, forming silicon carbide.

(*c*) Amorphous Silicon Carbide—Being a fair conductor of heat, this is best used merely as a wash over ordinary firebricks, as should all silicon carbides. The best binding materials to use are glue, sodium silicate or gas tar, according to circumstances, or the particles of carbide may be fitted together by surface oxidation.

3. Crystallized Magnesite—Ordinary calcined magnesite brick is now recognized as the best material for lining basic open hearth furnaces, cement kilns, etc., on account of its durability, freedom from moisture and silica, and resistance to corrosion. The native magnesium carbonate is usually calcined in a kiln, but the temperature is insufficient to shrink it thoroughly. The paper describes experiments made by the author in shrinking magnesite in some calcium carbide furnaces at Meraker, in Norway. It was possible simply to pass the magnesite down the chutes in the same way as the raw materials for making carbide of calcium. After a two hours' run with 3,500 amperes at sixty-five volts a block, about fifteen inches cube, was obtained, which was practically pure crystallized magnesia. Thus to make three hundredweights of crystallized magnesite took about 300 horse-power for two hours.

It has now been tested as a wash over the firebrick lining of a carbide of calcium furnace, and it was found that the bricks lasted for two hundred hours with-

Digitized by Google

out repair, whereas the unprotected bricks required repair after a five hours' heat. The author is of the opinion that the crystallized material, without further preparation than being crushed to suitable dimensions, will prove of special value as a refractory material in metallurgical practice.

4. Ordinary firebricks, for the lower range of furnace temperatures.

Mr. H. N. Dains (communicated) gave some comparative analyses showing the differences between Indian, Grecian, Styrian and American magnesites. The great refractoriness of the first was due to the small amount of impurities it contained. Magnesite shrunk in the electric furnace certainly gave the most satisfactory results and in support of this contention he quoted several striking instances. The principal use of burned magnesite was for lining open hearth steel furnaces, converters, rotary kilns for cement manufacture, furnace hearths, crucibles, and refractory bricks. The power consumption given by the author was incorrect, because the experiment quoted was carried out on lightly calcined magnesia that had been lying about and had taken up about twenty per cent of CO_2 and water.

Mr. F. Gelstharp (communicated) said that if a material could be found to withstand the action of tri-silicate of soda and lime at high temperatures, and at the same time would not oxidize, it would be a great boon to glassmakers. None of the materials mentioned by the author was suitable for the port-holes of tank glass furnaces.

Mr. W. Murray Morrison hoped the author would furnish them with further more exact data regarding the temperatures the various refractory materials could stand, their mechanical properties and their heat conductivities. Tar was the best binder to use for high temperatures, and the increase of conductivity it caused was unimportant; but something that would help the refractoriness of the material would be preferable.

Mr. L. Gaster said that a siloxicon wash was insufficient for lining cement kilns, for example; hard bricks of the material were necessary.

Mr. R. Cremer found, after much experience, that silicate of soda was a perfect binder for carborundum. He considered carborundum as good a refractory material as any that had been described, and its mechanical properties were excellent.

Mr. R. S. Hutton said that if magnesite were calcined in an electric furnace the CO_2 given off would rapidly consume the electrodes. But there was another "shrinking" in the sense of increasing the specific gravity, and to this true shrinkage the valuable properties of magnesite (as of quartz) were due; this was the best effected by fusion in an arc furnace, and Moissan had obtained a magnesite of specific gravity 3.654 in this way. In the author's experiments the magnesite was never more than in a semi-plastic condition; magnesia was easily melted in the electric furnace at something above 2,000 degrees centigrade. Electric furnaces, contrary to what had been said, did not require such highly refractory linings as ordinary furnaces, because the material itself should be the effective lining. More information on the thermal conductivities of these materials was needed.

Mr. R. S. Hutton and Mr. W. H. Patterson contributed a paper entitled "Electrically Heated Carbon Tube Furnaces" (part i).

This type of furnace seems to be the most readily available for the very highest temperatures, and the authors have been able to get satisfactory results with a very simple type of construction. The important points to bear in mind are the end-connections (which must be kept cool), protection of the tube from contact with air, and heat insulation. Two types of furnace are described.

1. Graphite Tube Furnace—This is bored from a solid rod of Acheson graphite and screwed into graphite plates which form the end-connections, the latter being clamped to copper holders. The central thinner portion of the tube is surrounded with carborundum or other heat insulator, and the material to be heated is placed in small carbon boats. In a 1.5-centimetre tube (internal) 320 amperes at 9.6 volts melt platinum in sixteen and one-half minutes.

2. Agglomerated Carbon Tube Furnaces—These are more suitable than the former type when much experimental work has to be done, and the tubes can be readily obtained. The ends of the tubes (which are too hard to be worked) are coppered electrolytically and soldered to copper tube extensions provided with water-jackets to keep the joint cool. Into these the current is led by copper clamps, and glass tubes for the passage of gases, etc., are connected by means of rubber stoppers. Carborundum kept in place with an external asbestos tube serves as the jacketing material, as before. Tube furnaces up to sixty-seven millimetres internal diameter have been successfully made. It is hoped to use these in a vertical position, so that large crucibles may thereby be heated. In such a tube 850 amperes at thirteen volts melt nickel in twelve minutes and platinum in twenty and one-half minutes.

In a special tube furnace for experiments in atmospheres of pure gases (free from carbon monoxide), the furnace proper is surrounded by an outer jacketed carbon tube, also provided with water-cooled copper extensions, and the joint between the two is gas-tight. Hydrogen is passed through the space between the tubes.

In a later paper full details as to current and temperature measurements will be published.

Mr. L. Gaster remarked on the ease with which graphite can be machined.

Mr. A. H. Hiorns hoped to adopt some of the valuable suggestions given in the paper in his own laboratory.

Mr. W. Murray Morrison considered that the water-cooled terminals were a great advance on previous modes of construction, and brought small electric furnaces within the scope of almost any laboratory. The ease of regulation in the author's furnaces was another noteworthy feature.

Mr. F. Hiorth drew the attention of the meeting to the wonderful natural facilities which his country (Norway) offered for the development of industries in which the electric furnace was an all-important factor.

The Century's "Great Inventions" Series.

The May *Century* will contain the story of "The Arc Light," by Charles F. Brush. This is the first of a series of papers on great inventions, described by their inventors. Mr. Brush gives in detail the history of arc and incandescent lighting, his own early experience and experiments, the beginnings of public lighting by electricity, the growth of the industry, and the organization of the Brush Electric Company.

In early numbers of the *Century* there will be papers on "Electric Traction," by Frank J. Sprague; "The Transmission of Power," by Nikola Tesla; "The Air Brake," by George Westinghouse, and descriptions of two important engineering projects, one of them the Simplon tunnel.

Interurban cars around Pittsburg are equipped with long-distance telephones which may be connected to a wire alongside the track and communication had over the Bell system.

Digitized by Google

The Application of Electricity in the New York Hippodrome.

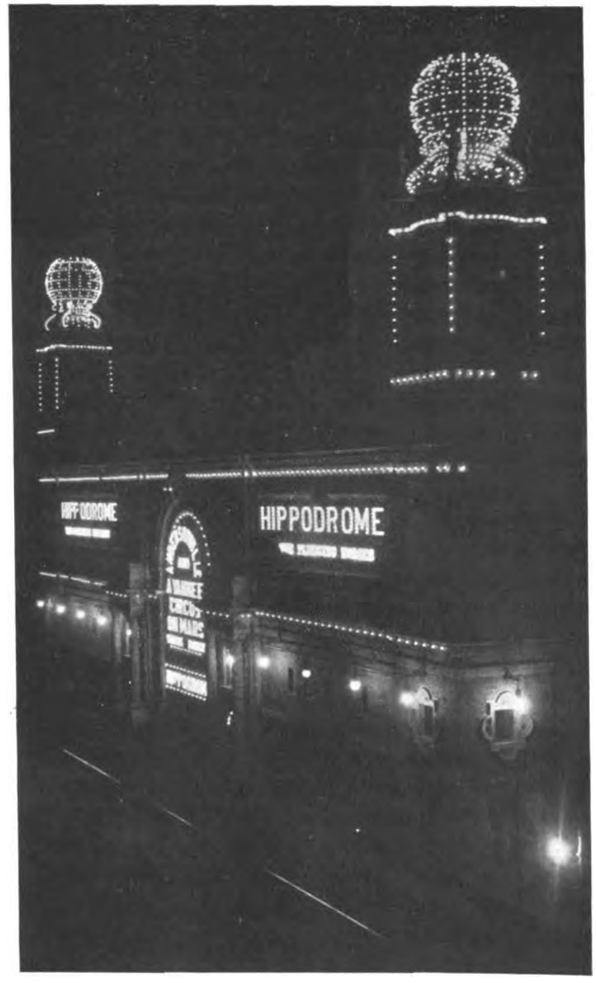
THE New York Hippodrome, which was opened to the public quite recently, occupies the entire block on Sixth avenue extending from Forty-third to Forty-fourth street. The building has a frontage of 200 feet on Sixth avenue, and extends 240 feet east on Forty-third and Forty-fourth streets. It is constructed of brick, marble and steel. The height on Sixth avenue is seventy-two feet, and 110 feet over the stage. The seating capacity of the building is 5,200 persons.

A novel feature of the Hippodrome is the stage. This consists of two portions. Behind the proscenium arch the stage is fifty feet in depth by 200 feet in width between the side walls. The stage extends in front of the proscenium arch for a distance of sixty feet. This portion is known as the apron, and is generally elliptical in form. It has a total width of ninety-two feet.

The portion of the stage immediately behind the proscenium arch is capable of a movement of eight feet vertically. The platform is carried upon four plate girders. At the intersection of the girders are placed four twelve-inch plungers, which may be raised and lowered by hydraulic power. This portion of the stage may be either raised as a whole or in sections.

The movable portion of the stage is provided with counterweights. Sheaves for the counterweights are placed at the top of the steel columns which are used as guides for the platform. The guides are built with a slot in which slide dogs, which may be given a horizontal movement and lock the stage at any desired elevation. The dogs are operated in unison. They are driven by two lines of countershafting extending the entire width of the stage. One of these countershafts is at the forward, and the other at the rear end of the stage. A motor is at the centre of each countershaft, and drives it through a worm gear. The countershaft carries a small pinion at each dog, the pinion engaging with a rack on the upper side of the dog. When the motor is started, the dogs are simultaneously moved to a locking position.

The necessary hydraulic pressure to raise and lower the stage is furnished by a Deane geared, triplex, motor-driven pump, with cylinders three inches by eight inches. The pump is located in the basement under the stage. It is driven through double reduction gearing by a forty-horse-power, 220-volt motor running at 650 revolutions per minute. The motor is controlled by one of the Otis Elevator Company's magnet regulators. The pump delivers water to a pressure tank in which pressure is maintained at 1,000 pounds per square inch by two accumulators. These accumulators consist of massive weights supported on the top of a steel plunger working in a cylinder. They are electrically connected with the magnet regulator, and stop and start the pump.



EXTERIOR OF NEW YORK HIPPODROME AT NIGHT.

The portion of the stage in front of the proscenium arch also has a vertical movement. Like the other portion, it is carried on twelve-inch plungers, but has a vertical motion of fourteen feet instead of eight. The normal position of the apron will be at the same level as the main stage. Beneath it is built a steel and concrete tank about fourteen feet in depth, and of such dimensions that the apron will readily sink into it. When it is desired to give aquatic performances, the movable apron is lowered to the bottom of the tank, which is then filled with water.

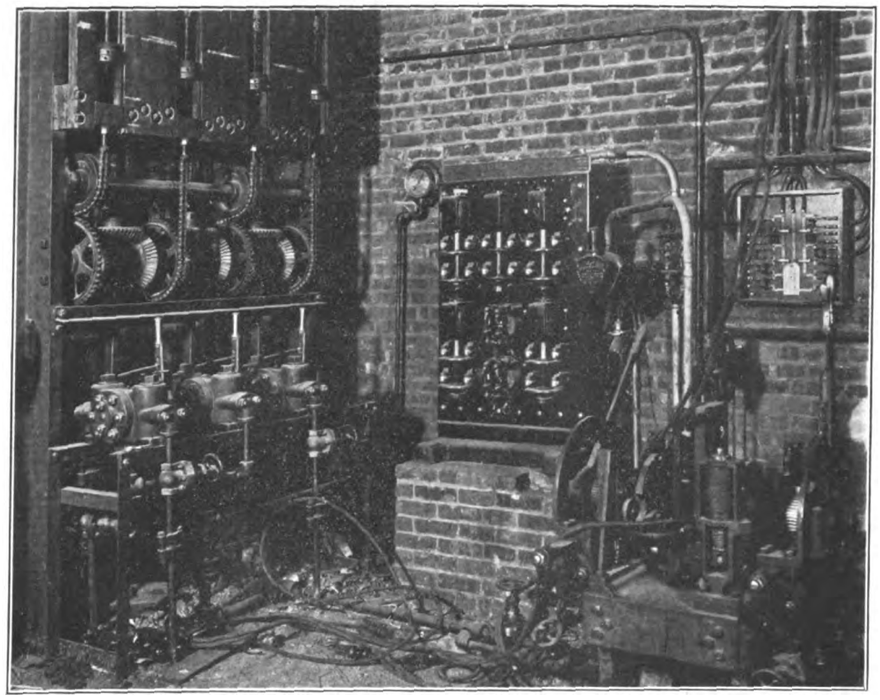
The tank is supplied with water by three centrifugal pumps, which have a combined capacity of 8,000 gallons per minute. These are installed directly under the stage. Two of the pumps are size six, and one is size eight. The size six pumps are direct-connected to C. & C. direct-current motors of eighteen horse-power, running at 620 revolutions per minute, at 230 volts. The size eight pump is direct-connected to a forty-horse-power, 230-volt, C. & C. motor, running at 410 revolutions per minute. The discharge pipe of the size six pump is six inches, and of the size eight pump, eight inches in diameter. All three pumps discharge into a twelve-inch main running to the tank. The motors are controlled by means of Ward Leonard starting boxes, there being two fifteen-horse-power and one thirty-horse-power boxes installed.

In the basement, under the stage, are also installed the fans for ventilating the building. These fans are four in number, and were built by the American Blower Company, of Detroit, Mich. The fans are sixty-six inches in diameter, and deliver air to all parts of the building. Each fan is driven by a twenty-five-horse-power, 230-volt C. & C. motor, running at 585 revolutions per minute, which is belted to the fan. Each motor is controlled by a twenty-five-horse-power starting box furnished by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

There are also in the basement boilers for heating, and other auxiliary machinery. The boilers—two in number—are of 250 horse-power, and operate at seventy pounds pressure. They were built by the Stirling Company, New York city. The boilers are in a vault directly under the Forty-third street sidewalk. Coal is dumped through the sidewalk into a coal bin at one end of the vault, and is wheeled from there to the front of the boilers.

Digitized by Google

Feed-water is supplied to the boilers by two Deane triplex steam pumps, seven and one-half by five by six inches. The water passes through a feed-water heater before entering the boiler. All the pumps



EQUALIZING AND CONTROL MECHANISM FOR STAGE LIFT, NEW YORK HIPPODROME.

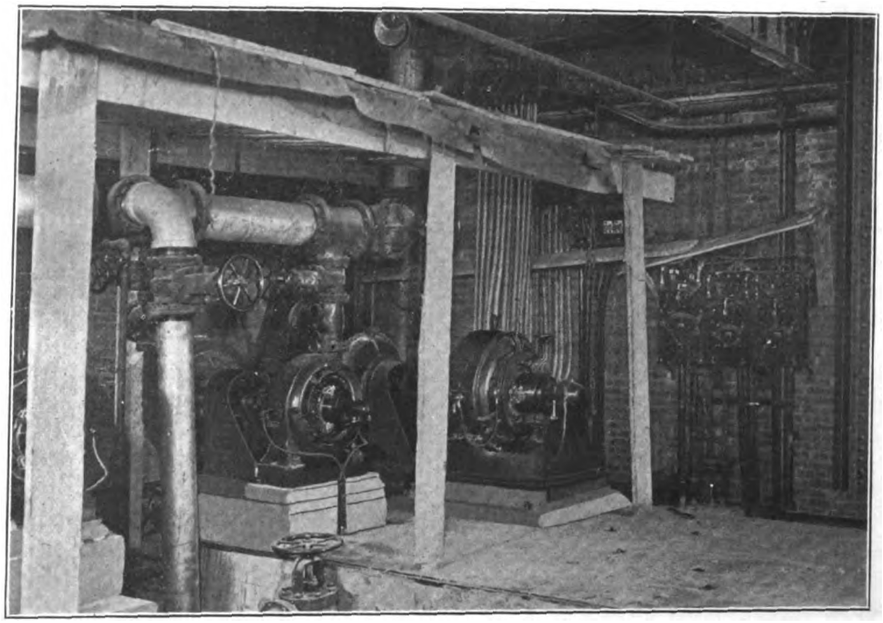
in the house exhaust to the heater, and some live steam is used as well. Besides this heater there is in the boiler room another water heater used for the purpose of heating the water for the house supply. This is run entirely with live steam.

Three other pumps are installed, two of them being used for fire purposes, and one for the house supply. The fire pumps are ten by six by twelve-inch Deane duplex pumps, and are fitted with self-starting pump governors. These pumps deliver water to a 30,000-gallon tank placed on the roof, and also to six four-inch standpipes in various parts of the building. These pipes may also be supplied from the storage tank. Automatic sprinklers are placed in all portions of the building excepting in the café and auditorium, and numerous hose are connected to the stand pipes. The pump in the pump room is a Deane duplex, eight by four by six inches, and is used entirely for the house service.

In the pump room is placed a three-panel switchboard for the Edison service supplying the building. Current is taken from this board to the light and power switchboard on the stage, and also to another switchboard in the pump room, from which all the lights and motors in the basement are controlled.

Electricity is extensively used in the Hippodrome for the handling of scenery. Underneath the gridiron over the stage are four tracks arranged in concentric semi-circles. These run from a pocket behind the side wall on one side of the stage to a similar pocket on the other side. The track is formed of twelve-inch I-beams, upon the lower flange of which run trolley hoists, which are used for handling set pieces of scenery. The hoists are fitted with two-horse-power traverse motors, and one three-horse-power hoisting motor. The traverse motors are each fitted with a drum, around which a cable is wrapped, and are moved by winding up on the cable. All three motors are controlled from the floor by means of pull-ropes operating reversing switches on the hoist.

For lifting the set pieces of scenery there is installed in each of the wings a set of hoists, each of which carries eight winding drums about a foot in diameter. To each set of eight drums there is a three-horse-power, 220-volt Robbins & Myers motor running at 1,350 revolutions per minute. This drives a shaft extending the length of the hoist frame. The shaft of each hoist drum carries a worm-wheel which is driven by a worm on a vertical shaft. On the upper end of this vertical shaft is a paper cone. The horizontal shaft to which the motor is coupled carries two wooden cones at each winding drum, which are located on opposite sides of the cone on the worm-shaft. Either of the cones on the main shaft may be thrown in contact with the cone on the worm-shaft by means of a lever which latches as soon as contact is made between the tow cones. The use of the two cones permits the drum to be driven in either direction. The wire cable which is wound on the drum passes through a slot in the cone-shifting lever. A knob is placed on the cable at such point as it may be desired to stop it. This knob, striking the cone-shifting lever, unlatches it, and it is thrown into mid-position by springs, thus disengaging the friction cones and stopping the hoisting drum instantly. Knobs are placed on the cable so as to stop the drum at the proper point, both in hoist-



MOTOR-DRIVEN CENTRIFUGAL PUMPS, FOR FILLING TANK, NEW YORK HIPPODROME.

Digitized by Google

ing and in lowering. Each drum is capable of lifting a weight of 800 pounds. There is a total of sixty drums installed. Each bank of sixteen drums is operated by one man. The motors are controlled by Ward Leonard starting boxes placed on panels immediately adjoining the hoists.

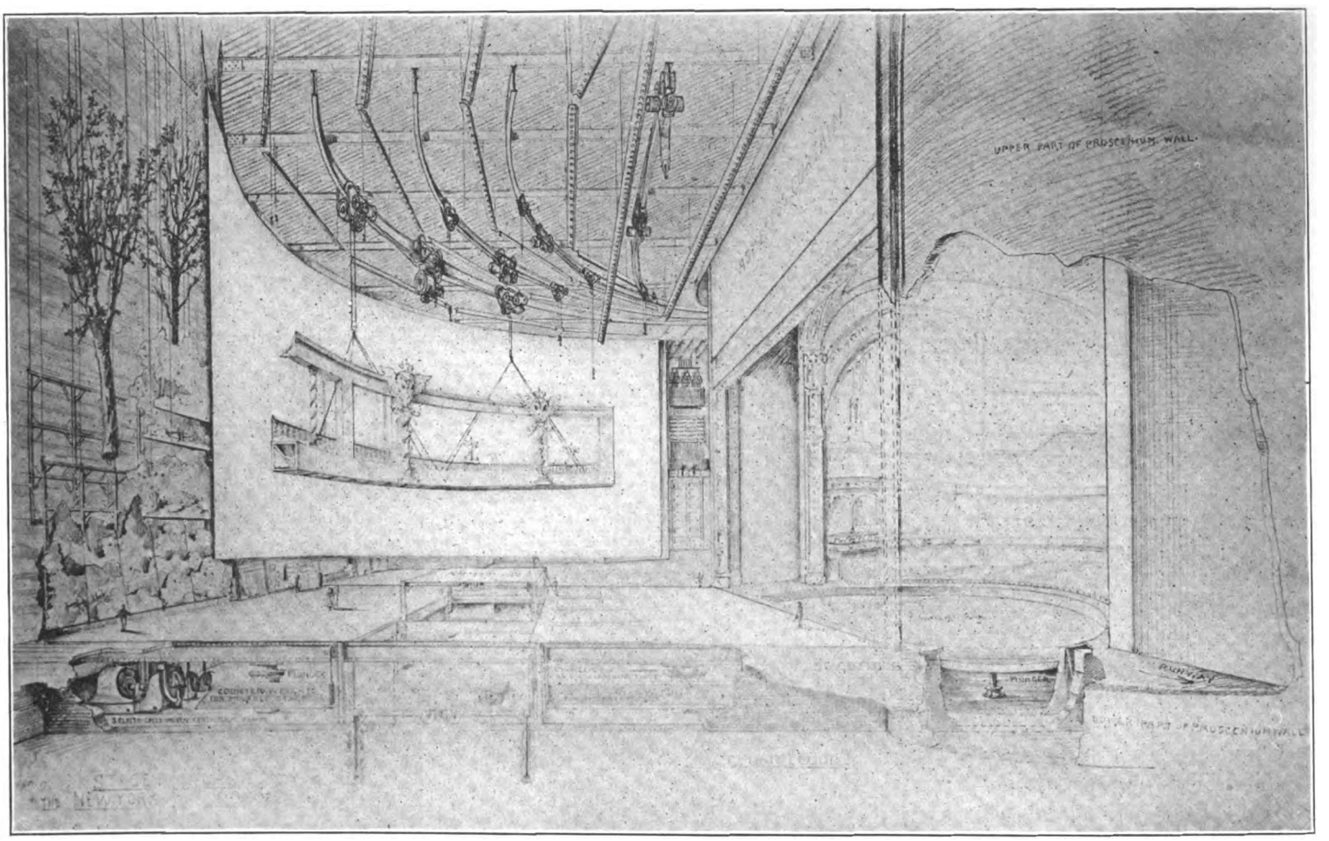
The most interesting portion of the electrical equipment at the Hippodrome, however, is the switchboard for controlling the lights. This is located in one of the wings on a gallery about twenty feet above the floor. The operating board consists of two panels, on which are installed 162 push-button switches. These switches operate solenoid switches on a switchboard in the rear of the operator's board. These solenoid switches were furnished by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Current for the lighting circuits passes only through the solenoid switches, the operator controlling directly only the current energizing the solenoids.

Current for energizing the solenoids is controlled by a separate panel at the left of the operating board. This panel carries a three-pole, single-throw switch, which closes the circuit which controls the current for all the solenoids. The current is taken from this switch to eight other sets of switches, which control various separate banks of solenoids controlling the different colored lights.

On the operating board the push-button switches are arranged in duplicate—that is, there are two sets of switches for each circuit, so that the lights for one act may be set while another act is being performed. In order to prevent interference with the act that is being performed, the push-button switches which are being set are disconnected from the solenoids by one of the sets of switches on the solenoid control panel at the left. When it is desired to throw in the new set of lights, one switch is thrown open on the solenoid control board, and the other is closed. This duplication of the circuits prevents any loss of time in arranging the lighting effects for a given act.

The operating panel is divided into two parts by the dimmer handles. There are two rows of dimmer handles between the two portions of the board, and another row at the top and bottom. The operation of the dimmers is something entirely new in theatre work. On a framework behind the switchboard are mounted four one-quarter-horse-power Holtzer-Cabot variable-speed motors. These motors drive a screw carrying a nut. The nut is connected by a link to a lever on the shaft of the dimmer handles, causing it to rotate as the nut moves either forward or back. On the framework underneath the screw is placed a snap switch which is thrown by the nut whenever it reaches the end of its travel in either direction. This switch cuts the current off from the motor, and thus prevents injury to the dimmers in case the operator neglects to stop it in time. The switch is so arranged that, in cutting off the current from the motor, it throws another portion of the switch in such a manner that the motor is permitted to run in the reverse direction.

Each bank of dimmers controls a set of different colored lights, the colors in use being white, blue, green and red.



SECTIONAL VIEW OF STAGE, SHOWING TRAVELING SCENERY HOISTS, NEW YORK HIPPODROME.

Each dimmer shaft carries a pulley, which is connected by a belt to seventy-six Ward Leonard 200-light theatre dimmers, located in a gallery above the switchboard gallery. These pulleys are controlled by interlocking handles, permitting any circuit to be thrown out if desired.

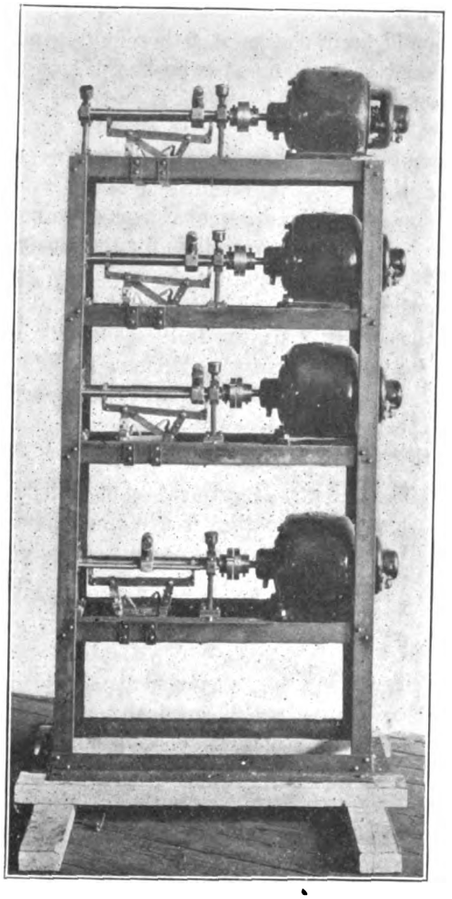
The motors operating the dimmers are controlled by four Cutler-Hammer starting boxes located on a panel set underneath the lower portion of the light board. The switches for the motors are set on a separate panel over the light board.

At the right of the main lighting board is another panel carrying a number of two

Digitized by Google

and three-pole switches. These control alternating current which is brought into the building on the Forty-third street side from the service of the United Electric Light and Power Company. This alternating current is used for the miniature lights and for decorative effects. In order to conform to the underwriters' regulations as to voltages for these lights, transformers are installed whenever it is necessary to operate at a low voltage, and the current is stepped down to whatever potential is required.

At a number of different points in the building are placed emergency switches, which control a master solenoid switch on the solenoid board. This switch throws on the glare lights around the proscenium and lights in various portions of the house. In case the operator is driven away from the main switchboard by fire, or otherwise, the house may be lighted from any one of these emergency stations. The current controlled from the emergency stations

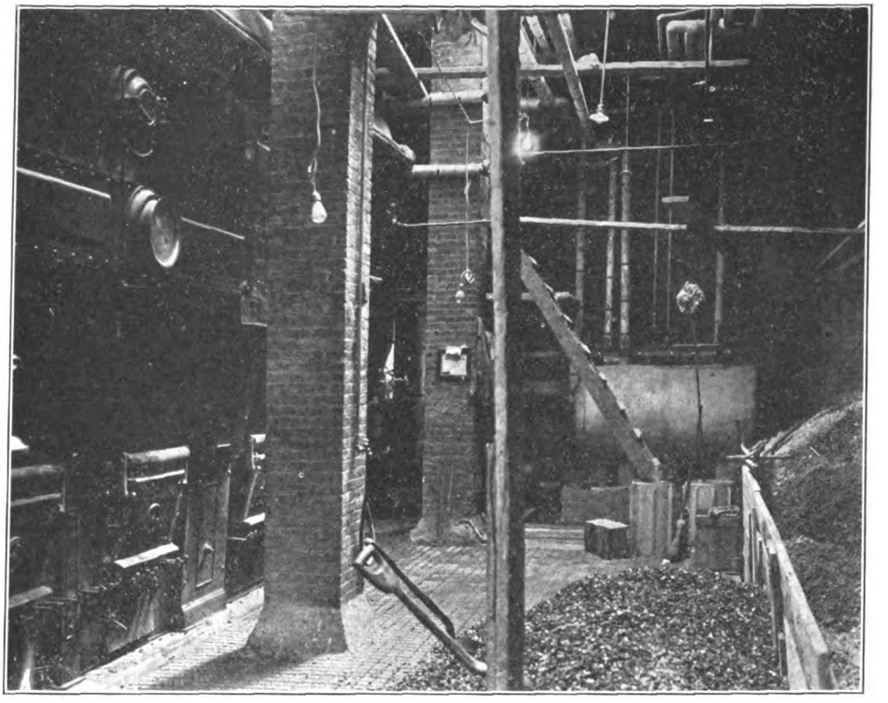


Motors for Operating Dimmers, New York Hippodrome.

is brought into the building from the Forty-third street mains, thus ensuring light at all times in case of an accident to the main supply.

The lighting scheme of the Hippodrome is novel, in that the switchboard is the largest ever employed for operating the lights in a theatre, and also because of the fact that this is the first use of motor-controlled dimmers in New York city. The total number of lights used in the entire building is about 25,000. Six hundred of these lights illuminate two globes located on the towers of the building, and 5,000 are arranged to form a sunburst over the auditorium.

The various portions of the building are connected by means of a telephone system.



Boiler Room, New York Hippodrome.

The prevailing ornament throughout the building is an elephant's head. These heads cap all the pillars, and are placed in every spot where they will be effective in the decorative scheme. The eyes are formed of incandescent lamps and each tusk is tipped with a lamp. A lamp is also placed in the centre of the forehead. Over the main entrance is a large head weighing two and one-half tons, and decorated in a similar manner.

The electrical work in the Hippodrome was done by the Lord Electric Company, Boston, Mass. This company designed the work under the supervision of Mr. Hugh Thomas, chief electrician of the Hippodrome, who is responsible for most of the novel features introduced.

Messrs. Thompson and Dundy, the proprietors of this remarkable enterprise, are justly entitled to the recognition which the public has accorded the Hippodrome. These gentlemen have done much in bringing about an appreciation of entertainment on a magnificent scale. In making use of the most modern agencies in the manipulation of the mechanical devices of the playhouse, and in utilizing so ably the wonderful possibilities of electrical lighting for illumination and decoration, an intensely progressive spirit has been manifested and rare courage shown.

THE PRACTICAL MANAGEMENT OF MAINTENANCE AND OPERATION OF A TELEPHONE EXCHANGE.[1]

BY C. E. STINSON.

The modern telephone exchange is a public necessity, and to so conduct it that patrons will be satisfied and business increase, while at the same time the maximum profit is derived for the investors, requires the closest managerial attention in all departments. The telephone business is a business of details, and no details should be neglected if the business is to be a complete success. To ensure successful management and proper attention to all details, the managerial work should be subdivided into departments, each under a responsible head, working harmoniously toward a common end and directed by a general manager of good executive capacity.

The practical maintenance and operation of a telephone exchange of 9,000 telephones illustrates the metropolitan idea of good service and management. The success of such an exchange, as a public institution and a profitable property, depends upon that attention to detail set forth in what follows.

The organization should consist of the following departments: managers, contract, record, operating, switchboard, wire chief, maintenance and equipment, construction and material, and supplies.

The manager, to do full justice to the

[1] Read before the Ohio Independent Telephone Association, Columbus, March 30.

Digitized by Google

exchange, should be thoroughly competent to take full charge of the entire operation and maintenance, involving the physical conditions of the property and the respective departments of the company. This is meant in a literal sense. The manager should be an infallible judge of the highest standard obtainable, in the way of maintenance; and he should be able to put that standard into effect in every branch of the business. It goes without saying that the ability to do this means practical knowledge of the most thorough sort. No detail of his department should escape him. He should have at his finger-tips a complete knowledge of the records, material, apparatus and operation; and a thorough understanding of aerial and underground construction and maintenance.

It may occur to you that I am demanding from the ideal manager a collection of almost impossible virtues; but such is not the case. The manager can not personally attend to these multitudinous duties, but he can surround himself with employés in charge of the different departments competent to carry out his ideas and let the authority radiate from him through them. To preserve the highest possible degree of excellence and service in discipline, he should confine his orders to the heads of the departments; trusting to their ability to transfer these orders to other employés.

The manager should look upon himself as being personally responsible to the subscribers of the company. The moment he begins to shift the responsibility for dissatisfaction on to some of his subordinates, that moment does he cease to be in fact, as well as name, the manager of the business. He is the head of the exchange, and as such should feel himself in duty bound to remove every possible cause for complaint against the service.

He should never make a useless rule, but having made a rule which he considers useful and necessary for the best conduct of the exchange, he should enforce the rule at all hazards. A rigid insistence on the observance of such rules need not be the cause of any friction or ill-feeling, whatever, on the part of the employés. If his stand be firm and unyielding—but generous—their respect for him will increase proportionately. Friction between the heads of the different departments is a deadly blow to the discipline of the exchange and should not be tolerated a day beyond the time when its presence is made manifest. The old rule: "I will have peace if I have to fight for it," is a pretty good one to follow, in preserving harmony between the several branches of the business.

If, in addition to this firm adherence to the discipline of the exchange and the steady insistence upon frictionless working between the departments, the manager lets it be known that employés will be promoted as vacancies occur, according to their ability, he will be in a fair way toward the establishment of a perfect organization. If the possibilities of promotion are thoroughly understood, you will find that the majority of the employés will look for promotion and an advance in salary; and as a result take infinitely more interest in their labors and in the affairs of the company. I believe that every department and every position in the exchange should have a fixed salary attached thereto.

The most successful manager is he who assumes that the plant, property and service are always in a condition which permits of betterment. If he will proceed on this theory—constantly preserving a critical attitude toward his own property—the company, the service and the subscribers are bound to benefit by it.

Such an attitude does not necessarily involve a steady increase in the pay-roll. It means rather a constant improvement in the class of employés for the better operation of the system of organization.

The maintenance of the switchboard and central office apparatus is, of course, a vital feature, inasmuch as it is the source of poor service and dissatisfaction to the subscribers. Let us suppose, for instance, that the cords on an operator's position at the switchboard become defective and are allowed to remain so for any length of time: in all likelihood, the manager will receive complaints of poor service; and after an investigation by him (through the proper department), he can only satisfy the subscriber by sending a repair man, change his telephone or wire, or make some other imaginary repairs.

This costs money and does not relieve the situation a particle and the expense incurred would help maintain the cords and remove the cause of the trouble. The very plain moral is: keep up your maintenance and it will increase your earnings and make everybody happy and contented. When your telephone exchange gives good service and is made to work properly, it will pay. This may sound like almost as much of a platitude as the old proverb "honesty is the best policy," but it is true nevertheless. The manager's own selfish interests and the best interests of the company should suggest to him that he satisfy his board of directors or superior officers, that he is seriously and sincerely striving every day and every night, and every minute of every day and every night, to render the company's subscribers the most perfect telephone service possible.

This, of course, can only be accomplished with a proper system of maintenance and operation. He must leave nothing undone that should be done; he must watch the individual department expenses and pay-rolls, overtime, light, heat, power, car fare, and all the other small expense items which usually go to make up a large maintenance account. Everything in the way of material and supplies should be standardized, for that is unquestionably an important saving in the cost of maintenance.

CONTRACT DEPARTMENT.

It is doubtful if there is a more vitally important department in the conduct of a successful telephone exchange then the contract department. The business of the company originates there and its affairs should be in charge of a thoroughly competent contract agent, who knows how to secure business for the company on the best possible basis. This contract agent should be responsible for the character of the contracts taken under the rates adopted for the different classes of service to be furnished; as well as for the moving of telephones, changing of equipment, discontinuance of service, etc.; and all orders issued should be carefully made out, so that no unnecessary work may be shouldered upon the construction or equipment department.

RECORD DEPARTMENT.

The record department should be in such a condition that it will immediately be possible to refer to any and all records of construction, maintenance, equipment, operation, etc.

OPERATING DEPARTMENT.

The operating department should be actually and not theoretically in charge of the chief operator. There should be, of course, proper rules for all the employés of this company covering the duties assigned them. The duties of the chief operator may be outlined about as follows:

To see that all employés are prompt and regular in attendance; to have order and quiet at the time the forces are changed; to preserve neatness in the halls and rooms of the building through which the operators pass; and, above all, to keep the operating room free from confusion.

The chief operator should keep in intimate touch with the work of every operator by personal supervision, from

Digitized by Google

monitors and supervisors' reports; and should absolutely insist that each operator furnish speed, accuracy and courtesy in this work. Meetings should be held at least once a month, for the purpose of explaining the necessity of the rules made from time to time, and also for the purpose of arousing in each employé an active and enthusiastic interest in her work. The students can be carefully selected and coached. They should be made thoroughly conversant with all of the rules and impressed with the necessity of observing each rule; and thoroughly schooled in the proper care and use of the apparatus before being assigned to duty.

The chief operator should impress upon the operators the importance of prompt answering, prompt disconnect signals, supervision, proper testing and ringing. She should make tests on all parts of the service every day, keeping a record of complaints against operators and advancing them according to their merit.[1]

She should also preserve records, enabling her to give accurate information regarding the telephone number, name, address, date of in and out of all exchange lines, and see that new numbers are assigned so as to properly distribute the load of work on the different positions. Business and residence telephones should be properly distributed, so as not to overload any individual position.

Traffic record should be kept on all positions one day each month, in order to know the actual amount of work done by each operator and the average number of calls from each subscriber. All these reports should be sent to the manager at the end of the month.

SWITCHBOARD DEPARTMENT.

The switchboard department should be in charge of a thoroughly practical and capable switchboard man, who assumes all responsibility of the proper maintenance of the switchboard, power plant, and all auxiliary apparatus in the exchange. Everything should be kept neat and clean and the maintenance should be kept in such a manner that there will be very little depreciation, other than the cords on the switchboard.

WIRE CHIEF'S DEPARTMENT.

Under the direct supervision of the wire chief, should be furnished an assistant and trouble clerk. He should be responsible for the supervising and testing of all circuits entering the exchange; oversee all terminals and cables entering said exchange; keep a record of all cable repairs and the O. K. of all orders going through his department, making the necessary daily reports of the amount of trouble and the kind to the manager. He should be thoroughly competent and capable of guarding against errors and giving of wrong information to the maintenance department, where the trouble is taken care of.

MAINTENANCE AND EQUIPMENT.

This department is under the direct supervision of the superintendent of equipment, whose duty it is to see that all orders from the manager (or record department), covering installation, removal of equipment, etc., are properly executed and that proper specifications are made covering their work; also the maintenance of all apparatus; all interior wiring, and exterior wiring not included in the work handled by the construction department.

He should oversee the proper distribution of supplies and material which is taken from the stockroom by the men in his department.

The maintenance and equipment departments should be divided into four subdivisions under separate heads, namely: chief inspector's department, private exchange, equipment and maintenance, shop and repairs, material and supplies.

The chief inspector should have direct charge of the cable testing and the location of all cable trouble, all trouble-men, installers and inspectors and a clerk who keeps the records of this work and the orders issued.

The duties of the superintendent of equipment are to see that all orders to his departments are promptly and properly executed, and to aid the employés in his department in improving their methods, etc.

The private branch exchange department and employés should be under the direction of the foreman who has direct charge of the installation and maintenance of private branch exchanges and special interior wiring of buildings. He should be provided with the necessary help to assist in this work.

CONSTRUCTION DEPARTMENT.

This department is under the direction of a general foreman, whose duty it is to see that the work under his supervision is performed in compliance with specifications. His work should cover all the outside construction of conduits, cables (aerial and underground), pole lines and all other outside property of the company. He is under the direct charge of the manager, to whom he makes report of all work done, and his reports should show the time, labor, material on construction and maintenance; all employés hired or discharged by him, subject to approval. He should be provided with a requisite number of men to properly perform this work; and be thorough and competent to decide as to the difference in construction and maintenance.

He should personally know every new line that is constructed; see that same is properly installed; and keep up the maintenance of pole lines, cables, etc., to a condition of betterment.

SHOP.

The shop should be under the supervision of a foreman and the necessary employés provided to make all shop repairs and tests of apparatus turned over to him by the different departments, including the mounting and building of new apparatus.

DEPARTMENT OF MATERIAL AND SUPPLIES.

This department should be in charge of a stockkeeper, under the supervision of the superintendent of equipment, in so far as the overseeing that the proper amounts of material and supplies are kept on hand and given out according to the orders issued. The stock and material should be well looked after and taken care of, and accessible only to the stockkeeper.

It might seem that I have suggested an embarrassment of system and details in this brief outline; but it will be found that the more firm and rigid the system, the greater the ease with which the business of the exchange will conduct itself. It is only the manager who departs from the idea of discipline, who brings upon himself trouble with his employés and dissatisfaction on the part of the subscribers. Every good thing in this world has to be worked for—and the perfect telephone exchange is no exception to this rule. Certain efforts will produce certain results, and as a matter of fact there is no more labor involved in the conduct of the successful exchange and indeed not as much as in the management of one which is not successful.

[1] If it were possible and practical a daily record should be made showing the exact work done by each operator; that is, the number of calls answered, the average time both for service and disconnections. The present system of taking this record or peg count is necessarily laborious owing to the fact that it adds too much unnecessary work upon the operator for the good of the service.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Form of Voltage Curves before and after Transformation.

M. Charles David had occasion, during an investigation carried out recently, to make use of transformers for reducing high electrical purposes to values suitable for measurement in his instruments. The question was then raised, whether this transformation had any effect upon the form of the curve, and a supplemental experiment was made to decide it. Several transformers were used, which had the following characteristics: the weight of the iron was 42.5 kilogrammes. The induction in the yokes was 12,000 gausses. The induction in the cores was 9,000 gausses. The thickness of the sheets was 0.35 millimetre. The loss, unloaded, was eighty-one watts. The diameter of the high-tension winding was 0.2 millimetre, and that of the low-tension winding, 1.8 millimetres. The resistance of the high-tension circuit at twelve degrees centigrade was 1,200 ohms; that of the low-tension circuit at the same temperature was 0.57 ohm. The transformers were cooled in oil, and could carry a continuous load of from two to three kilovolt-amperes. They were but slightly loaded when supplying the apparatus. In order to detect any effect whatever due to transformation, an interrupter was introduced in the alternating current which gave irregular waves, and by means of an oscillograph these waves were traced, both for the primary and secondary windings. The transformation ratio was 5,500 to 110. Experiments were made with single, double and fourfold transformation. The curves for the different experiments are given. They are very irregular, but, in each case, the curves for the current before and after transformation are practically identical. There is no clear or systematic difference between them, which leads to the conclusion that there is no appreciable error due to the use of transformers for voltage measurements.—*Translated and abstracted from the Bulletin de la Société Internationale des Electriciens (Paris), March.*

Lightning Discharge Effects.

A peculiar result of a flash of lightning which struck a chimney of a house in Bournemouth, England, is described here by Mr. Edgar L. Ingram. The chimney was shattered, and the discharge passed to the wires of the electric lighting installation, which are connected to the local supply company's distributing mains. These mains are triple, concentric, lead-sheated cables, drawn into stoneware ducts. The cables are arranged as usual, with the outer conductor neutral, and with 400 volts between the inner and intermediate conductors, the supply to the consumers being at 200 volts. The neutral conductor is dead-earthed at the transformer chamber—780 yards away from the house struck—and the lead sheathing of the cables is dead-earthed in each draw box. The discharge appears to have found its way to earth through the neutral earth at the transformer chamber, in its course blowing all the distributing and main fuses of the installation, shattering the porcelain covers with such violence that one piece of porcelain broke a window some yards away, and blowing the cast-iron service fuse box to pieces. The meter connected on the pressure main was burned out, the metal cover twisted out of shape, and the filaments of a number of incandescent lamps broken. In one case, three small holes were pierced in the lamp globe, and the globe blackened all over the inside. In other cases, the filaments were broken into short lengths and protected against the glass with such force that many pieces adhered to the glass firmly. All installations within a radius of 430 yards had several lamps affected in this way, though in no case were all the lamps destroyed. Apparently, the triple concentric cable has not been hurt, nor have the shunt coils of the meters been injured. None of the lamps destroyed was switched on at the time of the accident.—*Abstracted from the Electrician (London), April 7.*

The Tuning of Thermoelectric Receivers for Electric Waves.

When experimenting with electric waves, two assumptions are frequently made. One is that the exciter and receiver are identical in wave length, since they are usually identical in form and dimensions. The second is that the wave length of the linear receiver is twice the length of the receiver itself. To test the accuracy of these assumptions, Mr. A. D. Cole has made an investigation, and here gives his conclusions. Two Righi exciters were used. In one, the radiating cylinders had an effective length of seventy-four millimetres, and in the other, fifty millimetres. Both were 3.1 millimetres in diameter. The separating oil-gap was a fraction of a millimetre long. The receiver was of the same form and diameter as the exciters, but its length was variable, and a thermo-junction of iron and constantin wire replaced the spark-gap. The length of the receiver was varied by sliding tubes of thin metal over its cylindrical ends, so that any length between thirty-nine and ninety millimetres could be obtained. To facilitate these adjustments of the receiver, it was mounted behind a cylindrical lens formed of a two and one-half litre bottle filled with benzine. This lens was quite effective in concentrating the radiations, as by means of it the deflections were increased about five times. The wave lengths were measured by three interference methods, which gave results in fairly good agreement—first, by reflection on a plane mirror behind the receiver; second, by reflection on a plane mirror behind the exciter; third, by Bolzmann's two-mirror method. By varying the distance of the mirrors, curves were obtained showing maximum and minimum galvanometer deflections. From these curves the following conclusions were drawn: when a thermal receiver of linear form is used in connection with a Righi exciter, interference curves show the wave length characteristic of the receiver. When the receiver length is changed until a distinct maximum effect is produced from a given exciter, it is probable that the fundamental wave length of each is the same; and the interference instrument will then—and only then—give the wave length of the exciter. The mean ratio of measured wave lengths to receiver length, as shown in five measurements, is 2.52, which agrees well with the value of 2.53, as determined theoretically by MacDonald, and not with the value of two, as given by Poincarè.—*Abstracted from the Physical Review (Lancaster), April.*

The Insulation Resistance of Impregnated, Paper-Covered, High-Potential Cables.

Frequently specifications for high-potential cables call for very high insulation resistance. The purchaser, says Herr P. Humann, seems to assume that, because it is not difficult to obtain a lower voltage cable with a guaranteed insulation resistance of 100 megohms per kilometre, a high-potential cable should have a resistance of at least 1,000 megohms. It is easy for the cable manufacturer to obtain a high resistance by saturating the paper

Digitized by Google

with a solid material, but this treatment renders the insulation stiff and brittle. On the other hand, if but one layer of paper of the many covering the conductor be cracked, the entire thickness of the insulation will be punctured as soon as a very high potential occurs. This phenomenon is easily demonstrated on a plate of any insulating material, such, for instance, as a plate of glass. Such a plate may be inserted between the sharp-pointed discharging electrodes of a high-voltage transformer, and, usually, the discharge will take place around the edge of the plate without breaking it. However, as soon as a slight scratch be made on the surface of the plate, it is punctured at this point. To avoid this objection to the use of solid compounds, oil may be used. This leaves the insulation flexible, but it reduces very considerably the insulation resistance. This reduction in insulation resistance does not necessarily mean an increased insulation loss, because this loss is made up of two factors, one due to the dielectric hysteresis, and the other to leakage. Herr Humann has compared two cables, to determine how great a difference might be expected. One had a resistance of 1,280 megohms per kilometre and a capacity of 0.284 microfarad for the same length. The second had a resistance of 10,850 megohms and a capacity of 0.282 microfarad per kilometre. The insulation losses for different voltages up to 8,000 were determined, and while those of the low-potential cable were about ten per cent greater, an error of this amount might readily be accounted for by the method employed. The conclusion is drawn, that the increased insulation resistance of the second cable does not appreciably reduce the insulation losses. A comparison was then made between two cables, one of which had not been thoroughly dried. In this case, the undried cable showed a much greater insulation loss than did the other. Herr Humann concludes that, in no case, should an insulation resistance of more than 1,000 megohms per kilometre at fifteen degrees centigrade be demanded. In general, a resistance of 500 megohms per kilometre will be as good as one of 1,500.—*Translated and abstracted from the Elektrotechnische Zeitschrift (Berlin), March* 30.

Bimetallic Rheostats.

The choice of the proper material for a rheostat is one of the important factors in its construction. For starting rheostats, where ventilation is of little importance, the problem is to store up a certain amount of heat in the cheapest way. The materials generally used for rheostats have high specific resistance, and are expensive. The method of construction suggested by Mr. H. M. Hobart, which makes use of cheap materials, but in which special provision is made for storing heat, is here described by Mr. F. Funga. The material used for the conducting wire is copper, and storage for heat is provided by adding iron wire in sufficient quantity; hence the term "bimetallic." Light copper wires are used for the conductors, and in the smaller forms of rheostats these are wound two or more in parallel, with a steep pitch, on porcelain tubes. The current density allowable is 150,000 amperes per square inch. Over the copper wire, or interwoven with it, but at a lesser pitch, are iron wires which make contact at many points. As the length of iron wire used is much greater than that of copper, the iron adds but little to the conductivity of the element. It has been found convenient to use the same diameter of iron wire for all sizes of rheostats. The iron wire is wound about six turns per centimetre of length, the copper wire having only one-half turn per centimetre of length. The greater the current which will pass through the element, the steeper the pitch of the copper wire. The tube form of rheostats is convenient for currents up to 100 or 150 amperes. For higher currents, the type adopted consists of two thick copper bars connected across by a number of parallel thin copper strips. Iron wires are intermeshed with these strips, and in this position add nothing to the conductivity, but greatly increase the heat storage capacity of the element. A simple method of winding the tubes consists in winding on one iron wire at a low pitch. The copper wires are then wound at an increased pitch, and over them is wound a second iron wire which falls in between the turns of the first. In this construction it is not necessary to tap on at intermediate points of the tubes. They may even be longer than is customary in the old type of rheostat, without necessitating any intermediate taps.—*Abstracted from Electrical Review (London), March* 31.

The 36,000-Volt Hydroelectric Installation of the Celina, Italy.

One of the modern hydroelectric installations of northern Italy is here described by Signor Enrico Bignami. The Celina river starts from the Claut at an altitude of 7,200 metres, in the Carnic Alps, and has a length of 453 kilometres. On account of its special geological conditions, it can deliver, at low water, about 30,000 litres per second. The new installation has been erected to supply electrical energy in the district of Venice. The construction was exceedingly difficult, for there was not even a pathway up the side of the mountain to the point where the dam has been erected. It is said that this work has cost more money and labor and lives of workmen than any other in Italy. The dam raises the water level at the intake three and one-half metres above the normal level, and creates a reservoir of about 300,000 cubic metres, to be drawn upon during periods of low water. The canal carrying the water to the power-house was also troublesome to build, and several tunnels had to be pierced for it. The power-house is close to the village of Malnisio. At this point the head of water is 58.64 metres. With a discharge of twenty cubic metres per second, there is available 15,600 horse-power. At the times of greatest consumption, and with the help of the reservoir, 18,900 horse-power may be obtained. The turbines are inward-flow reaction wheels, and consist of a single wheel on a horizontal shaft Each turbine will take 4,500 litres of water per second, and will develop at the shaft 2,600 horse-power at 315 revolutions per minute. The large turbines are connected direct, by means of rigid couplings, to three-phase alternators supplied by Brown, Boveri & Company, of Baden, Switzerland. These are of the usual type, with fixed armature and rotating field. The magnet wheel is a solid piece of steel, and carries sixteen alternate poles. The armature core is provided with four closed slots for each coil. The exciting current can be adjusted so as to vary the voltage at the terminals from 3,600 to 4,800. The commercial efficiency at full inductive load is ninety-five per cent. The fall of potential between no load and full load, with the usual speed and exciting current, is, with non-inductive load, five per cent of the normal voltage, and with inductive load, sixteen per cent. Direct current for exciting the fields of the alternators is provided by dynamos driven by three small turbines. Three single-phase transformers are used to raise the voltage to 30,000. When the primary voltage is raised to 4,300, the secondary voltage will be 36,000. All the switches work in oil. Those for medium voltage are double-break switches, and those for high-voltage, sextuple-break, enclosed in three separate boxes full of oil. The bus-bars are arranged in a ring which may be divided into two parts. All the electrical apparatus is controlled from operating switchboards.—*Abstracted from the Electrical Review (London), April* 7.

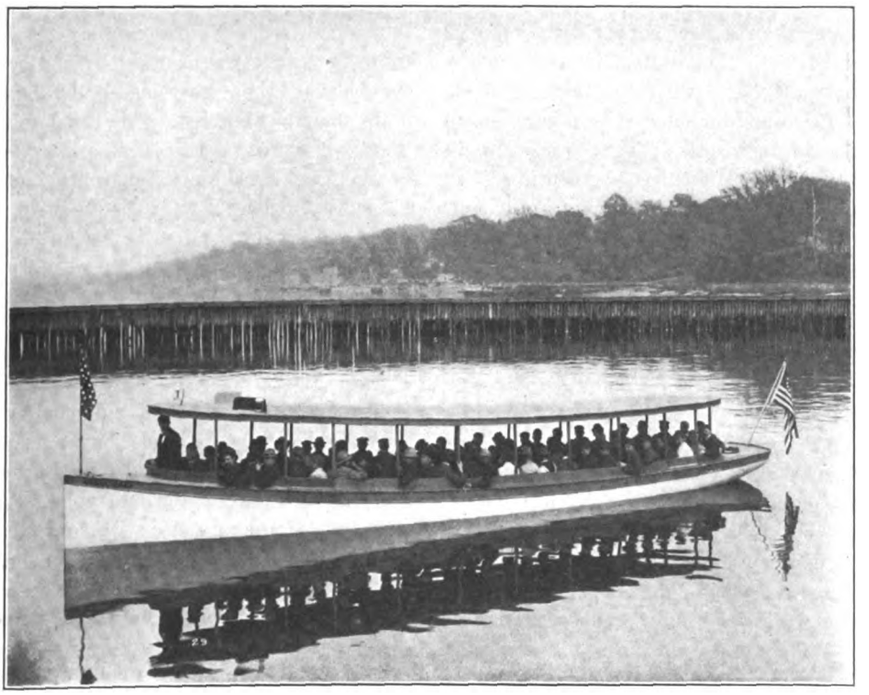
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The Electric Launch.

For the past six years the Electric Launch Company has maintained finely equipped modern boat-building shops on Newark bay, Bayonne, N. J. The company builds all kinds of pleasure craft, from launches to yachts. These are built on short notice, if necessary, from standard plans, or from the specifications of any yacht designer. The company makes a specialty of electric launches, and in this direction has been remarkably successful in placing in commission a long line of very satisfactory boats. The electric launch, by reason of the inherent simplicity of its motive parts, is the safest boat afloat. No inflammable fluid is carried, explosions are impossible, air tanks can be placed beneath the floor, and sinking is therefore out of the question. The electric launch is handled with great simplicity. There is no steam gauge to watch, no boiler in which to keep up steam. The only observation necessary is a glance now and then at the voltmeter, to determine the pressure of the storage batteries.



ELECTRIC LAUNCH BUILT BY THE ELECTRIC LAUNCH COMPANY.

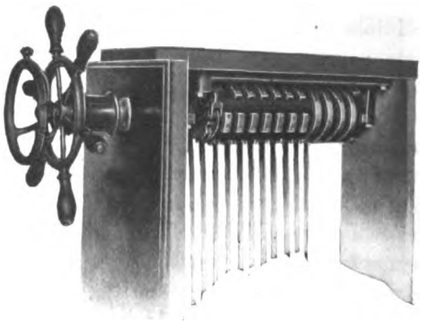
The electric launch is cheap in maintenance, using energy only as required. When the current is shut off, the operating expenses cease.

The objection which, for a long time, was leveled against the electric launch—that of the difficulty of maintaining the batteries properly charged—has been eliminated by reason of the many forms of convenient and portable charging outfits which have been recently placed on the market.

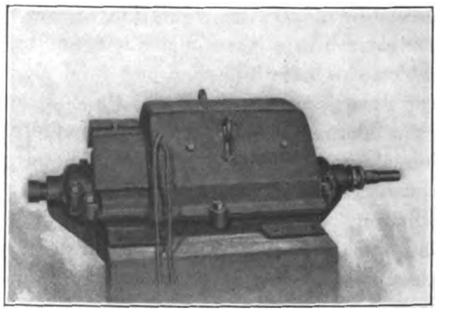
The company has done much to solve satisfactorily the battery problem. A lightweight cell of great capacity and durability is furnished. Three types of battery equipment are made. These will drive a twenty-five-foot boat for thirty miles, forty miles and fifty-five miles, respectively. In any of these types the plates need be renewed at intervals of about three years. The annual bill for repairs, including renewal, the company states, will be hardly more than five per cent.

The boat hulls are built only of well-seasoned lumber, of long lengths, with white oak keel. The stem and deadwood are of oak or hackmatack, secured by galvanized iron rods, well riveted. The frames are of selected white oak, steam bent over moulds reenforced by oak floors and knees. The planking is of selected white southern cedar. The upper works and interior are finished in hardwood, oak being used for the sheer-strake mouldings and plank-sheer. The decks are finished in pine, oak or mahogany.

The speed controller is placed under the forward deck, giving five available speeds ahead and two reverse speeds. The steering and controller wheels are combined on one shaft located at the forward end of the cock-pit. The motor is directly connected with a Tobin bronze propeller shaft placed below the flooring. All bearings of the motor are self-lubricating. The propeller wheels are of composition brass. The combination motor and charging switch, with charging plug, running plug and safety clip fuses, are fitted on the bulkhead. The batteries are placed under the floor below the water line, and supported on patent porcelain insulators. The elements of the battery are placed in patent marine-type hard-rubber jars, so constructed that the terminals may be securely clamped under or above the box covers by metal bindings. The spilling of the battery solution is impossible. The voltmeter and ammeter are placed conveniently on the forward bulkhead, near the controller and steering wheels. Only the best of insulated wire is used to connect the batteries with the motor. All wires are supported on porcelain insulators.



STEERING WHEEL AND CONTROLLER FOR ELECTRIC LAUNCH.



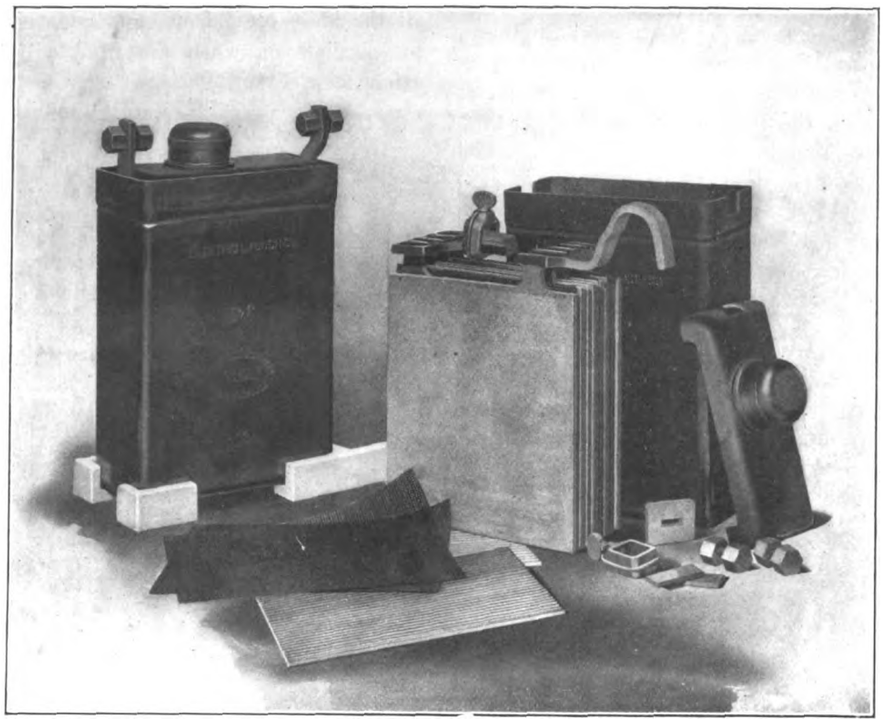
MOTOR FOR ELECTRIC LAUNCH.

The company builds cabin electric launches in five sizes—thirty-six feet, forty-two feet, forty-seven feet, fifty-four feet and sixty-three feet.

One of the most popular boats that the

Digitized by Google

company builds is the electric passenger launch. This is particularly well fitted for the carrying of passengers, the motive machinery being mounted beneath the flooring entirely out of the way. Side seats provide ample accommodation for passengers, and, for roominess, no type



STORAGE BATTERIES FOR ELECTRIC LAUNCH.

of self-propelled boat can approach the electric launch. The battery capacity is sufficient for a continuous run of six to seven hours at a normal rate of speed.

A Demonstration of Heating and Cooking by Electricity.

On April 11 the Philadelphia Electric Company, Philadelphia, Pa., arranged a meeting for its district managers and solicitors, to familiarize them with the use of electric cooking and heating apparatus, and so promote the sale of apparatus and current for this service. A lecture was given on electric cooking and heating by Mr. Max Loewenthal, secretary and electrical engineer of the Prometheus Electric Company, New York city. Mr. Loewenthal showed by experiments the historical development of the electric heating industry, and presented considerable valuable data relating to this subject.

During the course of the evening a complete meal was prepared by means of Prometheus electric cooking apparatus by Miss Helen Tovell, and after the lecture this meal was served to those who remained.

Orders for Allen-Bradley Controllers.

The Western Electric Company, of Chicago, recently placed with the American Electric Fuse Company an order for Allen-Bradley electric controllers to equip all the new cranes being installed at the Hawthorne plant of the Western Electric Company. This is one of the largest single orders for electric crane controllers ever placed in Chicago, and the American Electric Fuse Company states that the order was given after a six months' thorough and rigorous test of Allen-Bradley controllers in the Chicago factory of the Western Electric Company.

The Allen-Bradley controllers for the Hawthorne plant are all standard type machines, ranging from three and one-half horse-power to fifty horse-power in size, and are adapted for use with Niles-Bement-Pond cranes. A number of the controllers are arranged to be set in the rear of the controller cage, and to be operated by extension levers from the front.

Despite the unusual size of the order, the American Electric Fuse Company made a very prompt delivery of the Western Electric Company controllers, all machines having been shipped complete within fifteen days after the order was placed. The American Electric Fuse Company is now turning out over one hundred Allen-Bradley controllers a month, an increase of almost one hundred per cent in less than six months' time.

Besides the Western Electric Company order, the American Electric Fuse Company has recently received orders from the George S. Smith Steel Casting Company, of Milwaukee; Lackawanna Steel Company, of Buffalo; Bethlehem Steel Company, South Bethlehem, Pa.; American Bridge Company, Ambridge, Pa.; John A. Roebling's Sons Company, Trenton, N. J.; Otis Elevator Company, New York; American Locomotive Company, Paterson, N. J.; Trenton Iron Company, Trenton, N. J.; Gould Storage Battery Company, Depew, N. Y., and many others.

To Manufacture Field and Armature Coils.

The Magnet Wire Company, New York city, has established a department for the manufacture of field and armature coils for electric railway motors. This company is well known as the manufacturer of "Magnet" wire, and has found that there is a large market for complete coils, not only among the smaller roads which have small shop facilities, but also among the greater systems, whose coil-winding departments are sometimes inadequate for the demands upon them. The Magnet Wire Company has recently purchased the designs and plant of a large electrical manufacturing and repair company, securing excellent facilities for electrical repair work and the manufacture of field coils. The new plant has been consolidated with the already existing plant of the company, making an extensive equipment.

Mr. H. S. Williston, who is a technical graduate and a member of the American Institute of Electrical Engineers, will take charge of this new manufacturing department. Mr. Williston is especially well equipped for this class of work, having had considerable experience in the manufacture of railway motor armature and field coils, and having been, for five years, in charge of this manufacture with the General Electric Company.

The company is prepared to manufacture both field and armature coils for existing types of railway motors. The more common forms will be manufactured in advance, in accordance with the usual specifications, and quantities kept in stock for emergency orders. The company is prepared to build, however, coils upon order for any requirement.

Mr. Edwin W. Moore is president, succeeding Mr. Valentine; F. H. Cowles is secretary, and J. Nelson Shreve, treasurer of the company.

Digitized by Google

Westinghouse New York Changes.

Westinghouse interests will occupy all but a small part of the nineteenth and twentieth floors of the new Trinity Building at 111 Broadway, New York, after May 1. The executive offices of the Westinghouse Electric and Manufacturing Company, which have for nearly twenty years been in the Equitable Life Building at 120 Broadway, will be on the nineteenth floor of the new building, and the eastern sales offices of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company will occupy a large part of the twentieth floor. The law offices of Hunt, Hill and Betts, which have been for several years in the Equitable Life Building, will be on the twentieth floor of the new building, and the remaining part of the floor has been sublet to an engineering company.

The United States Electric Light Company, which was absorbed by the Westinghouse Electric Company shortly after the organization of the latter company, opened offices in the Equitable Life Building in 1878, and the old building has been more or less a Westinghouse headquarters in New York for the past generation, and the New York office of Mr. George Westinghouse. The new offices in the Trinity Building will be more commodious to provide for the growth of the working staff in the treasury and other departments.

The New York sales offices of the Westinghouse Electric Company will remain in the Hanover Bank Building at Pine and Nassau streets, without changes, and the New York office of the Westinghouse companies' publishing department, formerly at 10 Bridge street, will be connected with them. The export offices of the electric company will continue at the same address, under the management of Mr. Maurice Coster, recently appointed to succeed Mr. F. B. H. Paine, and the office of Mr. Charles S. Powell, the new general agent of the electric company, will be connected with the sales and export offices. Mr. Coster and Mr. Powell have arrived from Paris and from London to take up their new duties after long terms of successful Westinghouse service abroad.

Mr. Coster, who has acted as sales manager of the Société Anonyme Westinghouse since the spring of 1899, has had a broad experience in domestic and foreign markets. His Westinghouse connection began in 1888, in Pittsburg, and later he acted as manager of the Chicago office of the electric company. His work for the French Westinghouse Company, which manufactures nearly all forms of Westinghouse products—railway appliances, prime movers, and electrical apparatus—involved several branches of engineering, and he will act as export manager in New York for the Westinghouse Machine Company as well as for the electric company. He has for many years been a full member of both the Electrical Engineers and the Mechanical Engineers.

Mr. Powell returns to America after two years and a half as assistant manager of the British Westinghouse Electric and Manufacturing Company, in which his duties brought him into contact with all the important plans for the electrification of England's traction systems and railroad terminals. Prior to his departure for England in December, 1902, Mr. Powell had acted as manager of the Cleveland offices of the Westinghouse Electric and Manufacturing Company, with which he began work in 1893. His brother, Mr. Thomas Carr Powell, was recently appointed fifth vice-president of the Southern Railway.

Electric Plants for the Supplying of Electricity to London.

The Administrative County of London and District Electric Power Company, which is responsible to a committee of the British House of Lords, is planning to construct three electric plants for generating current to supply the whole of London and those suburbs controlled by the London County Council. Each plant is to consist of six turbo-generators, each of 10,000 kilowatts normal, and 20,000 kilowatts maximum capacity, making a maximum total of 360,000 kilowatts. Experts have been appointed to decide upon the practicability of units of this size. The electrical expert chosen for this important problem is Mr. C. F. L. Brown, of Brown, Boveri & Company, Baden, Switzerland. The Crocker-Wheeler Company, Ampere, N. J., is the American licensee of Brown, Boveri & Company, which acts as its consulting engineer on alternating-current propositions.

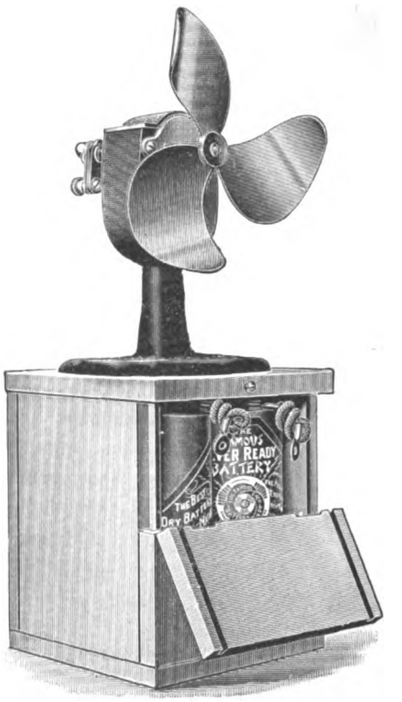
Publicity.

The Denver Gas and Electric Company, Denver, Col., is one of the most extensive users of publicity in the country. Hardly a day passes that every one in the city, and, in fact, outside of the city, who has any interest in, or need for, an electrical system does not receive some intimation from this enterprising company that electricity is the thing for overcoming every difficulty. The literature is presented in every conceivable form. A system of beautifully colored postal cards, delineating picturesque scenes throughout Colorado, is one form of publicity. A complete series of menus for various styles of dinners is another form. Then, again, comes a paper-folder in the shape of a key, bearing the inscription, "Here's the Key to the Situation." In fact, it is hard to see where all the ideas come from, and one begins to speculate on when the fund will be exhausted.

A New Battery Fan Motor Outfit.

The Electric Motor and Equipment Company, Newark, N. J., has placed on the market a portable electric fan, which is designated as the "Beaver" battery fan motor outfit. This is especially applicable for use in the sickroom, dining room, telephone booth, or, in fact, in any place where street current can not be obtained.

The fan motor consists of a carefully constructed small motor, a three-blade brass fan seven inches in diameter, and a switch provided on the back of the fan in an accessible position. Four high-grade dry batteries are contained in a neat,



BATTERY FAN MOTOR OUTFIT.

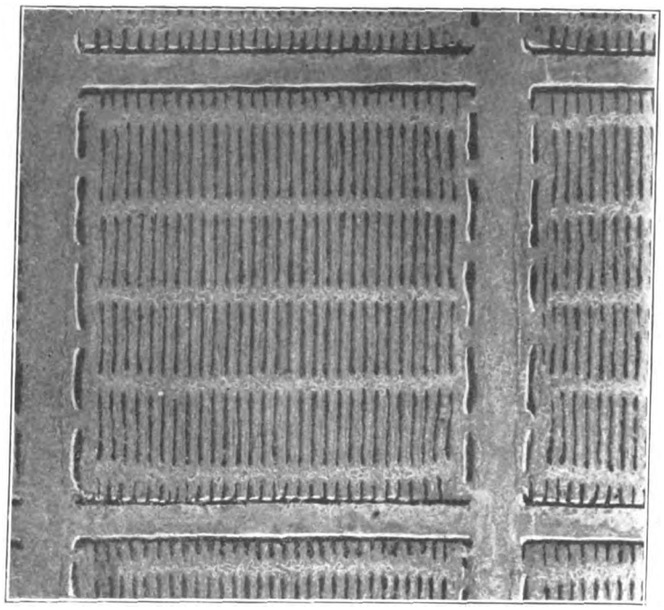
substantially made box, and connection is made to the fan motor by a flexible cord. The fan will run approximately fifteen to twenty hours continuously, or about 100 hours if used at infrequent intervals on one equipment of batteries. The weight, complete, is sixteen pounds, the weight of the fan motor being five pounds.

Digitized by Google

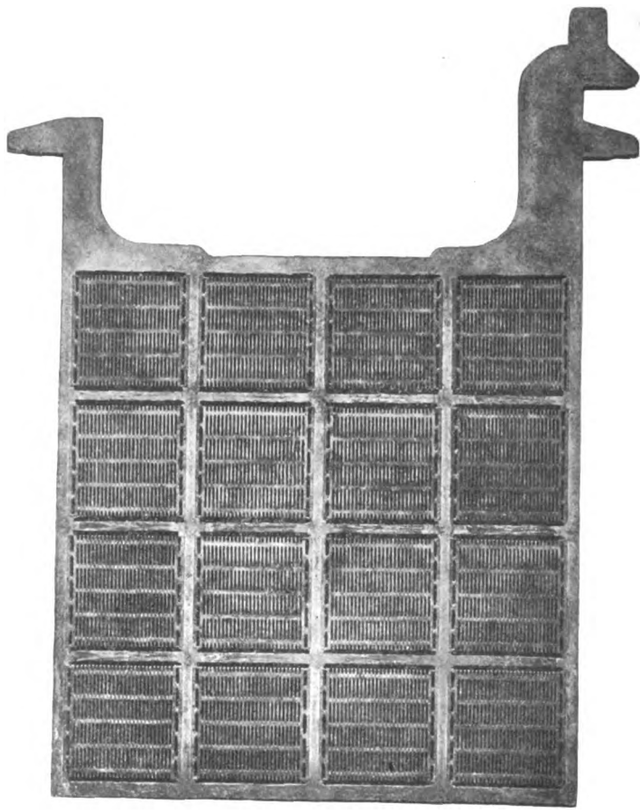
The Bijur High-Duty Storage Battery.

Some years ago Mr. Joseph Bijur, of New York, undertook to develop an improved type of storage battery. As a result of his labor, in which he had as collaborator Dr. J. S. C. Wells, of Columbia University, the cell to be described below has been produced. The aim of Mr. Bijur's endeavor was to devise a construction mechanically and chemically correct. The end to be attained was a rigid structure which should be free from any tendency to buckling, and which should, at the same time, allow free circulation of the acid and hold the active material so that it could not be displaced. To be successful, the cell should have a high specific capacity and admit of high rates of charge and discharge. Necessarily, the efficiency should be high, the regulation good, and there should be no tendency to sulphate. To construct a plate having these characteristics, it was decided that it must be made up of small parts, each free to expand, but all firmly welded together to a supporting and conducting grid.

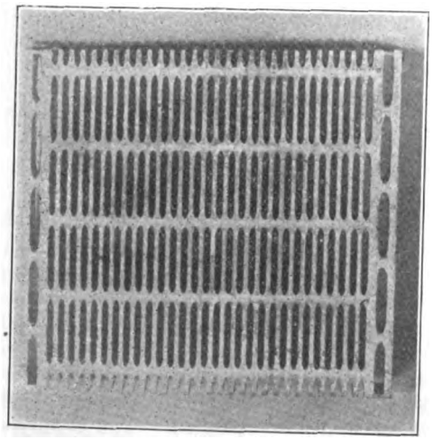
The type of plate finally decided upon is shown in the accompanying illustration. It will be seen that it consists of a number of small grills, which are supported at two opposite ends by being firmly welded to the supporting grid. These grills are cast in moulds under pressure, and are therefore one piece of lead; but they can be described best by comparing them with a number of flat ribbons of lead held together by short intermediate cross-pieces. The grills thus formed are held at intermediate points to the terminals which are welded to the supporting grid. This method of support allows the grill to expand in the direction of the support when formation takes place, and, as will be seen from the illustration, as the grill is attached to the grid at these sides only, the ends being free, expansion can take place freely in the other direction as well. The grills themselves are formed of pure



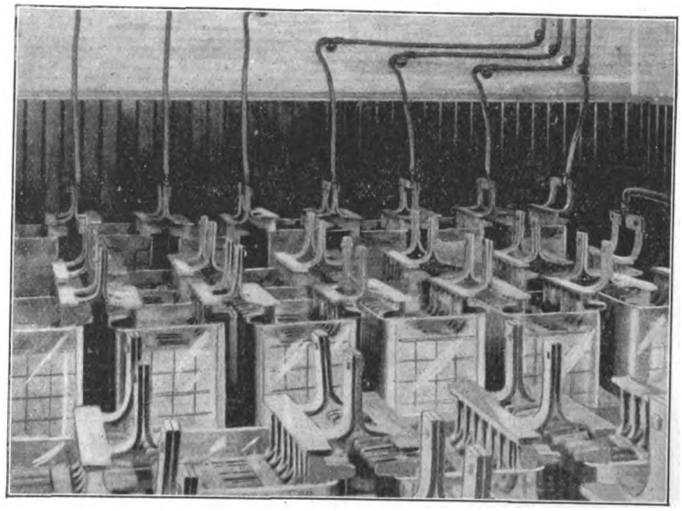
SECTION OF FORMED PLATE, "BIJUR" BATTERY.



FORMED PLATE, "BIJUR" BATTERY.



INDIVIDUAL GRILL.



BATTERY EQUIPMENT, PROSPECT POINT CAMP, ADIRONDACK MOUNTAINS.

Digitized by Google

lead, while the supporting grid is an alloy containing a small percentage of antimony.

This particular form of plate has the following characteristics: formation takes place principally in the rectangular openings of the grill. As these openings are small, the depth of formation is slight, so that a large surface area is exposed to the electrolyte. After formation, it is found that these openings are not completely closed by the active material, so that the acid has free access to the interior of the plate. As the active material is formed, it wedges itself into the rectangular openings of the grill, tending to expand the latter into an elliptical form, and is thus wedged tightly in place and held firmly against the conducting lead of the grill. This formation, which exposes a large surface of thin active material, is held to give the following advantages: this large surface, always in contact with the electrolyte, permits of high rates of charge and discharge without injury to the plate, and, at the same time, there is but little polarization, so that the charging voltage is comparatively low.

Having decided upon a type of grid, the next step was to find a means of attaching the grills solidly to the grid. This has been done by devising a method of welding which, so far as can be determined, makes a perfect joint between the terminal of the grill and the sides of the grid. In the type of plate shown, the horizontal bars of the grid are cast first, and these, together with the requisite number of grills, are assembled in position, and then the vertical bars of the grid are cast, the welding action taking place when the casting is made. This welding is merely a union of the pure metal of the grill and the alloy of the grid. No solder or other material is used. The joint is so firm that if a grill be hammered it breaks to pieces, but the joint is not loosened.

The next step in the process is formation. The positive and negative plates are constructed in this way, but the negative, being somewhat thicker, has the increase in surface necessary to obtain a capacity equivalent to that of the positive plates. A new process of formation has been devised, which, the inventor believes, gives great toughness and porosity, and which is at all times under the control of the operator. After formation, the positive plates still have sufficient reserve lead to allow for the future oxidation which always takes place. The negative plates are, of course, fully formed in the first case.

The free diffusion obtained with this construction, it is said, allows the batteries to be charged fully with two and one-half volts only. This, of course, means a high efficiency and a decrease in the size of the auxiliary apparatus required.

The Bijur high-duty battery is now being placed upon the market by the General Storage Battery Company, which has equipped a factory at Boonton, N. J., with special automatic machinery for producing these batteries rapidly and cheaply. This point was selected because power could be obtained cheaply and abundantly hydraulically.

The company has also developed a new and complete line of automatic boosters, end-cell switches, and other auxiliary devices for all classes of station work and power plants. It is said that these devices differ as radically from the present types as does the Bijur high-duty plate from the usual storage battery plate.

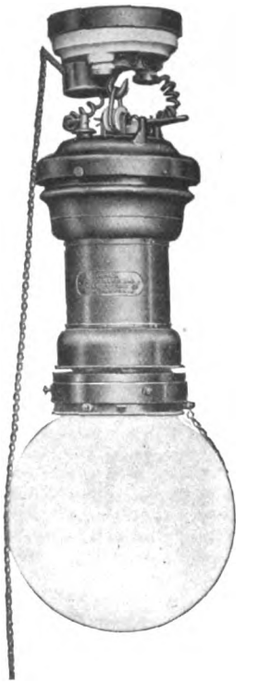
A recent installation of these batteries was made at Prospect Point Camp, on Upper Saranac Lake in the Adirondack mountains, when there was a small lighting plant driven by a 100-horse-power gasoline engine. The service for some reasons had not been satisfactory, so that a battery consisting of sixty-two Bijur cells was installed, the plates being eight by eight inches. Ten are end-cells for regulation. All are placed in a room sixteen feet long by thirteen feet wide. Since their installation, Prospect Point Camp has not been without light at any time of the day or night, and it is said that considerable economy in station operation has been effected, amounting to several times the interest and depreciation of the battery. The accompanying illustration is a view of this battery room. As operated at present, the engine is started at 5 P. M., and runs until midnight. During this period the battery is charged and current is furnished for such lights as are needed, the engine and dynamo running at full load. After midnight the engine is shut down, and during the rest of the twenty-four hours the load is carried by the battery, regulation being effected through the end-cells.

The General Storage Battery Company is now prepared to turn out cells of any size and for any purpose. It is fully equipped to furnish complete and durable installations.

The New York offices of the General Storage Battery Company are at 42 Broadway.

New Form of Ceiling Board.

The General Electric Company, Schenectady, N. Y., has placed upon the market an improved porcelain ceiling board for arc lamps. One of the most valuable features of this board is the use of a snap switch and a ratchet and chain, the lamp and board thus being self-contained and requiring no additional wiring to connect them with a switch. Every lamp in a circuit is made independent of the other lamps by means of standard Edison plug



NEW FORM OF CEILING BOARD.

cutouts, affording a better means of protection than a universal cutout. The ceiling board is furnished for either concealed or cleat wiring.

The hook from which the lamp hangs is supported by a spiral spring mounted in a recess in the porcelain. This spring takes up any jarring to which the lamp may be subjected, reducing vibration to a minimum. The ceiling board is particularly adapted for use with lamps installed on wharves, in railway stations, or in factories or mills.

The illustration herewith shows the new ceiling board supporting a form 5 alternating-current multiple arc lamp.

Electric Power for Spinning Mills.

An innovation in Lancashire, England, is attracting considerable interest among manufacturers of that section. A new spinning mill in Lancashire County, operating 84,000 spindles, is to be lighted and driven entirely by electricity. It is said that this will be the first establishment to be so operated. The supply of electricity is to be obtained from the mains of an electric power company. The experiment will have a double value, because it will test the feasibility of electric power in a great spinning factory, and test also the practicability of an outside source of power supply for such an installation.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

POWER PLANT ON THE SUSQUEHANNA RIVER—It is stated that New York capitalists have formed a company to build a power plant on the rapids of the Susquehanna river, in Pennsylvania. About $10,000,000 will be expended in the enterprise. The power is to be transmitted to Philadelphia for use there.

DEVELOPMENT OF WATER POWER IN TENNESSEE—A power plant is to be erected at Great Falls, on the Caney Fork river, to develop 50,000 horse-power, or more. Eastern capitalists have been investigating recently to ascertain the amount of electrical power which can be disposed of in the vicinity. It is stated that the property at Great Falls has recently passed into the possession of C. H. Ackerman, of Binghamton, N. Y.

NEW ELECTRIC LIGHT AND POWER COMPANY IN NEW JERSEY—The Paterson Electric Light, Heat and Power Company has been formed with a capital of $500,000. The stock is held principally in the city of Paterson, and it is the intention of the company to extend the business of furnishing light and power to all the cities in the vicinity. Peter S. Van Keik, Angelo H. Knapp, Thomas Jornold and others are the organizers.

ELECTRIC ROAD IN BARBADOES—A steam railroad on the island of Barbadoes, running from Bridgeton to the opposite coast, is to be operated by electricity. The tramways of Bridgeton, which are now operated by mules, have been purchased by an English company, which has also bought the electric light plant. It is proposed to change the traction power of the tramway system to electricity, and operate the cars over the steam railway which is at the present time abandoned.

WATER-POWER PLANT ON THE WATEREE RIVER, S. C.—It has been announced that a syndicate will construct a power plant on the Wateree river, seven miles from Camden, S. C. The syndicate has a capital of $2,000,000, and has purchased the site for the station at a cost of $100,000. The plant is to generate not less than 14,000 horse-power, and the surveys have already been completed. The legal representatives are Smyth, Lee & Frost, of Charleston. S. Logan Lang, William M. Shannon and F. M. Zemp, of Charleston, are said to be interested in the scheme.

ELECTRICAL NOTES FROM MEXICO—A waterfall at Amaxtlan, in the Las Lajas mountains, Guerrero, has been sold to an American company for $100,000. The purchasers will construct a hydroelectric plant. The tramway lines in the city of Mexico will increase their equipment by forty cars during the present year. The first order will be placed about May 1, and another about September 1. An electric plant is to be installed at San Miguel de Allende, Guanajuato. The power will be obtained from a fall near Atontonilco, about ten miles from San Miguel.

CONSOLIDATION OF ELECTRIC LIGHT AND POWER PLANTS IN LOUISIANA—The electric light and power plants and the street railway of Baton Rouge, La., are to be consolidated in one company. The enterprises are the Baton Rouge Electric and Gas Company, the Capital Light and Power Company and the street railway company, which is already controlled by the Baton Rouge Electric and Gas Company. The new concern will extend the street car service so as to afford traffic accommodations to all parts of the city, and will spend about $100,000 in improving the lighting system. The electric light plant will probably be rebuilt.

ELECTRIFICATION OF TRAMWAYS IN LONDON, ENGLAND—The highways committees of the London County Council has recommended the electrification of a line of tramways in southern London. The line comprises seventeen and one-half miles of single track, and extends from Westminster bridge to Vauxhall, and thence through Battersea to Nine Elms and Tooting, where it will join the existing line. Another line to be electrified extends from Vauxhall to St. George's Cross. The cost of the work will approximate £450,000, of which £280,000 is for track work, £51,000 for cables and cable ducts, £31,400 for cars, and £57,000 for car sheds and substations.

ELECTRIC FREIGHT ROAD IN NORTH CAROLINA—The Asheville & Burnsville Railroad Company has secured the rights of the Weaverville & Asheville Electric Power Company and also of the Estatoe Electric Company. The capital stock of the new company is $1,000,000, and the officers are George D. Mills, Warsaw, Ind., president; E. F. Watson, Burnsville, N. C., vice-president; W. W. Chapman, of Yancey County, N. C., secretary and treasurer. The company is to build a road from Boonford, in Mitchell County, to Asheville, N. C. The road will run through fifty miles of timber land and carry freight exclusively. About ten miles of the grading are completed. A dam has been built on the Estatoe river, forty-three miles from Asheville, and will furnish 1,000 horse-power. The company is to build another dam on the Kane river, to furnish an additional 750 horse-power. The line will cost about $1,250,000, and it is expected that the road will be in operation within one year.

NEW MANUFACTURING COMPANIES.

ST. LOUIS, MO.—The Doxsee-Barrere Electric Company has been organized with a capital of $30,000, by Arnold S. Doxsee, William H. Barrere and I. J. Doxsee.

ALTON, ILL.—M. S. Anderson has organized the Anderson Electrical Company. The company will buy and sell motors, and do general repair and construction work.

AKRON, N. Y.—The Talbot Electric Company has been formed at Washington by Emmet Talbot and Francis Whitney. The company will deal in electrical appliances.

KOKOMO, IND.—The Rex Electric and Supply Company has been organized with a capital of $1,000. Frank L. Clifford, Charles L. Moore and J. H. Richardson are the incorporators.

PORTLAND, ME.—The Postal Telephone Company has been organized to deal in telephone instruments, with a capital of $500,000. H. E. Mason, Portland, is president, and J. J. Hernan is treasurer.

COLUMBUS, OHIO—The Ross Electric Specialty Company, of Cleveland, has been incorporated with a capital of $10,000 by W. H. Kildow, M. Aldredge, George W. Ross, J. W. Burwell and H. C. Gahn.

NEW YORK, N. Y.—The Thomas & Betts Company has been organized to do a general electrical business. The capital is $50,000, and the incorporators are William Bailey, J. Foster Symes and Adnah McMurtrie, of New York city.

ALBANY, N. Y.—The Empire Engineering Company, of New York city, has been incorporated with a capital of $1,000,000, to do a general engineering and contracting business. The directors are Edward D. Adams, Lindon W. Bates, William Barclay Parsons, Alfred Skitt and William S. Hulse, of New York.

TROY, N. Y.—The Eastern Electric Company, of Troy, has been organized to do a general contracting business. The capital is $100,000, and the directors are W. Lewis Burke, W. C. Colburn, Henry J. Speck, James H. Caldwell, William Connors, Cornelius Collins, Troy; E. Frank Andrews, Saratoga Springs.

SACRAMENTO, CAL.—Articles of incorporation have been filed for the Electrical Appliance Development Company with a capital of $64,000. The directors are Herman H. Grau, William Ellery Briggs, J. C. Ellis, Charles W. Hutton and Frederick T. Kitt, all of Sacramento. The purpose of the company is to deal in mechanical devices.

Digitized by Google

ELECTRIC LIGHTING.

CONRAD, IOWA—W. J. Stanton is projecting an electric light plant for Conrad.

COLUMBIA, PA.—The Columbia Electric Light and Power Company has been granted a franchise.

LINDSAY, NEB.—It is stated that plans are being made for the installation of an electric light plant in Lindsay.

ALBION, N. Y.—The board of trustees has granted a franchise to the Niagara Falls Power Company to furnish power to Albion.

SODUS, CAL.—Work is now being hastened on the building for the Sodus Gas and Electric Light Company. It is planned to have the plant in operation by June.

ST. JOHNSBURY, VT.—The village trustees have signed a contract with the St. Johnsbury Electric Company to furnish street lights for the year 1905 at the old price, $64.30 per light.

SILVERTON, COL.—Owing to the inadequacy of the Silverton municipal electric plant to supply the demand for light and power the council has decided to install an additional engine.

McKINNEY, TEX.—The contract for the municipal electric light plant has been let to J. Payton Hunter, of the Hunter Electric Light Supply Company, of Dallas, for $6,500, which covers the necessary material and machinery.

CATSKILL, N. Y.—At the annual election of the Catskill Illuminating and Power Company the following were reelected: W. S. C. Wiley, president; A. M. Young, vice-president; A. O. Shepardson, secretary; W. E. Lampman, treasurer.

MEXICO, MEXICO—A stock company, with a capital of $30,000, to build an electric light plant at Nuevo Laredo, the terminus of the National Railway, on the Mexican side of the Rio Grande, is being organized by Octaviano Gonzalez and associates.

TROY, N. Y.—Because of the extensive interests of the Hudson River Water Power Company and its subsidiary companies in the central part of the state, the principal business offices of the companies will be removed from Glens Falls to Albany.

YORK, PA.—Four electric light companies of York County, the Dallastown, the Red Lion, the Yoe and the Windsor, have been merged into one company under the corporate title of the York & Windsor Electric Light Company. The merged company will have a capitalization of $30,000.

DENVER, COL.—The Guanajuato Power and Electric Company held its annual election of officers in Denver recently, with the following results: Henry Hine, John Hays Hammond, Leonard E. Curtis, Irving W. Bonbright, Horace G. Lunt, John S. Bartlett and C. A. Coffin, reelected directors.

HARTFORD CITY, IND.—Montpelier has found that municipal ownership is a failure, and the city council of that place has passed a resolution turning the control of the light and water plant over to R. G. Kerlin. For a number of years the town of Montpelier has been operating its own water and light plant at a loss.

COLUMBIA, S. C.—It is announced that the Mercantile Trust and Deposit Company, of Baltimore, has purchased the Columbia Electric Light and Power Company. It is also stated that this new affiliation of the Columbia company will not affect its local connections, the executive management remaining the same.

CARLISLE, KY.—A new stock company, with C. C. Cole as president; M. V. Bostain, vice-president; George A. Straus, secretary; John N. Riss, treasurer, has been organized for the erection of a new and modern up-to-date electric light plant, to cost not less than $15,000. Work has begun and light is promised in sixty days.

CHICAGO, ILL.—The Chicago Edison Company will build three substations. At 77 and 79 Plymouth place it will build a three-story station, sixty-two by fifty feet, at a cost of $60,000; at Twenty-second street and Wabash avenue, a substation, fifty-three by sixty-four feet, to cost $50,000, and at Twenty-second and Fiske streets another.

WALLA WALLA, WASH.—The announcement is made that Isaac Anderson and associates, acting for the Northwestern Gas and Electric Company, will build forty miles of transmission line from Pendleton to below Echo and to the Columbia river to furnish power to pump water from the river to irrigate a large tract of desert land.

DENISON, TEX.—The annual meeting of the directors of the Denison Light and Power Company was held recently. Those present were John P. Scullin, of St. Louis; J. T. and W. B. Munson and J. B. McDougall. W. B. Munson was elected president of the company; J. B. McDougall, vice-president, and W. A. Everitt, secretary and manager.

CENTRAL CITY, KY.—The city clerk of Central City recently sold at public auction to the highest bidder the franchises for electric light and street railway. B. F. Creech was the purchaser of both franchises. The conditions under which the sale was made are that the electric light plant shall be completed in eight months and the street railway in eighteen months.

CONNERSVILLE, IND.—A few weeks ago the Connersville Gas, Electric and Power Company was sold at receiver's sale to George B. Markle, of Hazleton, Pa. The new ownership will incorporate as follows: George B. Markle, president and treasurer; R. Neil Burgess, of New York, vice-president and secretary. Mr. Markle, Mr. Burgess and Mrs. Burgess will be the directors.

INDIANAPOLIS, IND.—The new contract between the city and the Indianapolis Heat and Light Company has gone in effect, and will be effective for a period of ten years. This contract provides for the establishment of electric lighting service in any part of the city, upon the petition of property owners, and fixes the yearly rate of the arc street lights at seventy-four dollars per year for each light.

BUTTE, MONT.—The transfer of the Gallatin Light, Railway and Power Company to the Butte Electric Power Company has been completed. The property bought by the Butte company comprises the electric light and street railway systems of the Gallatin County capital, in which the controlling interest was held by Samuel Mendenhall and the estate of Henry Elling. Power for operating the two systems will be obtained from Madison County.

SAN FRANCISCO, CAL.—Charles R. Muller and F. A. Keith have closed a $250,000 contract for the construction of an electric power transmission plant to be located in California, just across the line from Nevada, at a place called The Wells, where there is a plentiful supply of water. Messrs. Miller and Keith are members of an eastern syndicate which has arranged to furnish electric light and power to the Tonopah mine owners and the inhabitants of the Tonopah and Goldfields districts.

LAWRENCEBURG, KY.—The differences between the Lawrenceburg city council and the Electric Light Company have been obviated, and a formal contract has been signed and delivered. The company will begin work on an independent plant as soon as estimates can be prepared and contracts let, and it expects to have the plant in operation within the next four months. The city has an option to purchase the plant at any time within twelve years. The cost will be in the neighborhood of $12,000.

HATTIESBURG, MISS.—The Hattiesburg Light and Power Company has issued a schedule of rates for lighting. The flat rates for lights up to twelve o'clock, midnight, range from a minimum charge of $1 per month up to $6.10 per month, for ten sixteen-candle-power or twenty-eight-candle-power lights. For lights burned all night there is a flat rate of $1 per month for each sixteen-candle-power lamp. The rate for motors ranges from $1 per month for a one-eighth-horse-power motor, to $20 for a five-horse-power motor. For each additional horse-power above five, the charge is $4 per month.

MUSKEGON, MICH.—The Muskegon city council has granted a twenty-five-year franchise to the M. B. Wheeler Electric Company, of Grand Rapids, to furnish electricity for light, heat and power. According to the provisions of the franchise all wires of the company must be laid in conduits in Western avenue, from Pine to Seventh street, and in the valley parallel with and lying between Western and Clay avenues, between Pine and Fourth streets. The company is to pay a fee of $100 a year. The franchise must be accepted in ninety days and the work of installing the wires and apparatus must be completed in four years, or the franchise shall be forfeited.

Digitized by Google

TELEPHONE AND TELEGRAPH.

IMOGENE, IOWA—A rural telephone system is being built between Imogene and Colfax.

COLUMBUS JUNCTION, IOWA—Charles Estle has been granted a franchise for a telephone exchange at Columbus Junction.

CLINTON, IOWA—The Iowa Telephone Company plans the expenditure of about $100,000 in placing its wires underground.

HOBOKEN, N. J.—A new office building will shortly be erected by the New York & New Jersey Telephone Company in Hoboken.

NEW ORLEANS, LA.—The Cumberland Telephone and Telegraph Company will install an up-to-date telephone exchange at Algiers.

COUNCIL BLUFFS, IOWA—Work will begin at once on the Council Bluffs exchange of the new Independent Telephone Company.

FORT WORTH, TEX.—The Southwestern Telephone and Telegraph Company has purchased a plot of ground in Fort Worth, upon which it will erect a new exchange building.

SAN DIEGO, CAL.—The Home Telephone Company will shortly commence work on a number of extensions to its system. These include lines to National City, La Jolla, El Cajon, Ramona, Lakeside, Julian, Alpine and other near-by towns.

EAST PEMBROKE, N. Y.—The directors of the East Pembroke Telephone Company have elected officers for the ensuing year as follows: president, E. C. Richardson; vice-president, Wilber C. Choate; secretary, C. C. Day; treasurer, Ezra A. Seamans.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will erect a $30,000 toll station in Merriam Park during the coming summer. The statement is also made that the company will construct over 1,000 additional miles of long-distance lines during the year.

BLOSERVILLE, PA.—Citizens of Bloserville and vicinity have organized a telephone company, which will be known as the Bloserville Telephone Company. The company will begin the construction of a line from Bloserville to Newville to connect with the United Telephone and Telegraph lines.

DECATUR, ILL.—The Morgan County Telephone Company has about 150 men at work building a long-distance telephone line from Decatur to Birmingham, a distance of eighty-seven miles. At Birmingham connection will be made with all the cities south, and at Memphis with cities west, south and east.

TRAER, IOWA—The farmers of north Tama County, not satisfied with the service they are receiving, are considering the matter of installing an exchange of their own. The plan is to charge a $6 membership fee for country patrons, and $12 for city patrons, and to tax each telephone $3 a year to maintain the exchange.

ROCK HILL, S. C.—The Rock Hill city council has granted a ten-year franchise to the Rock Hill Telephone Company. The city has the privilege of using the company's poles for fire-alarm, police, telegraph and telephone wires. The rate for instruments is not to exceed two dollars per month for residences, and three dollars for business houses.

CORNING, N. Y.—The Corning Telephone Company announces the completion of a new line connecting Monterey and Beaver Dams and intermediate points. The Bell company's exchange now makes direct toll-line connections to Buena Vista, South Howard, Jonesville, North Cameron, Cameron, Cameron Mills, North Jasper, Swale, Adrian and Bonny Hill.

LOS ANGELES, CAL.—At a meeting of the stockholders of the Home Telephone Company officers for the ensuing year were elected as follows: president, Charles E. Summer; vice-president, Heber Ingle; secretary and treasurer, William Godfrey. Directors, William Mead, of Los Angeles, and Heber Ingle, L. J. Wilde, Roscoe Howard, Charles E. Summer and William Godfrey.

BERKELEY, CAL.—The Pacific States Telephone and Telegraph Company is planning a number of improvements to its system in Berkeley. Many of the wires will be placed underground, and a number of new aerial circuits installed. The company is replacing ten-party lines with four-party, two-party and main lines, and will also enlarge its central switchboard to accommodate the increased number of subscribers.

PENN YAN, N. Y.—The annual meeting of the Dundee & Crystal Springs Telephone Company was held at Crystal Springs recently, and the following directors elected for the ensuing year: Frank VanGordon, Barrington; Alfred Horton, Delmar J. Knapp, Barrington; Lyman Pitcher, Lyman Disbrow, George O'Neil, Herbert Lazenby, Tyrone. The following officers were elected: president, Delmar J. Knapp; vice-president, Frank VanGordon; secretary and treasurer, Lyman Disbrow.

WEST PALM BEACH, FLA.—A franchise has been asked for by Dr. J. T. Liddy and associates to build a telephone system. The ordinance submitted provides for commencing the work of installing the system within six months after its passage. Within twelve months the building must be completed. The schedule is not to exceed eighteen dollars per year for private houses and twenty-four dollars per year for hotels and business houses per instrument. The franchise is asked for a term of thirty years.

DENVER, COL.—Extensions of the Colorado Telephone and Telegraph Company, which will cost $200,000 to $250,000, and which will connect Denver with Santa Fe and Albuquerque, N. M., by telephone has been decided upon. At present the local telephone company has been operating in New Mexico only as far as Las Vegas. It is expected that the whole of the extension will be completed by early fall, although many New Mexican places now without telephones will be connected with Denver long before that.

BEAUMONT, TEX.—The new plant of the Southwestern Telephone and Telegraph Company in Beaumont is rapidly nearing completion. A new and modern switchboard will shortly be installed in the exchange headquarters in the Landry Building on Pearl street. When the new equipment is installed approximately fifteen miles of cable will have been strung and the switchboard installed with a capacity of 1,500 telephones, which can be increased to 5,000 if necessary. It is estimated that the equipment installed by the company will be sufficient for the needs of Beaumont for many years.

SPARTA, TENN.—The Gainesboro Telephone Company held its ninth annual meeting of stockholders at Gainesboro recently. The report of the manager showed such a prosperous condition that the dividend was increased from six to seven per cent, beginning July 1. The former directors and officers were reelected. It was decided to spend $50,000 in construction work in Tennessee and Kentucky during the coming summer, new stock to be issued as needed. This company, the headquarters of which are at Sparta, has 2,200 miles of toll line, and operates twenty-five exchanges in Tennessee and Kentucky.

BROKEN BOW, NEB.—A cooperative telephone company has been organized at Broken Bow, for the purpose of purchasing the plant of the Central Telephone Company. At a recent meeting the following directors were elected: J. D. Ream, Broken Bow; M. S. Eddy, Merna; W. E. Warren, Anselmo; William Warren, Calloway; Charles Jeffords, Broken Bow; Thomas Arthur, Comstock; J. O. Taylor, Berwyn; J. E. Cavance, Georgetown, and F. E. Delano, Lee Park. J. D. Ream was elected president, M. S. Eddy, secretary, and L. H. Jewett, treasurer. The cooperative companies of Milburn and Anselmo will effect an agreement with the new company.

CONNELLSVILLE, PA.—The Somerset Telephone Company has put into operation two lines from Pittsburg to Baltimore. The new lines are Nos. 8 and 10. The No. 8 line extends from Meyersdale to Pittsburg, *via* Connellsville, and No. 10 to Pittsburg, *via* Somerset and Johnstown. This makes direct independent connection between Pittsburg and all the principal points in Ohio and West Virginia, *via* Tri-State lines. At Baltimore connection will be made with the Maryland Telephone Company, and communication will be established with York, Pa.; Frederick, Md.; Hagerstown, Md.; Martinsburg, W. Va.; Winchester, Va.; Wilmington, Del. At Philadelphia connection will be made with the Keystone company. The Pittsburg connection is with the Pittsburg & Allegheny Telephone Company.

Digitized by Google

ELECTRIC RAILWAYS.

VALLEY CITY, N. D.—A franchise for a street railway has been granted to O. A. Beeman.

BALTIMORE, MD.—The United Railways Company is to build a new power station with a capacity of 4,000 kilowatts.

MUNCIE, IND.—The Indianapolis & Martinsville Rapid Transit Company will build an extension from Martinsville to Bloomington this year.

CLINTON, S. C.—An electric road is projected to connect Clinton with Spartanburg and Laurens. J. F. Jacobs is at the head of the enterprise.

PITTSBURG, PA.—Work will soon be started on the Wilkinsburg, Turtle Creek & East Pittsburg street railway. The cost of the road will be about $200,000.

BURLINGTON, IOWA—The street car company has received from the city council the right to construct a number of extensions and to double track some of its lines.

SAYRE, PA.—A franchise has been granted to the Sayre & South Waverly Trolley Company. Work must begin within six months. The road is to be completed by December 1, 1907.

COLUMBUS, OHIO—The Columbus, Delaware & Marion Electric Railway is preparing to extend its lines from Marion to Galion. This will give a through service from Cincinnati and Columbus to Cleveland.

MONTGOMERY, ALA.—The Montgomery Traction Company has given a mortgage for $2,000,000 to the Real Estate and Trust Company, of Philadelphia. The money is to be used to build new lines of road and rebuild old lines.

LIMA, OHIO—The Lima Electric Railway and Light Company has been sold to a syndicate of Philadelphia capitalists, headed by Thomas Dolan and Randall Morgan. The new owners propose to extend the line from Lima to Toledo.

ELGIN, ILL.—M. Long, of Woodstock, and other capitalists are securing the right of way for an electric line north from Carpentersville, the terminus of the Elgin, Aurora & Southern Traction Company's road, to Fox and Geneva lakes.

LAGRANGE, IND.—The part of the St. Joseph Valley traction line between Lagrange and Shipshewana has been opened. The line will be extended to Middlebury at once. It is expected that the road will be pushed to Elkhart this summer.

BANGOR, ME.—The Bangor Railway and Electric Company has been organized with a capital of $1,000,000. The new corporation absorbs a number of other railways and electric companies in and around Bangor. John T. Graham is president.

BIG STONE GAP, VA.—Local capitalists have started a survey for 100 miles of electric road to radiate from Big Stone Gap to Appalachia, Stonega, Norton, Wise, Toms Creek and Dorchester. Mineral and timber property will be touched.

BLOOMSBURG, PA.—The Bloomsburg & Millville Electric Railroad has elected the following officers: president, C. W. Miller; directors, L. E. Waller, C. W. Miller, C. M. Creveling, J. C. Brown, Joseph Ratti, C. C. Peacock, Ellis Eves. Construction of the road is to begin immediately.

RICHMOND, IND.—The Tucker-Anthony Syndicate, of Boston, Mass., has announced that it will construct a traction system to connect Indianapolis and Terre Haute. The new line will parallel the St. Louis division of the Big Four Railroad, and pass through several important towns in Indiana.

SEATTLE, WASH.—A franchise has been granted for an electric railroad crossing the south end of Elliott bay and piercing Riverside and Mountain View precincts, in a southerly direction to the end of the McSorley road. The franchise was taken out in the names of Howard H. Lewis and John P. Jacobsen.

RALEIGH, N. C.—A charter has been issued to the Greensboro Railway and Light Company, authorizing the purchase, construction and operation of street railway and lighting plants. The company has $750,000 capital, and the principal stockholders are F. R. Williamson and W. W. Damwell, Greensboro.

CUMBERLAND, MD.—It is reported that a company has been formed to build an electric railway from Rowlesburg, W. Va., to Durbin, a distance of 100 miles. C. W. Mosser and C. E. Mower, Hendricks, W. Va.; E. D. Baker, Beverly, W. Va.; H. A. Armstrong, Parson, W. Va., and R. F. Whitner, Philadelphia, are incorporators.

HARTFORD, CT.—Boston capitalists have bought the Hartford, Manchester & Rockville trolley system and charter of the company, giving them the right to build from Rockville to Worcester, Mass. This line is to built, giving a trolley from Hartford to Boston twenty-three miles shorter than the steam road.

GREENFIELD, IND.—A company has been organized to build an electric railway from Fortville, in Hancock County, to Shelbyville, through Maxwell, Greenfield and Fountaintown. The promoters are M. B. Walker, of Fortville; J. M. McCreery, of Indianapolis; Arthur Jones, of Alexandria; Edwin Downey, of Anderson, and W. A. Hough, of Greenfield.

CUMBERLAND, MD.—The Cumberland & Westernport Electric Railway has been transferred to the Lonaconing & Westernport Electric Railway. The directors of the new Cumberland & Westernport Electric Railway are: Judge R. H. Kock, Pottsville, Pa.; U. B. McCandlish, Piedmont, W. Va.; Roderick Clarey, W. A. Morgart and De Warren H. Reynolds, Cumberland.

DENVER, COL.—The Arapahoe county commissioners have granted a franchise to the Colorado Monorail Company to build a road from Denver to Littleton. The company purposes constructing and operating a system having but one rail. It will use a double trolley. Work must be started before July 1, 1905, and cars must be running before January 1, 1906.

YORK, PA.—A syndicate of Philadelphia capitalists has been granted a charter by the state department to build a street railway from York to Long Level, on the Susquehanna river, a distance of fourteen miles, and taking in the towns of Green Hill, Longstown, Yorkanna and East Prospect. The directors are Joseph T. Walmsley, John F. B. Atson, William Fine Gleason and Joseph B. Lanning, all of Philadelphia.

CHICAGO, ILL.—The Chicago, Kankakee & Champaign Electric Railroad Company has been incorporated with a capital of $100,000 to build a road from Chicago to towns in Will, Kankakee, Iroquis and Champaign counties. The incorporators and the first directors are F. L. Butterfield, C. V. Donovan, W. J. Root and Attorney C. O. Patton, of Chicago; E. D. Risser, R. A. McCracken, of Paxton, Ill., and Upton Schaub, of Watseka.

LAFAYETTE, IND.—The Lafayette & Southwestern Traction Company proposes to build from Lafayette into the Indiana coal fields. The capital stock will be $1,000,000. It is understood that the right of way of the Fountain-Warren Traction Company will be used by the Lafayette & Southwestern and that the directors of the former road will be interested in the new venture. William S. Baugh, of Lafayette, is at the head of the road.

BOSTON, MASS.—A charter for a new trolley line between Boston and Haverhill has been obtained by incorporators interested in the Haverhill and Boxford and the Maplewood and Danvers companies. The Haverhill and Boxford line will be eleven miles long, and will have a capital of $110,000. The Maplewood company's line will be nineteen miles long and will be capitalized at $190,000. The route of the combined companies will be through Malden, Melrose, Saugus, Lynnfield, Peabody, Middleton, Boxford and Haverhill.

ST. LOUIS, MO.—The county board of Monroe County, Ill., has granted a franchise to the East St. Louis, Waterloo & Chester Suburban Railroad Company for an electric line from East St. Louis to Columbia, Waterloo, the Mammoth Cave, Red Bud and other points through to Chester. Construction work will begin within thirty days and the road be completed by November, 1906. The company has also been granted the right of way through Randolph County to Chester, and expects to secure a similar privilege through the western part of St. Clair County. Thomas N. Chase, of St. Louis, is president of the road.

Digitized by Google

PERSONAL MENTION.

MR. HORATIO A. JOHNSON, northwestern manager for the American Telephone and Telegraph Company, with headquarters at St. Paul, Minn., has resigned. He is to be succeeded by P. K. Harlan, of Chicago.

MR. JAMES F. BOYLE, manager of the Pittston, Pa., office of the People's Telephone Company, has been transferred to Scranton as manager of the material department, and will enter on his duties in that city May 1.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, Ill., has been selected as principal assistant engineer of the drainage board. Mr. Ellicott probably will have charge of the water-power development works at Lockport.

MR. J. E. FORMAN has tendered his resignation in the electrical department of the Burlington railroad shops at Hannibal, Mo., to accept a position as constructing engineer for the electric street car line which is to be built at Monroe, La.

MR. WILBUR B. DRIVER announces that he has disposed of his interest in the Driver-Harris Wire Company, of Newark, N. J., and has resigned as president of that company. He will hereafter devote himself to the sale of special materials to meet particular requirements.

OBITUARY NOTICE.

MR. ARTHUR C. FROST, for many years superintendent of the Direct United States Cable Company, died on Sunday, April 23, at his home in New York city. He was fifty-one years of age, unmarried, and had no relatives in this country. He came from Wakefield, England, twenty years ago, and for thirty years had been in the service of the Cable Company. His office was at No. 60 New street, and he was very well known among men identified with the cable interests of the country.

NEW PUBLICATIONS.

THE TWENTIETH CENTURY ELECTRIC LIGHT—Mr. F. M. F. Cazin, Hoboken, N. J., has reprinted, in book form, a number of articles entitled "What Next in Electric Incandescent Lamp Making?" In addition there is a contribution on "An Important Natural Law Relating to Hydraulics, Nautics, Aeronautics and Astronomy." Mr. Cazin is the inventor of the Cazin lamp, which makes use of a filament embodying the applicability of rare earths as an illuminant. The book contains a great deal of very interesting reading. The frontispiece is an illustration of a fifty-candle-power Cazin lamp.

PHILIPPINE POWER-HOUSE AT THE LOUISIANA PURCHASE EXPOSITION—The Philippine Exposition Board of the United States War Department has issued a small pamphlet descriptive of the Philippine power-house at the Louisiana Purchase Exposition. The pamphlet contains twenty-one pages, and describes and illustrates very completely the power plant on the Philippine grounds at the World's Fair, St. Louis. The ground for the plant was surveyed on April 4, 1904, and the first machine was started on May 24. The boiler-room equipment consisted of four 256-horse-power Franklin water-tube boilers, arranged in batteries of two each. The engine room contained four generating units, delivering sixty-cycle, two-phase current at 2,200 volts. The machines ranged in size from 160 kilowatts to 240 kilowatts, and were driven by various types of engines.

PROJECT FOR THE PANAMA CANAL—Mr. Lindon W. Bates has published in book form, "A Project for the Panama Canal, with General Plans and Profiles of the Waterway, the Regulation Works, and the Terminal Harbors." Mr. Bates first takes up the factors and conditions on the Isthmus of Panama. He sketches the character and description of the present favored projects, and analyzes the tidal conditions at the Atlantic and Pacific sides of the proposed isthmian waterway. Criticisms are made of plans which have been considered, from time to time, and received more or less favor, and a critical analysis is made of the plan at the present time most favored by the commission which has the undertaking in hand. The project which Mr. Bates sets forth he considers more scientific and conducive to a considerable lower cost of construction and maintenance.

STATE AND TERRITORIAL GENERAL STATUTES RELATING TO THE USE OF STREETS AND HIGHWAYS—Under the title of "State and Territorial General Statutes Relating to the Use of Streets and Highways by Street Railway Companies, Water and Electric Light Companies," James S. Cummins, general counsel for H. M. Byllesby & Company, engineers, Chicago, Ill., has compiled a vast amount of matter of great value. The design of this book is to make a ready reference, giving the general laws of the various states and territories primarily governing the subject of franchise rights. Much preliminary expense has been incurred through an ignorance on the part of business interests on the subject of the fundamental laws governing the issuance of franchises. A preliminary reference to such laws would have shown at once whether the franchises in question were invalid or doubtful. The work is published by H. M. Byllesby & Company.

ELECTRICAL SECURITIES.

The four-day session of the market last week was full of activity, and, to some interests, was fraught with the elements of demoralization. The sharp break in prices brought about a number of notable declines, with the average at the close of the session considerably lower than for many weeks. In some quarters it is held that the rapid upward swing of prices which has marked events for several weeks past made inevitable the reactionary turn just witnessed; in fact, those interests which reaped the greatest benefit from the decline, materially helped to boost values latterly in order to make the market more vulnerable to the bear attack. It is significant, too, that the up-and-down movement has been almost entirely professional, the public stolidly refusing to accept the high valuation placed upon stocks by the boomers, and taking away a large part of the support upon which these interests relied in maintaining these issues at their high level. Notwithstanding the market decline, however, there appears to be no abatement in the general condition of prosperity. The continuance of favorable climatic conditions seems to assure early planting with the ultimate promise of bounteous harvests, and the mild weather prevailing makes for uninterrupted constructions, the apparent slumbering of destructive labor agitation helping materially to add to the stability of the prophecy of a good spring and summer season.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 22.

New York:	*Closing.*
Brooklyn Rapid Transit	66
Consolidated Gas	200
General Electric	180¼
Interborough Rapid Transit	206½
Kings County Electric	200
Manhattan Elevated	164½
Metropolitan Street Railway	120
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	192

Boston:	*Closing.*
American Telephone and Telegraph	144
Edison Electric Illuminating	255
Massachusetts Electric	68
New England Telephone	138½
Western Telephone and Telegraph preferred	99½

The American Telephone and Telegraph Company's instrument output for March broke all records for both gross and net output. The gross output of 169,159 for March compares with the previous high record of 134,301 made in February, while the net output of 121,514 compares with the previous record of 92,934 made in January. Coupons from the 5 per cent, three-year gold coupon notes of the company, by their terms payable on May 1, 1905, at the office of the treasurer in the city of New York, or, at the holder's option, at the office of the treasurer in the city of Boston, will be paid in New York by the Manhattan Trust Company, 20 Wall street, or in Boston by the National Bank of Commerce, Sears Building.

Philadelphia:	*Closing.*
Electric Company of America	12¼
Electric Storage Battery common	84
Electric Storage Battery preferred	84
Philadelphia Electric	11⅜
Philadelphia Rapid Transit	34⅜
United Gas Improvement	121⅞

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	165
Metropolitan Elevated preferred	61
National Carbon common	67
National Carbon preferred	115
Union Traction common	6½
Union Traction preferred	30

It is stated that Chicago Union Traction passenger earnings are showing an increase of $2,000 per day this year, due mainly to improved electric cars.

Digitized by Google

NEW INCORPORATIONS.

BENSON, MINN.—The Swift County Telephone Company. $25,000.

ITHACA, N. Y.—Spring Lake & Red Creek Telephone Company, of Westbury, Wayne County. $1,000.

AKRON, IOWA—Akron Telephone Company. $30,000. Directors: E. F. Cobb, C. B. Cobb and M. C. Pember.

SUMMITVILLE, IND.—Summitville Telephone Company. $5,000. Directors: R. W. Inglis, A. A. Inglis, T. E. Cartwright.

LAWN RIDGE, ILL.—Lawn Ridge Telephone Company. $3,500. Incorporators: J. W. Hurd, P. E. Phillips and William Gruner.

KENOSHA, WIS.—Burlington, Brighton & Wheatland Telephone Company. $5,000. President, Henry Runkel, Wheatland.

INDIANAPOLIS, IND.—The Dinkins Electric Company. $10,000. Incorporators: D. E. Dongan, Henry Hedley and J. H. Hall.

SPRINGFIELD, ILL.—Chicago, Joliet & Kansas City Railroad Company. To construct a line from Chicago to Joliet. $1,000,000.

CHUCKATUCK, VA.—Chuckatuck Telephone Corporation. $1,000. Incorporators: G. W. Butts, W. A. Willis, Robert C. Hall, all of Chuckatuck.

NEWARK, ILL.—Farmers and Merchants' Telephone Company, of Newark, $4,000. Incorporators: Peter Thompson, Albert Fowler, F. Sleezer.

NEW YORK, N. Y.—The Weiderhold Light Company. $200,000. Directors: George Lucas, Alfred Matthews and W. A. A. Brown, of Brooklyn.

McCONNELLSVILLE, OHIO—Riverside Telephone Company. $25,000. Incorporators: John D. Erwin, W. A. Cosgrave, W. P. Scott and others.

TIEMONTON, UTAH—Bear River Valley Telephone Company. $25,000. Officers: G. L. Carlton, president; John Sommer, treasurer and general manager.

NEW YORK, N. Y.—Williamsburg Power Company. $150,000. Directors: F. P. Foster and James Foster, New York city, and W. H. Robinson, Brooklyn.

NEWARK, N. J.—Mobile Electric Company. $100,000. Incorporators: Percy Ingalls, West Orange; Daniel H. Rich, East Orange; Earl E. Whitehorne, Verona.

BIRDSEYE, IND.—Farmers' Telephone Company. $110. Directors: George T. Veach, Joseph E. Harmon, W. H. Sinclair, Thomas Nelson and John W. Adkins.

HATTIESBURG, MISS.—The Hattiesburg Traction, Light and Fuel Company. $250,000. Incorporators: H. L. McKee, S. H. Witherspoon, J. M. McBeath and others.

PIERRE, S. D.—Palatine Telephone Company, of Palatine township, Aurora County. $24,000. Incorporators: A. D. Dougan, John Saville and others, of Plankinton.

ALBANY, N. Y.—Findley Lake & State Line Street Railway Company. $130,000. Incorporators: F. R. Nicols, Titusville, Pa.; F. Baeder, Corry, Pa.; E. A. Austin, Cutting, N. Y.

RICHLAND TOWNSHIP, ILL.—The Richland & Shelbyville Township Mutual Telephone Company. $2,500. Incorporators: L. N. Douthit, James Stewardson, William H. Brown.

EDGERTON, OHIO—Edgerton Telephone Company. $30,000. Incorporators: Jacob Zeeb, Claude E. Hoover, Walter S. Unger, James F. Reasoner, Lewis E. Graff and Emmet A. Geauque.

MONTGOMERY, ALA.—The Tallapoosa Water Power and Electrical Company. To build a dam at or near Sturdevant, for the purpose of generating electricity by water power. $100,000.

VANDALIA, ILL.—The Dieckmann Electric and Improvement Company. $110,000. To operate heat, light and power plants. Incorporators: George A. Dieckmann, J. R. Myers, J. F. Hibbetts.

PASSAIC, N. J.—Yanticaw Light, Heat and Power Company. $50,000. Incorporators: Michael F. Burns, Brooklyn, N. Y.; Solomon M. Shatzkin, Walter Kip, John J. Bowers, William H. Carroll, Leonard L. Grear, William H. Gilmor, Passaic.

BELLE PLAINE, IOWA—Iowa Valley Interurban Railway Company. $100,000. Incorporators: A. J. Hartman, W. A. Mall, M. J. Randall, H. R. Mosnat, George W. Voss, T. H. Milner, William A. Montgomery, C. J. Snitkay, Fred McCulloch, Thomas F. Murray, F. C. French.

DALLAS, TEX.—Texas Consolidated Long-Distance Telephone Company. To build and operate a long-distance telephone system in a number of counties of north Texas. $30,000. Incorporators: G. Locke Arnold, C. L. Simpson, A. W. Stearns, F. B. McElroy and A. J. Brown, all of Dallas.

ALBANY, N. Y.—Cohocton Telephone and Telegraph Company. To construct telephone lines connecting towns and villages in Steuben, Ontario and Livingston counties. $3,000. Directors: H. M. Bennett, Hornellsville, and A. H. Wilcox, H. P. Wilcox, C. C. Newcomb, F. E. Jackson, A. C. Westfall and E. S. Brown, of Cohocton.

PIERRE, S. D.—City Railway Company, of Sioux Falls. To construct an electric railroad system in Sioux Falls and in the surrounding country, to extend into the counties of Minnehaha, McCook, Turner, Lake, Moody in South Dakota, and Rock in Minnesota, and Lyon in Iowa. $500,000. Incorporators: J. R. Sheeley, Osceola, Iowa; G. W. Rhine, Tore Tiegen, Sioux Falls.

EDUCATIONAL.

SUMMER COURSES AT THE ARMOUR INSTITUTE OF TECHNOLOGY—The Armour Institute of Technology, Chicago, Ill., will offer courses in mechanical engineering, electrical engineering, telephone engineering, civil engineering, chemical engineering, drawing and shopwork, manual training, mathematics and physics, from June 26 to August 4, 1905. The course in telephone engineering is something new, and is designed to meet the wants of those who desire to devote their whole time to the acquirement of a knowledge of telephony as it is practised to-day.

SUMMER COURSES AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The Massachusetts Institute of Technology, Boston, Mass., announces a summer course during the months of June and July, supplementing the work of the regular school year. The summer courses are undertaken primarily for the benefit of two classes of students: first, for those who wish to prolong their stay in summer in order to distribute their work over a larger portion of the year or to gain more time for advanced work in the regular courses; second, for those who, through illness or other causes, have deficiencies to make up. The summer courses are also open to persons not students in the Institute of Technology, if they possess the necessary qualifications.

ENGINEERING SOCIETIES.

STEVENS CLUB OF NEWARK—The Stevens Club of Newark, N. J., held its second regular meeting at C. A. Stetter's restaurant, Newark, on the evening of April 14. After the transaction of business a paper on "Motor-Driving of Machine Tools" was presented by Mr. E. R. Douglas, of the Crocker-Wheeler Company. The paper dealt with the various methods of motor driving, and discussed the great advantages to be obtained by the use of variable-speed motors and high-speed steel. Comparisons of the cost of performing various operations on belt-driven and motor-driven tools were made, showing the saving due to the use of the motor.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY—Vol. vi, of the transactions of the American Electrochemical Society, covering the meeting which was held at St. Louis, Mo., September 13 to 16, 1904, in conjunction with the International Electrical Congress, has been received. This volume is divided into two sections, the first comprising a series of papers which was read at the sixth general meeting of the society. The second part comprises those papers which were read at the joint meeting of Section C of the fifth International Electrical Congress and the American Electrochemical Society. There are in all twenty-one papers, some of which are of much interest. "The Chemistry of Electroplating," by Dr. Wilder D. Bancroft; "The Carbon Cell," by F. Haber and L. Bruner; "The Electrochemical Series of Metals," by Louis Kahlenberg; "A Study of the Metals Used in Standard Cells and Their Preparation," by H. S. Carhart and G. A. Hulett; "The Electrometallurgy of Iron and Steel," by Paul L. T. Héroult, and "Electrolysis and Catalysis," by W. Ostwald, are perhaps the papers which attracted the most attention. While these transactions are distributed to the members of the society and the members of the Faraday Society, of England, only, they can be purchased by others. The price is three dollars; to colleges, technical societies and journals, two dollars. The secretary of the American Electrochemical Society is Mr. S. S. Sadtler, 39 South Tenth street, Philadelphia, Pa.

Digitized by Google

INDUSTRIAL ITEMS.

THE CORLISS ENGINE WORKS, 4041 North Fifth street, Philadelphia, Pa., is distributing a catalogue describing the "Rickard" Corliss engine.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, has issued bulletin No. 19, describing direct-current fan motors. These include both desk, wall and ceiling fans.

THE BRYAN-MARSH COMPANY, Chicago, Ill., has moved its office from the Fisher Building to 1113-1116 Manhattan Building. At this place the company will occupy larger quarters.

THE A. D. GRANGER COMPANY, 95 Liberty street, New York city, has issued a catalogue describing the "Vulcan" shaking and dumping grates, also boiler fronts and other boiler accessories.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued bulletin No. 70. This bulletin describes single-phase motors for elevator, hoist and traveling crane service.

THE AMERICAN ELECTRIC AND CONTROLLER COMPANY, 12 Dey street, New York, has issued bulletin No. 3, describing the solenoid switches for alternating current which are made by it.

H. M. BYLLESBY & COMPANY, Chicago, Ill., have been appointed managers and engineers of the gas and electric properties of the San Diego Consolidated Gas and Electric Company, of San Diego, Cal.

THE BROWNING ENGINEERING COMPANY, Cleveland, Ohio, is distributing some attractive literature concerning its locomotive crane. Other bulletins describe the coil spring friction clutch and an automatic grab bucket of the improved clam-shell type.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., will be pleased to send circular No. 8 and circular No. 10, series B. These circulars describe, respectively, controlling apparatus for the "Interpole" variable-speed motor, and the constant-speed motor, type I.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1007 Market street, St. Louis, Mo., will be pleased to send its descriptive literature containing "Trojan" electric fans. These are made both in desk and ceiling types, and contain many features of particular merit.

THE WILMARTH & MORMAN COMPANY, Grand Rapids, Mich., has issued catalogue No. 90, describing the new "Yankee" drill grinder made by it. The catalogue describes and illustrates a large number of different types of drill grinders, and also gives some information relating to drills.

THE F. BISSELL COMPANY, Toledo, Ohio, is distributing a circular, calling attention to the applicability of the Burns adjustable telephone. In addition to a special form of telephone instrument, the adjustable holding rack is made so as to accommodate any form of standard desk telephone.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., will be pleased to send issue No. 3 of its electrical catechism. The introductory to this number is a quotation from Sir Oliver Lodge, and the rest of the number is given up to a description of the application of electrical measuring instruments.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Ames, Iowa; Liberty, Ill.; Daykins, Neb.; Higginsville, Mo.; Ashton, Ill.; Sheffield, Ill.; Walnut, Ill.; Lamoille, Ill., and Buffalo Gap, S. D.

I. B. WILLIAMS & SONS, 45 Dey street, New York, have issued a booklet entitled "What a Belt Should Do." In it are discussed the proper care and application of belts, together with rules for horse-power of belts, and also some notes on the adaptation of the different types of belts to various uses.

THE SHAW ENGINEERING AND MANUFACTURING COMPANY, Fuller Building, New York city, has been retained as consulting electrical engineer for the Asbury Park Pier Company, in connection with the installation of an isolated plant. There will probably be installed 10,000 incandescent lamps, and a 200-arc lighting equipment.

THE COLONIAL FAN AND MOTOR COMPANY announces that it has moved its office from Ravenna to Warren, Ohio. This is necessitated by the increase in business. The company will now be in a much better position to handle orders and to make more prompt shipments than from the office at Ravenna.

FRANK B. GILBRETH, Boston, Mass., will send, upon request, his illustrated bulletin calling attention to his system of rapid construction. Mr. Gilbreth acts as general contractor for all kinds of construction work, and has been remarkably successful in carrying to completion in short time some very large installations.

THE NERNST LAMP COMPANY, Pittsburg, Pa., is distributing a very attractive pamphlet entitled "Church Lighting by Electricity." This gives some interesting information concerning the problem of church lighting by electricity. Illustrations are given, showing the application of Nernst lamps for this particular form of illumination.

THE CROWE METAL MANUFACTURING COMPANY, Chicago, Ill., is distributing a novel catalogue showing, in a very attractive manner, the form of stampings and name-plates which it manufactures. These name-plates are printed in characteristic colors, and in bronzes of various forms, so that a very realistic reproduction is possible.

THE ELECTRIC UTILITIES COMPANY, Fuller Building, New York city, is distributing a catalogue descriptive of the "Metaphone," which is an interior telephone, consisting of a transmitter and receiver mounted on opposite ends of a short metal handle. The catalogue describes various uses of the "Metaphone," including office and hotel call systems.

THE BRYANT ELECTRIC COMPANY, Bridgeport, Ct., has issued a very extensive catalogue, illustrating and giving dimensions of the electrical supplies which it manufactures. This book is very complete, and in its 210 pages includes a very wide range of electrical supplies. A carefully arranged index makes it easy to find any particular piece of apparatus.

THE WILLIAMS TELEPHONE AND SUPPLY COMPANY, Cleveland, Ohio, has issued a booklet which, under the title of "A Short Trip to Town," illustrates and describes the telephone apparatus manufactured by the company. This apparatus includes lightning arresters, transmitters, receivers, magneto generators, induction coils, extension bells and complete sets.

W. H. SCHOTT, 1218 Marquette Building, Chicago, Ill., designer and builder of the Schott systems of central station heating plants, has published an attractive booklet entitled "From Necessity to Luxury." This sets forth the advantages of a central station heating plant. Attention is called to the convenience and accommodation which are inherent with this form of residence and large-area heating.

THE NEW YORK SAFETY STEAM POWER COMPANY, New York city, will occupy offices on the fourth floor of the Engineering Building, 114 Liberty street, New York city. The company will also maintain an erecting and repair department storeroom in New York city, and a complete stock of finished products will be carried ready for immediate shipment from the works, which is within twelve hours of New York.

THE WELLMAN-SEAVER-MORGAN COMPANY, Cleveland, Ohio, is distributing a circular describing the Johnson patent arch plate. This plate is to facilitate repair to open-hearth furnace door arches. It fits on the ram of the charging machine, and can be quickly placed in position. It shields the workmen from the heat in the interior of the furnace, thus enabling repairs to be made without shutting down the furnace.

THE GERMANIA ELECTRIC LAMP COMPANY, Harrison, N. J., has been incorporated with a capital stock of $125,000. The president is George Campbell; vice-president, S. G. Waterman; secretary and treasurer, Edward Campbell. The company expects to make extensive enlargements to its plant in the near future, which will not only enable it to keep up its high standard of

Digitized by Google

Germania lamps, but which will also give facilities for a greatly increased output.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is distributing a very attractive booklet entitled "Summer Comforts." This booklet describes, in very interesting fashion, the part played by "Wood" fan motors in producing summer comfort. The various details of "Wood" fan motors are described, and the text is illustrated by a number of engravings showing the assembly and application of the various types of fan motors.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., has published a new bulletin, No. 30, covering "Boston" cable clips and "Shawmut" marlin hangers. The "Boston" clip is the original metal cable clip which has been manufactured by the Chase-Shawmut Company for a number of years. The "Shawmut" marlin hanger is a new departure with this company. Copies of the bulletin will be sent to any one interested upon request.

DODGE & DAY, engineers, Philadelphia, Pa., who have for the past three years designed the electrical equipment for operating the hoisting and conveying machinery built by the Dodge Coal Storage Company, will also have charge of similar work in connection with the telepherage apparatus that will now be manufactured by the Dodge Coal Storage Company as a result of its acquisition of the United Telpherage Company's interests.

JOSEPH H. THOMPSON, JR., 11 Broadway, New York city, will be pleased to send his new catalogue of electrical and steam machinery for immediate delivery. This is designated as "Bargain List No. 3." The list contains a large variety of direct-connected units, compound and simple engines. boilers, generators and motors, alternators, railway motors and cars, arc dynamos, steam shovels, and a large assortment of miscellaneous equipment.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is distributing publication No. 25, entitled "A Guide to Telephone Promotion and Organization." The book tells the advantages of the telephone on the farm, and gives estimate of the cost. Directions for organizing a farmers' mutual telephone company, together with a model constitution and by-laws, are given. Directions for erecting and operating the lines comprise a large part of the book.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., announces that it has designed and now has ready for the market an entirely new line of induction motors which it can offer at considerably lower prices than the motor it has heretofore been furnishing. A careful study of the design of induction motors has been made, covering a period of some years, with a view not only to improving the motors, both mechanically and electrically, but also to cheapening their cost.

THE FREDERICK PEARCE COMPANY, New York city, has been incorporated under the laws of the state of New York, to continue the business of Frederick Pearce, successor to Pearce & Jones, manufacturing electricians. The business has been successful, and the aim is to do only strictly first-class work, the basis upon which the company has operated since its establishment in 1872. Mr. Frederick Pearce is president of the corporation; Charles F. Pearce, vice-president; George H. Tamlyn, secretary and treasurer. In addition, Mr. Walter H. Pearce is one of the directors.

W. N. MATHEWS & BROTHER, 219 North Second street, St. Louis, Mo., are distributing a handsome booklet entitled "Anchors That Hold." This booklet gives a few facts concerning the "Stombaugh" guy anchor. A very interesting contribution is the account of tests made by Professor R. C. Carpenter, of Sibley College, Cornell University. This describes several very severe tests to which this guy anchor was subjected, and develops a formula for computing the resisting power of the anchor. A number of illustrations are given, showing typical applications of the "Stombaugh" anchor.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY, through the office of the general passenger agent, Grand Central Station, New York city, is distributing No. 38 of the *Four-Track* series. This gives an idea of what the New York Central lines are doing to give service to all parts of the country. This great system of American railways accommodates more than one-half the entire population of the United States, and a large proportion of the population of the Dominion of Canada. It also handles considerable business to and from the republic of Mexico. The company has offices, with its own correspondents, in every country on the globe, placing a belt of information bureaus around the earth.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces the following contracts, which have been closed very recently: as an extension to its system the Louisville Railway Company will install two 750-kilowatt, three-phase rotary converters, six 300-kilowatt air-blast transformers with blower outfits, and two switchboards. The United Railways and Electric Company, of Baltimore, has contracted for three 1,000-kilowatt rotaries and nine 350-kilowatt air-blast transformers. These will operate on a 13,000-volt line, transforming to 330 volts. Eighteen rotary converters, with a total capacity of 27,000 kilowatts, in 1,000 and 1,500-kilowatt units, will be placed in substations for the New York Central & Hudson River Railroad Company. Two 1,500-kilowatt, direct-current generators will be built for the Carnegie Steel Company, to furnish power to two 1,500-horse-power, 250-volt motors. For the protection of this apparatus, 10,000-ampere circuit-breakers will be mounted on the switchboard. These motors will be the largest ever built for this voltage. The company's name is generally associated with large machinery and extensive enterprises. An immense business, however, is done in small apparatus. For the driving of machines in its works, the Surpass Leather Company, Philadelphia, Pa., has ordered eighteen induction motors, varying in size from one-half to fifty horse-power. The State Company, of Columbia, S. C., has contracted for twelve direct-current motors, ranging in capacity from one to twenty horse-power; and Murdock, Kerr & Company, of Pittsburg, will receive the same number, having various outputs from two to seventy horse-power.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces the purchase by the Detroit United Railway of one heavy-duty, cross-compound Reynolds-Corliss engine, 32 by 68, for direct connection to a 1,500-kilowatt generator. This will be installed in the company's station on Atwater street, in Detroit, Mich., where it has been found necessary to provide for an extension to the existing power plant. The Wheeling & Lake Erie Railroad Company has ordered from the Allis-Chalmers Company's electric department, the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, equipment for its new machine and car repair shops at Canton, Ohio, consisting of two engine-type 250-volt generators, one of which is 150 kilowatts and the other seventy-five kilowatts, and sixteen motors with capacities aggregating 300 horse-power. The Mansfield, Ohio, Railway, Light and Power Company, which is completely revamping its power plant, has placed an extensive order for the necessary machinery, including one 250-kilowatt and two 530-kilowatt Bullock generators, one 500-kilowatt and one 600-kilowatt railway generators, one 125-horse-power motor and one motor-generator set. The contract goes to Allis-Chalmers Company, which will construct the apparatus at its electrical works in Cincinnati. The Allis-Chalmers Company has also received an order from Chapin & Gore, Chicago, for three Reliance engines and three generators for direct connections to same, complete with switchboards, etc., to be installed as a plant for electric light and power used in the Majestic Theatre and office building in that city. The Chicago & Northwestern Railway Company has placed an order with the same company for two Reliance 32 by 36 inches belted engines and two 250-kilowatt direct-current Bullock generators. These will be installed as two separate units in the power-house of the company at Buxton, Iowa, and used for driving machinery in the coal mines there, which furnish fuel for some of the western divisions of the road. It is also announced that the Turner Falls Company, of Turner Falls, Mass., is to erect a power plant consisting of four 1,000-kilowatt generator units, two 300-kilowatt generators for light loads, and one seventy-five-kilowatt exciter generator, all water-wheel driven and direct-connected to water-wheel shafts, together with one motor-driven exciter of seventy-five kilowatts. The generators will all be alternating-current, three-phase, sixty-cycle, 2,000-volt machines. One 1,000-kilowatt Bullock generator and the seventy-five-kilowatt exciter are to be installed shortly, the apparatus having been ordered from the Allis-Chalmers Company. The water power at Turner Falls is being developed for commercial uses, and promises to become a factor of considerable importance in the industrial activity of that section of Massachusetts.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 18. NEW YORK, SATURDAY, MAY 6, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
- Steam and Fogs . . . 715
- Curious Comments . . . 715
- Electrical Measuring Instruments . . . 716
- The Meeting of the American Electrochemical Society . . . 717

The International Railway Congress . . . 718
The American Railway Appliance Exhibition . . . 718
Lighting Investigation in New York City . . . 720
Electrical Exhibition . . . 720
Society of Post Office Engineers . . . 720
The Electric Ore Unloaders at Conneaut, Ohio . . . 721
Electricity on Steam Railroads . . . 723
The New Plant of the Manila Electric Railway and Lighting Company . . . 727
The Seventh General Meeting of the American Electrochemical Society . . . 731
Locomotives as Fog-Makers . . . 736
American Institute of Electrical Engineers . . . 737
The Iowa Electrical Association . . . 739

INDUSTRIAL SECTION:
- Asbestos Building Lumber . . . 740
- New Electrical Apparatus . . . 742
- National Electric Company Reorganized . . . 743
- An Electromagnetic Clutch and Brake . . . 743
- An Automatic Speed Adjuster . . . 744
- Annual Report of the General Electric Company . . . 746

CURRENT ELECTRICAL NEWS . . . 747

STEAM AND FOGS.

It has been stated recently that the terrible London fogs are due mainly to the steam escaping in that city from locomotives and steam-generating stations, and it was suggested at the same time that the general introduction of electric in place of steam locomotives would do much toward alleviating this evil. This would be a rather unexpected result of the introduction of electricity in place of steam. Only recently the electrical method of dispersing fogs proposed by Sir Oliver Lodge was under discussion, as the result of a particularly bad fog; but an ounce of prevention is worth a pound of cure, and there is some hope for a fogless London if the steam locomotive is guilty, for it will soon be banished from the city. However, all of the blame can not be laid to the locomotive, as, undoubtedly, far more steam is turned loose from the stationary plants. This suggests that such plants be required either to install condensers to prevent the escape of steam into the air, or to purchase electric power and abandon the steam engine.

CURIOUS COMMENTS.

In a recent issue of one of our esteemed British contemporaries devoted to the electrical industries are found some comments made by a British engineer as a result of a trip through this country last fall. These comments are interesting from several points of view: first, they are the opinions of an Englishman doubtless well informed in his own line of work, and who took advantage of a trip to this country to study, so far as time permitted, the methods adopted for carrying out the processes with which he was most particularly concerned. Naturally, he was quick to see points where we are behind English practice, but it is rather curious that he apparently did not see any processes in use better than those which his own company employs.

Some of the views expressed in these comments are interesting, because they apparently conflict. For example, at several points our critic dwells upon the better class of labor found in this country, and the better remuneration given; yet, almost in the same breath, he says that, generally speaking, we do not take so much care with the product as is usual in English practice, and the inspection of the finished article is less rigid. Perhaps this difference in practice results from the higher class labor obtainable on this side of the water.

Another criticism—in fact, the one upon which the greatest stress is laid—is rather surprising to us, at least. The critic says that, in the particular class of work in which he is concerned, we are far behind the times, the directors of one factory evidently fancying that what was a good method fifty years ago is quite suitable to present-day requirements. The machines we use are run too slowly, and are not of the best design. This would seem not to be in agreement with our reputation for scrapping machines whenever we can find an excuse for so doing. But it is even more surprising to find our good critic concluding his remarks with the statement that he learned it was the practice with nearly all large firms in America to send one of their representatives to England and the Continent every year. They generally tour on that side for about two months, and by this means the firms in America keep themselves posted as to what are the latest English and Continental practices. This idea struck him as being particularly good. But it is more than strange to learn that, although we make a practice of finding out what is best and latest, we still adhere to processes fifty years behind the times. We must conclude either that the manufacturers whose work is criticised know what is being done abroad and are satisfied that they are doing better, or that they are an exception to the general practice mentioned above.

Digitized by Google

ELECTRICAL MEASURING INSTRUMENTS.

The part played by measuring instruments in the electrical arts is very probably more important than that played by similar apparatus in any other applied science. There are several reasons why this should be so. One is the comparative ease with which the different states of electrical energy can be measured. For example, it is a simple matter to measure the energy delivered to an electric motor; but to determine the energy supplied to a steam turbine is somewhat troublesome: we must determine the amount of steam supplied, and its condition before and after passing through the turbine. With an electric motor, what is, in effect, the same process is accomplished directly by the ammeter and voltmeter, or perhaps the wattmeter alone.

Another influence which has had much to do with developing the use of electric instruments is what we may call the comparative youth of applied electricity. Electrical science was fairly well developed before we began to make practical use of this form of energy. Then young and enthusiastic men took hold of it, and began to develop its useful features and apply them in many directions. They soon realized that in handling this invisible form of energy—one which could not easily be stored up, as heat is in steam—it was most desirable to devise apparatus which would indicate what was going on in the electrical circuits. Doubtless, the inquisitive minds of these young men led them to attribute more importance to the measuring of electrical energy and its states than older minds would have thought necessary. At any rate, it is a noteworthy fact that, from the very first, when electric generators began to be put to actual work, some form of measuring instrument has been attached to the machine. The old steam engineer, on the other hand, or the man who had mechanical energy for sale, paid little attention to this matter, and was satisfied to make a flat rate with his customer, and to see that his coal pile did not dwindle away too rapidly.

It is significant, in view of the important part played by electrical measuring instruments in all branches, that at the recent meeting of the American Institute of Electrical Engineers several papers were presented which dealt with a number of phases of the use of these devices. Indeed, one of the remarkable features of electrical development is the increasing importance of the measuring apparatus. Although it has been the custom, from the first, to equip an electric generating station with measuring instruments, these were of a crude character; and but few of them were thought necessary in a station. From these small beginnings of a single switch for each dynamo, and one or two instruments for the station, the switchboard has expanded until, in a large, modern station, it has become a separate division of the power-house. It was early recognized that indicating instruments served a double purpose: they not only showed that everything was going along properly, and just what work was being done, but in times of trouble they showed its character and where to look for it. These features led to the multiplication of instruments, until every generator and finally every feeder has its own instrument.

With this great increase in the number of instruments, and owing to the desirability of arranging them as compactly as possible, so that they could be watched by one or two operators, types of instruments which occupy but little space were desirable; and the switchboard expanded to an elaborate affair of marble or iron, ingeniously contrived so as to obtain the greatest possible safety in an arrangement occupying the least possible space. It is true that the greater part of the switchboard is devoted to appliances other than instruments, but the latter, when taken with the leads, shunts, switches and other appliances necessary for their operation, form a very considerable part.

This crowding together of instruments has some undesirable features, since neighboring instruments may influence the readings of each other. This matter should not be so serious in the more modern high-tension stations. Here it has been found necessary for safety to spread out the switching appliances. They are now arranged on different floors of a separate part of the station building. This makes it convenient to place some of the auxiliary appliances used with the modern instrument at a distance from the indicating device itself. Thus there is less need to crowd the instruments together than there was in the old low-tension station. The operator of the modern station—the man who is responsible for the output of the station—is not infrequently shut up in a room where he has nothing to go by but his instruments: he does not know what is going on in the generator room, except as he is informed by his measuring devices. By means of them he controls practically the entire performance of his station. He orders the starting and stopping of different units. He can even control the speed of the generators so as to bring them into synchronism. He knows at any time just what power is being used in each section of the district which his station supplies, and he can group his supply circuits to the best advantage. He can tell at any time how much energy his station is delivering during a given period—that is to say, he knows not only the rate at which energy is being consumed, but the total amount supplied to each and every section.

One of the points up for discussion at the meeting just referred to was the general accuracy of the so-called integrating meters. President Lieb spoke of the lack of faith which the public has in all measuring instruments, particularly when it has to pay for the thing measured, and stated that the experience of a certain company had been that by far the greater number of meters are slow, or record less than the total energy used. This is due to several factors, one being the tendency of all such devices to run slow on account of the increase in friction as the parts wear. Another is that meters having a certain maximum capacity are installed, while for the greater part of the time they are operating at only about ten per cent of this. A constant error, then, of one per cent at full load means about a ten per cent error in the final result, and this, as has been indicated, is nearly always against the company.

On the other hand, taking these meters as a whole, and

Digitized by Google

comparing them with other measuring devices, their work is most creditable. For example, the average error of all the meters tested in 1904 in the state of Massachusetts was just about one per cent, which is said to be about fifty per cent better than the accuracy shown by gas meters. It may be comforting for the layman to know that, of these meters, only fourteen per cent were fast.

One of the troublesome features in integrating meter construction is the bearing. In order that the error may be small, the friction must be kept as low as possible; and it has been, for some time, the practice to use sapphire jewels as the bearing upon which the hardened steel spindle revolves. Unfortunately, sapphires are brittle and do not stand the service well; hence has come the later practice of replacing the sapphire by a diamond, sometimes flat, sometimes ground to a cup. This gives better results, although it is not an easy matter to grind a diamond, and the bearing is necessarily somewhat expensive. This condition suggests the possibility of manufacturing an artificial jewel in the electric furnace. Rubies have already been made, and it is not impossible that a material sufficiently hard and brittle could be made in this way. If it is tough enough, and hard enough, its color will be of little importance.

THE MEETING OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The meeting of the American Electrochemical Society, which was held in Boston last week, proved to be no exception in matter of interest to the previous meetings of this organization. The papers presented dealt with both theoretical and practical topics, with possibly a little more interest attaching to the former. This is true, however, only because the topics discussed in several papers were upon processes which have not yet passed the theoretical stage, though some of them will doubtless be put to use before long.

The presidential address of Dr. Carhart, upon "The Revision of the Theory of Electrolysis," was particularly enjoyable, because he not only aroused a personal interest in the men who have played such important parts in the theories of electrolysis, but because he covered the ground so thoroughly that at the subsequent meetings the discussions upon the theory of dissociation were marked principally by their absence.

Of the papers themselves, but little need be said. We have done a good deal of theorizing about what goes on in an electrolyte. We have methods of picturing the actual process by which the electric current is passed through the solution. We know that different conditions obtain in different parts of the solution. But there are still many phases of electrolytic action to be cleared up. Professor W. S. Franklin and Mr. L. A. Freudenberger, in a paper upon "Reversible and Irreversible Polarization," have attempted to add to our knowledge in this matter, while the paper upon "The Rotating Diaphragm," by Dr. W. D. Bancroft, was the result of another deduction from our accepted theories of electrolysis. It would, to the layman, seem a simple matter to electrolyze a substance like common salt; yet to do this commercially has baffled many. The trouble lies, of course, in the elements which unite to form sodium chloride. Salt itself is a harmless substance which is formed by the union of two very active materials. The principal object in electrolyzing it is usually to obtain sodium or some sodium compound other than chloride; and the value of these materials depends largely upon the chemical activity of sodium. One difficulty is, therefore, to separate the sodium, or rather, we should say, the sodium hydrate, and get it out of the electrolyzing cell. At the other end of the cell the chlorine is set free, and chlorine is a wicked substance: it has little regard for man or matter, in the usual form, and there are few conducting materials which are able to withstand its attacks when in the nascent state. It is necessary to provide an anode of a material which will resist it, or one which is so cheap that it can be renewed at slight expense, and, at the same time, the gas as it is given off must be collected. Fortunately, this gas is of some value when caught, and thus repays partially for the nuisance which it causes in the cell. A recent attempt to obtain a cell which will avoid some of the difficulties experienced in others was described by Mr. C. P. Townsend.

Aluminum, a material which is always interesting because of its peculiar properties, was not slighted. Mr. C. I. Zimmerman, in a paper entitled "The Aluminum Electrolytic Condenser," described some interesting features of this surprising device; and Mr. A. Lodyguine told how aluminum might be plated with other metals.

Silicon was the subject of two papers, one by Mr. F. J. Tone, who told how this metal—which until a year or two ago was a curiosity—could be prepared easily in the electric furnace. Mr. A. B. Albro, in a well-illustrated paper, showed the effects of silicon and the silicon alloys when present in alloys.

The application of the electric furnace to the reduction of iron ores was brought up for discussion by a second paper contributed by Mr. A. Lodyguine, who endeavored to show that, by means of the new furnace, ores hitherto useless could be profitably worked. It is significant that a good part of the profit arising from the use of the electric furnace in reducing these ores would lie in the by-products.

The interesting application of electrostatic action in concentrating ores was described in a paper contributed by Professor L. I. Blake. This, so far as we can recall, is about the only commercial use—if we may use the expression—of static electricity. It is interesting for this reason, as well as for the results which are accomplished at a slight expenditure of power.

Certain of the papers read described interesting and new processes which may be of much practical value. It was shown by Professor H. R. Carveth that a good adherent coating of chromium is not difficult to obtain. This might easily become useful, for chromium is hard and resists atmospheric conditions fairly well. A number of the papers read were exceedingly instructive and valuable, but are of particular interest to the man who is dealing largely with theoretical considerations.

Digitized by Google

The International Railway Congress.

Washington, D. C., May 3 to May 14, 1905.

PREPARATIONS for the assembling of the International Railway Congress, in Washington, D. C., were commenced in good season and when the delegates commenced to arrive, on April 30, everything was in readiness for their reception. Ten days before that date President Stuyvesant Fish, chairman of the American section, and his family took possession of the spacious, elegant house on Scott Circle, just north of the White House, built by Senator Don Cameron and enlarged and fitted up by Mrs. D. P. Morgan. They will give a series of receptions and other entertainments to the foreign delegates to the congress. The business office of the American section was opened last week in the New Willard Hotel, by Secretary W. F. Allen, and the headquarters of the permanent commission of the congress established in the same hotel by the secretary-general, Louis Weissenbruch, of Belgium.

Mr. Hugh Wilson, president of the *Railway Age,* has his office located in an accessible and convenient place on the second floor of the hotel, and has an efficient staff of assistants and reporters ready to publish the official records of the congress in two numbers each day, one in English and the other in the French language. The meetings of the various sections of the congress will be held in executive session and the records will be made up by the official reporters and such portions as are given out to the public will be issued by them. Mr. Wilson has the exclusive privilege of publishing these reports.

The Washington entertainment committee is composed of the following members:

Mr. Fairfax Harrison, chairman, assistant to president, Southern Railway; Mr. Joseph Crawford, general agent, Pennsylvania Railroad; Mr. George E. Hamilton, counsel, Baltimore & Ohio Railroad; Mr. S. H. Hardwick, passenger traffic manager, Southern Railway; Mr. H. W. Fuller, general passenger agent, Chesapeake & Ohio Railway.

This committee has made elaborate arrangements for the pleasant and profitable entertainment of the foreign members of the congress. The plans for Wednesday included a visit to the top of the Washington monument, from which an extensive view of the city and surrounding country could be had; an automobile tour of the city; an evening reception at the residence of President Fish and a midnight meeting on the exhibition grounds to witness the sending out of the time signals. Thursday, after the formal opening proceedings of the congress, the party of foreign delegates went by special electric train and steamer to Mount Vernon, and in the evening attended a private exhibition of the works of art in the Corcoran Gallery of Art which was opened by the trustees of the institution.

On Friday Vice-President Fairbanks, in the absence of President Roosevelt, received the delegates at the White House, and on Saturday the Library of Congress will be visited. During the following week inspections will be made of the new Union station and the tunnels in process of construction; the naval gun factory and other points of special interest. In all the government establishments special facilities will be afforded the members of the congress for examining the objects of most interest to them, and several banquets will be given in their honor. This gathering of leading officials, from foreign countries and from all parts of the United States, will be large and this meeting of the International Congress promises to be the most important ever held.

On Monday, May 1, the foreign delegates to the Congress were entertained in New York city by the entertainment committee of the American section. A party of about 200 started from the Transportation Club in the Hotel Manhattan. The terminal of the New York Central was first inspected and then the party was taken through the subway in a special train. The new power plant of the Pennsylvania Railroad in Long Island City was next visited. The party then embarked on a steamer and were taken to the Ninety-sixth street power-house of the New York City Railway Company, luncheon being served en route. After inspecting the power-house the party was taken down the East river and up the Hudson to Grant's tomb, stopping on the trip to visit the Pennsylvania Railroad terminal in Jersey City. The delegates were landed at the Interborough power-house at Fifty-ninth street, which was thrown open for their inspection. After spending an hour in the power-house, the party was conveyed to the Transportation Club in electric vehicles.

The American Railway Appliance Exhibition.

The exhibition occupies about twenty acres of the public park lying midway between the White House and the Washington monument. From the southern portico of the White House, distant about one thousand feet, a fair view of the "Little White City," as the group of exhibition buildings has become named, can be had. The law forbids the use of public grounds in Washington for any private purposes and permission for such use can be secured only by special act of Congress. On one or two occasions the Grand Army of the Republic has been given permission to establish its camp on the government reservation for a few days, but no occupation of the White Lot for commercial purposes has been allowed since Nobel undertook to give the first nitro-glycerine demonstrations in the United States on that spot forty years ago. The passage of a joint resolution by Congress, giving the railway men the right to establish the exhibition there, shows that the great importance of the occasion and the high standing of the men identified with it were fully appreciated.

The following are the members of the general committee of arrangements:

H. P. Bope, vice-president, Carnegie Steel Company.

L. F. Braine, general manager, Continuous Rail Joint Company.

A. E. Brown, vice-president, Brown Hoisting Machinery Company.

J. A. Brill, vice-president, J. G. Brill Company.

J. B. Brady, vice-president, Standard Steel Car Company.

O. H. Cutler, president, American Brake Shoe and Foundry Company.

C. A. Coffin, president, General Electric Company.

F. H. Eaton, president, American Car and Foundry Company.

H. Elliott, Jr., vice-president, Elliott Frog and Switch Company.

William Goldie, Sr., William Goldie, Jr. & Company.

F. N. Hoffstot, president, Pressed Steel Car Company.

H. S. Hawley, president, Railroad Supply Company.

A. B. Jenkins, Jenkins Brothers.

Alba B. Johnson, Baldwin Locomotive Works.

Digitized by Google

B. F. Jones, Jones & Laughlin Steel Company.
A. M. Kittredge, vice-president, Barney & Smith Car Company.
W. V. Kelley, president, Simplex Railway Appliance Company.
E. B. Leigh, vice-president, Chicago Railway Equipment Company.
Wm. Lodge, president, Lodge & Shipley Machine Tool Company.
General Charles Miller, president, Galena-Signal Oil Company.
Charles A. Moore, Manning, Maxwell & Moore.
Governor Franklin Murphy, president, Murphy Varnish Company.
D. C. Noble, president, Pittsburg Spring and Steel Company.
Hon. H. Kirke Porter, H. K. Porter Company.
A. J. Pitkin, president, American Locomotive Company.
Alfred A. Pope, president, National Malleable Casting Company.
H. S. Paul, president, Verona Tool Works.
George A. Post, president, Standard Coupler Company.
C. W. Sherburne, president, Star Brass Manufacturing Company.
C. A. Starbuck, president, New York Air-Brake Company.
W. W. Salmon president, General Railway Signal Company.
H. A. Sherwin, president, Sherwin-Williams Company.
Albert Waycott, president, Damascus Brake-Beam Company.
H. H. Westinghouse, vice-president, Westinghouse Air-Brake Company.
W. W. Willits, vice-president, Adams & Westlake Company.

In its general characteristics the exhibition, while arranged in orderly and tasteful manner, is entirely free of glitter and spectacular features and is remarkable for its simple and clear exposition of the best methods of up-to-date American railway practice. The great amount of heavy machinery, full-size railroad tracks, with switches, sidings and signal systems, etc., is very striking. The exhibition shows, at a glance, that it is not intended to attract the curiosity-seeking public, but is prepared for the benefit of experienced and expert practical railway officials. To such men the exhibition presents many important lessons they can not help learning.

The director of exhibits, Mr. J. Alexander Brown, has spent the last month on the ground, ably and energetically directing the work of laying out the grounds, erecting buildings and attending to the general administration of the undertaking. The chairman, Mr. George A. Post, has made frequent visits to the city for conference with his associates. Mr. C. B. Graham, of Washington, is the electrical engineer of the exhibition and the installation of wires for lighting and other purposes is under his supervision.

The requisite supply of electricity and steam, for all purposes of the exhibition, is furnished by the Potomac Electric Power Company, which has made every preparation for carrying out its part of the work in the most perfect manner. Underground conduits for an extensive system of electrical conductors, and for steam pipes, have been laid from the company's main central station, located just across the street, into the exhibition grounds. Three sets of conductors have been installed with provision for furnishing alternating current at 110 and 220 volts; direct current at 110 and 220 volts, and direct current at 550 volts. The wiring of the various buildings is being done by the National Electric Company and other Washington contractors.

The main exhibition building, 160 by 200 feet, provides space for about one hundred and fifty exhibitors and there are sixty-eight independent buildings erected and occupied by individual exhibitors. Of the latter the largest, by far, is devoted to the Westinghouse exhibits which embrace representations of the productions of the twelve associated companies under Westinghouse control. The General Electric Company also has a fine, spacious building. Fully one-half of all the exhibits, although classed under the general head of railway appliances, contain some important electrical features.

EXHIBITORS, MAIN BUILDING.

American Brake Shoe and Foundry Company, New York.
American Railway Supply Company, New York.
Ashton Valve Company, Boston, Mass.
Baldwin Locomotive Works, Philadelphia, Pa.
Bradford Draught Gear Company, Bradford, Ill.
Buckeye Steel Castings Company, Columbus, Ohio.
Bucyrus Company, South Milwaukee, Wis.
Buda Foundry and Manufacturing Company, Chicago, Ill.
Buffalo Forge Company, Buffalo, N. Y.
Cleveland Frog and Crossing Company, Cleveland, Ohio.
Cling-Surface Company. Buffalo. N. Y.
Consolidated Railway Electric Light and Equipment Company, New York.
Crane Company, Chicago, Ill.
Curtain Supply Company, New York.
Damascus Brake Company, St. Louis, Mo.
Dressel Railway Lamp Works, New York.
Electro-Dynamic Company, Bayonne, N. J.
Empire Safety Tread Company, Brooklyn, N. Y.
Galena-Signal Oil Company, Franklin, Pa.
Independent Railroad Supply Company, Chicago, Ill.
International Correspondence Schools, Chicago.
H. W. Johns-Manville Company, New York.
Kennicott Water Softener Company, Chicago, Ill.
Kerr Turbine Company, Wellsville, N. Y.
Gustav Lindenthal, New York.
Lodge & Shipley Machine Tool Company, Cincinnati, Ohio.
Lorain Steel Company, Philadelphia, Pa.
Lunkenheimer Company, Cincinnati, Ohio.
Manning, Maxwell & Moore, New York.
Monarch Coupler Company, Detroit, Mich.
Moran Flexible Joint Company, Louisville, Ky.
Morden Frog and Crossing Works, Chicago, Ill.
Morse Code Telegraph Signal Company, Milwaukee, Wis.
National Meter Company, New York.
New York Belting and Packing Company, New York.
Niles-Bement-Pond Company, New York.
Norton Grinding Company, Worcester, Mass.
Pantasote Company, New York.
Pittsburg Spring and Steel Company, Pittsburg, Pa.
Railroad Supply Company, Chicago.
Railway Appliances Company, Chicago, Ill.
St. Louis Car Company, St. Louis, Mo.
St. Louis Expanded Metal Fireproofing Company, St. Louis, Mo.
William Seller's Company, Philadelphia, Pa.
Spaulding Print Paper Company, Boston, Mass.
Standard Coupler Company, New York.
Trojan Car Coupler Company, New York.
Union Steel Castings Company, Pittsburg, Pa.
Vacuum Cleaner Company, New York.
Victor Stoker Company, New York.
Wells Light Manufacturing Company, New York.
Wheel Truing Brake Shoe Company, Detroit, Mich.
Yale & Towne Manufacturing Company, New York.
Yawman & Erbe Manufacturing Company, New York.

PRIVATE BUILDINGS.

American Steel Foundries, New York.
Booth Water Softening Company, New York.
Harold P. Brown, New York.
Chicago Car Heating Company, Chicago.
Chicago Railway Equipment Company, Chicago.
Consolidated Car Heating Company, New York.
Continuous Rail Joint Company, Newark, N. J.
Electric Controller and Supply Company, Cleveland, Ohio.
Electric Frog and Switch Company, East St. Louis, Mo.
Fairbanks, Morse & Company, Chicago.
General Electric Company, Schenectady, N. Y.
General Railway Signal Company, Buffalo, N. Y.
Gold Car Heating and Lighting Company, New York.
Gould Coupler Company, New York.
Hall Signal Company, New York.
Ingersoll-Sergeant Drill Company, New York.
Kinsman Block System Company, New York.
Miller Anchor Company, Norwalk, Ohio.
National Battery Company, Buffalo, N. Y.
New York Air Brake Company, New York.
Pyle National Electric Headlight Company, Chicago.
Rand Drill Company, New York.
Robins Conveying Belt Company, New York.
Standard Paint Company, New York.
U. S. Metal and Manufacturing Company, New York.
Universal Railway Supply Company, Baltimore, Md.
Westinghouse Companies, Pittsburg.

The most unique and striking object in the grounds is an immense outline map of the world, forty-two feet long and twenty-four feet high, placed on a wooden screen and fitted with 200 four-candle-power colored lamps and intended to give a visual illustration of the method of distributing standard time-signals from the Naval Observatory to all parts of the world. The map, which was prepared for this occasion by the Hydrographic Bureau of the Navy Department, is said to be the largest map of the world ever made. The transmission of the midnight time signals will be under

Digitized by Google

the direction of Admiral Chester and Commander Hayden of the Observatory, with the cooperation of the officials of the Western Union Telegraph Company who have placed all the facilities of that company at the disposal of the government. Both the Western Union and the Postal Telegraph companies give the free use of their lines for the time service on this occasion. The members of the International Railway Congress have made especial efforts to provide for the transmission of the signals to every part of the world, and it is expected that this experiment will result in more extensive distribution of the signals than has ever been accomplished. A colored lamp will be placed at each of the most important places shown on the map and will flash out at the exact fraction of a second that the electric impulse passes that point.

THE WESTINGHOUSE COMPANIES BUILDING AT THE AMERICAN RAILWAY APPLIANCE EXHIBITION.

The Western Union Telegraph Company, the Postal Telegraph-Cable Company, the American Telephone and Telegraph Company and the Chesapeake & Potomac Telephone Company will have offices on the exhibition grounds; military bands will furnish music and the National Biscuit Company will provide a daily luncheon of tea, coffee, chocolate, and the many kinds of crackers from 3 to 6 P. M., to all callers during the continuance of the exhibition.

The Electro-Dynamic Company, Bayonne, N. J., has on exhibition one hundred and twenty varieties of its variable speed and constant speed "Interpole" motors. The company occupies spaces 1 and 2 in section "O" of the main exhibit building. One of its motors is also operating the electric car-lighting equipment of the Consolidated Railway Electric Lighting and Equipment Company, spaces 9, 10, 11 and 12, in section "O," and a ten-horse-power motor of its manufacture also drives at a speed ratio of two to one a vertical turret lathe in the exhibit of the Bullard Machine Tool Company.

The Westinghouse building presents a remarkable display of the products of the Westinghouse companies. The brake and coupler appliances of the Westinghouse Air Brake Company and its associated interests are shown under conditions approximating actual practice. The Westinghouse Electric and Manufacturing Company exhibits complete operative equipments of its latest forms of multiple control systems for alternating-current and direct-current traction, important auxiliary substation apparatus, and heavy railroad shop tools driven with Westinghouse motors. The Westinghouse Machine Company has set up, open for inspection, a 600-horse-power steam turbine. Nernst lamps and Cooper Hewitt lamps are used liberally throughout. Mr. Frank S. Smith is the managing director, and Mr. C. W. Townsend is in immediate charge of the installation of the Air Brake Company.

Lighting Investigation in New York City.

The report of the Stevens New York city legislative lighting investigating committee recommends a reduction in the price of gas from $1 to 75 cents per 1,000 cubic feet; a reduction in the price of electric current from fifteen cents per kilowatt-hour to ten cents per kilowatt-hour; the establishment of a state lighting commission to have the same control and supervision of gas and electric lighting corporations in the state as the state railroad commission has of railroad corporations. This commission is to be appointed by the governor, and will comprise three members. Its powers and authority will be similar to those vested in the Massachusetts lighting commission. It will have authority to fix a standard of light, and, where gas is used, will make laws regulating the pressure. The committee also recommends a very thorough inspection of meters, and suggests the utilization of water power for the generating of current for municipal lighting for the city.

Electrical Exhibition.

The National Electrical Contractors' Association will hold its convention and exhibit in Boston, Mass., July 15-22, 1905. For this purpose the entire Mechanics' Building, containing 83,000 square feet of exhibit floor space, has been engaged. This space is being rapidly sold to manufacturers and jobbers throughout the country.

The annual convention of the association meets during the week in the same building, thus bringing all the contractors of the country, as well as architects, mechanical and electrical engineers, street railway officials, and other prominent mechanical and electrical people into direct contact with the exhibitors.

The Electrical Contractors' Association, of Massachusetts, will entertain the visitors and attendants at the convention.

The committee appointed to have charge of the exhibition consists of J. P. Coghlin, F. L. Barnes, A. T. Sampson, F. A. Richardson and T. T. Kelly. This committee has secured the services of C. I. Campbell, to act as general manager of the exhibition.

Society of Post Office Engineers.

The Society of Post Office Engineers, of Great Britain, was organized on Saturday, April 8, at a conference held in London. This conference was attended by over 100 engineers, and included the majority of the officers stationed within the metropolitan area, and also delegates from the post office engineering districts in Wales, Scotland and Ireland. It was decided that the administration of the affairs of the society should be vested in the hands of a president, vice-president, treasurer, secretary and council of eight members. The following election of officers took place: D. H. Kennedy, London, president; P. Jarvis, Sunderland, vice-president; J. M. Crawford, London, treasurer; J. W. Atkinson, 45 Arbuthnot Road, London, secretary. Arrangements were also made for the election of the council at an early date, and a subcommittee comprising the officers and five other engineers was appointed to draught the rules of the society on lines indicated by the conference.

Digitized by Google

The Electric Ore Unloaders at Conneaut, Ohio.

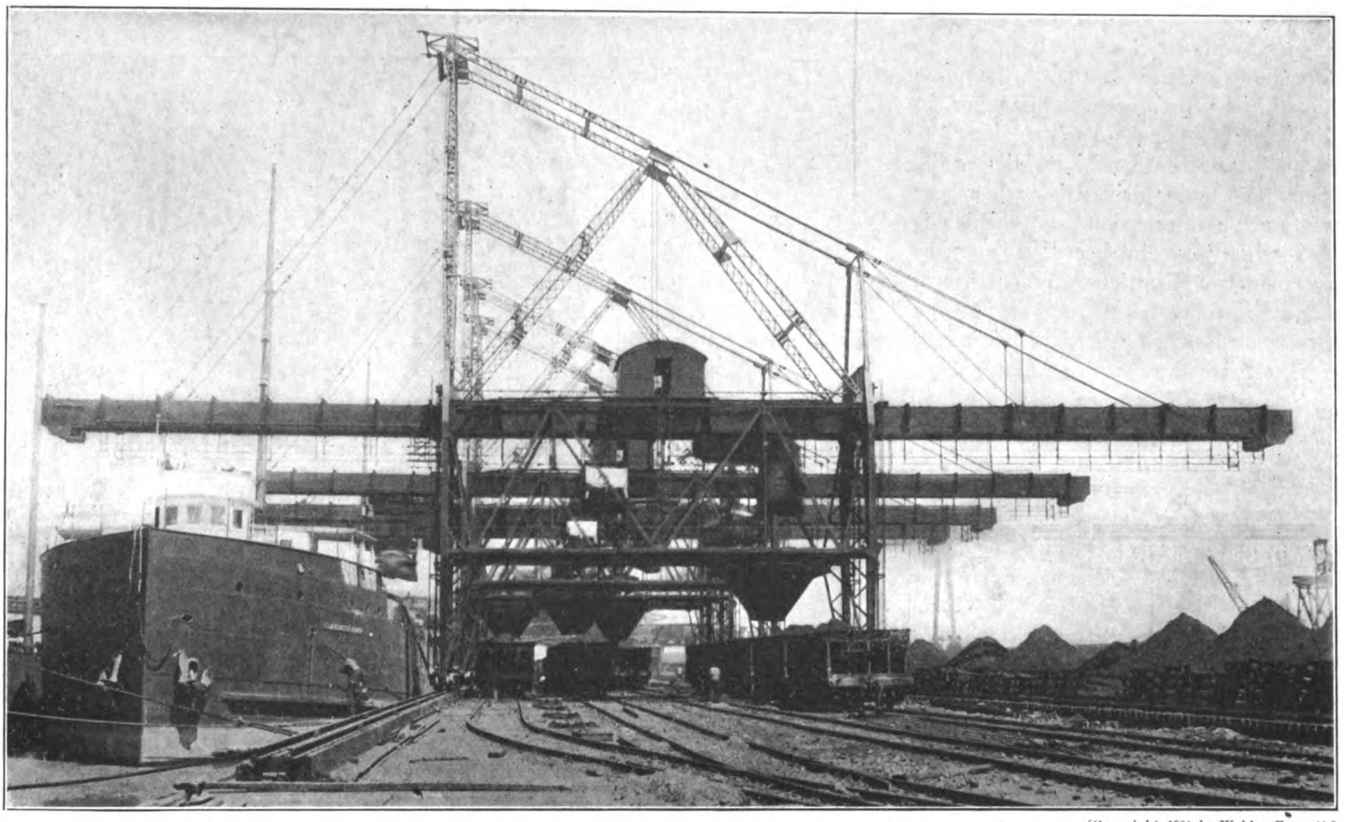
THE Pittsburg & Conneaut Dock Company, Conneaut, Ohio—a branch of the United States Steel Corporation—has recently installed four electric ore unloaders for transferring the ore brought in on ships from the mines on Lake Superior, either to cars or to a storage pile. The machines or cranes travel along a dock for a distance of about 1,000 feet. The piers are sixty-two feet ten inches wide, spanning four railroad tracks. In the other direction they are about twenty-three feet six inches wide, and so arranged that several machines can work in consecutive hatches of twenty-four-foot centres. The total height of the machines above the water is 117 feet.

The cranes are carried on four lines of rails, two under the front legs and two under the rear legs.

At the water end of the machine is a boom fifty-nine feet six inches long, which may be raised out of the way or lowered so that it will extend over the ship. When lowered it is forty-seven feet eight inches above the surface of the water, and the cross-travel of the carriage carrying the grab-bucket is then 157 feet. The capacity of each machine is 150 tons per hour for ten hours. This applies to unloading seventy-five per cent of the cargo from a boat with twenty-four-foot hatch centres. In order to get out 150 tons per hour the machines must remove the ore at the rate of 350 tons per hour for about the first thirty per cent of the cargo.

The ore is removed from the ships by means of an eighty-cubic-foot, two-rope Brown patented ore grab-bucket. The bucket is carried on a turntable, which enables it to be swung crosswise of the ship after passing through the hatch. This turntable is located on a carriage carrying the operator's cage, the hoist motors and the turntable motor. The hoist itself is operated by two 150-horse-power motors, running at 475 revolutions per minute. They are connected on the series parallel system. The motors are geared to the drum-shaft through two reductions. There are two drums, each three feet three-eighths of an inch in diameter, and taking eight wraps of seven-eighths-inch wire rope. The drums are located on either side of the main driving gear. The intermediate shaft carries an idler gear which meshes with what is termed the "shell" drum.

The bucket is suspended on two sets of lines, one set of which is attached to the shell of the bucket and the other set by means of a double set of blocks is connected with the spades. The bucket is closed and hoisted by this second set of lines, and is dumped by throwing the load onto the first set and allowing the second set to unwind, which drops and opens the spades. The idler gear is driven by a take-up friction which causes it to take up all the slack in the shell ropes, and to keep a constant tension on them. The shell drum is two feet four and five-eighths inches in diameter, and takes eight wraps of seven-eighths-inch rope.



[Copyright, 1904, by Waldon Fawcett.]

ORE UNLOADERS AT CONNEAUT, OHIO. VIEW FROM DOCK.

The turntable carrying the hoist machinery is operated by a three and one-half horse-power motor running at 776 revolutions per minute. This motor drives a small drum fifteen inches in diameter, which takes nine and one-half turns of one-half-inch rope. The drum is driven from the motor by means of a worm gear, and there is a Weston friction gear on the shaft which allows the motor to slip when the turntable is moved far enough to strike a stop.

The carriage also carries a racking drum for cross-travel. This drum is twenty-four and five-eighths inches in di-

Digitized by Google

ameter, and will take twenty feet of five-eighths-inch rope on each end of the drum. The drum is driven by a 100-horse-power motor running at 700 revolutions per minute. The motor is geared to the drum through a single reduction by means of an idler gear between the gear on the drum shaft and the pinion on the motor. The rope from one end of the drum goes over an equalizing sheave at each end of the trolley or carriage runway, and back to the other end of the drum.

Current is supplied to all motors on the carriage by three sets of copper bars on each side of the carriage, suspended over the runway. These bars are shown quite clearly in the illustration. A collecting-shoe presses on the underside of each bar.

The machine is caused to travel along the dock by means of a seventy-five-horse-power motor which is located in the house above the operator's cage. This motor, in addition to driving the machine along the dock, is also used to raise and lower the boom. The motor drives through a gear train and an intermediate shaft which is fitted with jaw clutches that may be thrown in two directions. When thrown in one direction, the motor is in position to raise or lower the boom; and in the other, to drive the machine up and down the dock. On each corner of the machine is a truck with four twenty-four-inch wheels. The intermediate shaft is fitted with two solenoid brakes, one of which acts on the driving gear, and the other on the boom hoist. The brake consists of a weight which is elevated by means of a solenoid when the current is thrown on, and which falls when it is shut off. The weight will cause a brake shoe to act on a brake wheel on the intermediate shaft, and is controlled by a two-throw switch in the operator's cage.

The operator's cage, which may be seen suspended below the runway, contains all the controlling mechanism used on the machine. There are three controllers, made by the General Electric Company, Schenectady, N. Y., and used, respectively, for controlling the hoist, the cross-travel and the travel along the dock. There is also a small controller for operating the turntable motor. On the switchboard in the cage are a main feeder switch, circuit-breakers for all motors except the turntable motor, a 2,000 ampere-meter, and light switches.

Current is furnished to the entire machine from two 100-pound rails, which are supported on "Manhattan" insulators made by the Standard Vitrified Conduit Company. The insulators themselves are carried on four-inch by six-inch angles, set eight feet apart in the wall of the storage pit alongside of the machine. The rails are set between three guard boards, and the current is collected by a cast-steel shoe two feet long.

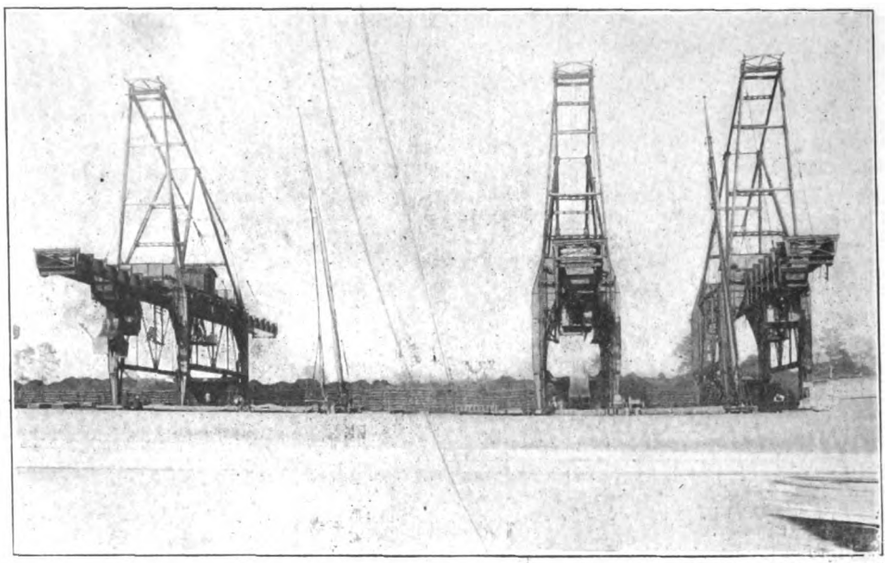
In addition to the four unloading machines, there was installed at the same time a transfer bridge, which is used to take ore from the unloading machines and pile it in the storage yard. The equipment of the bridge is similar in many respects to that of the unloaders. The length of the bridge over all is 565 feet, and the cross-travel of the carriage is 530 feet eight inches. The bridge has a main span between supports of 250 feet three inches, and there is an overhang of about 157 feet at each end. The height of the runway above the dock is sixty-eight feet, and the clearance under the bucket is fifty-one feet nine inches.

The bridge is carried on a double pier at the back end, which consists of two walls thirty feet from centre to centre, and twelve feet above the dock. On each wall are two 100-pound rails. The front end of the bridge is carried by a sheer leg running on a trestle. There are two lines of 100-pound rails on top of the trestle for carrying the sheer leg wheels.

The bridge is designed for a seven-ton bucket, supported by four strands of three-quarter-inch rope which pass over an equalizer and wind on a thirty-two-inch hoist drum. This drum will take eleven wraps of rope. The motor and controller arrangements of the hoist are similar in all respects to those on the hoists of the unloading machines. There is, however, no turntable for turning the bucket. The carriage is supported on four wheels, and drives by traction. Two seventy-five-horse-power motors, connected on the series parallel system, are used to move the carriage across the bridge. The bridge is moved up and down the storage yard by a 150-horse-power motor. This motor can not be controlled from the operator's cage, but there is a controller located at either end of the bridge, directly over the piers, and the operator must bring his cage to the piers in order to move the bridge. The bridge is driven by traction on all the wheels at the back, and on one-half the wheels at each corner on the front end. The motion of the bridge is controlled by a solenoid brake similar to that used on the unloader.

On the main driving shaft is a jaw clutch. This jaw clutch is arranged so that the front end of the shaft may be cut loose, and the back end operated. This enables the rear end of the bridge to be moved, so that it is offset fifty feet out of line from the front end. The guaranteed capacity of the bridge is 250 tons per hour.

Current for operating the bridge and the four unloaders is generated in a power-house located some 500 feet distant from the dock. The power-house consists of two buildings—an engine house and a boiler house. The engine house is of brick, 130 by sixty-two feet, with a peaked roof and concrete floor. In it are installed two 750-horse-power Buckeye tandem-compound engines, running at 125 revolutions per minute, with cylinders twenty and thirty-eight by thirty-six inches. These engines are direct-connected to 500-kilowatt, 220-volt Crocker-Wheeler generators. These machines fur-



[Copyright, 1904, by Waldon Fawcett.]

ORE UNLOADERS AT CONNEAUT, OHIO. VIEW FROM RIVER.

Digitized by Google

nish power to operate the machinery on the dock. In addition, there is installed in the power-house a fourteen by twenty-four-inch 150-horse-power Buckeye engine running at 150 revolutions per minute, which is belted to a 100-kilowatt, 110-volt, 525-revolution-per-minute generator for lighting. All engines exhaust into a Weiss jet condenser. A circulating pump is belted to the air-pump, which is driven directly by a small steam engine.

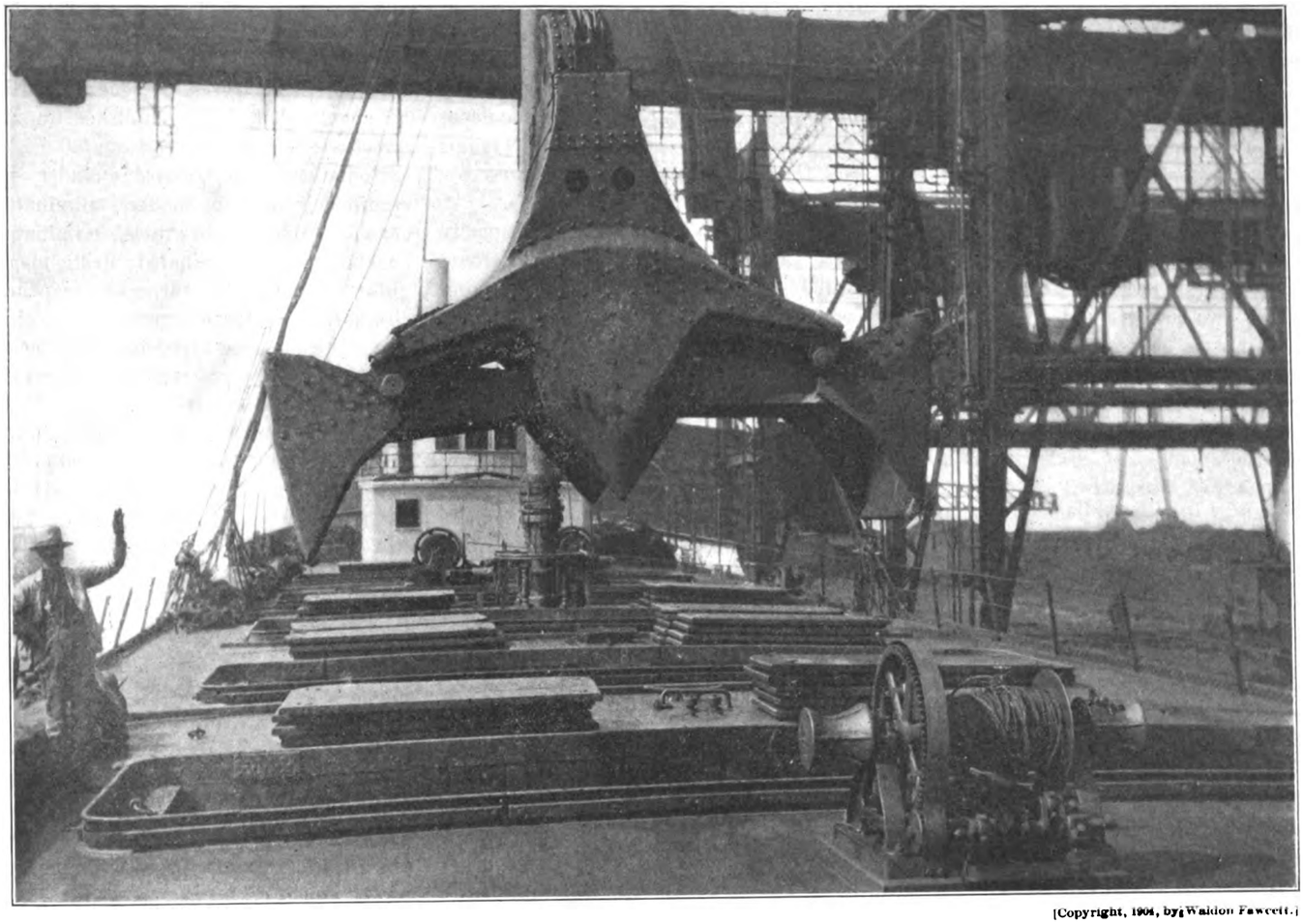
The main switchboard consists of six marble panels, each thirty inches wide and seven feet six inches high. Three of these are feeder panels, and carry each a circuit-breaker, an ammeter, and four single-pole, single-throw knife switches. Two generator panels each carry a circuit-breaker, an ammeter, four single-pole, double-throw, 4,000-ampere knife switches and a rheostat. The sixth panel is a total-output panel, and carries a 10,000-ampere ammeter, a 300-volt voltmeter and a 10,000-ampere recording ammeter.

A fifteen-ton hand traveling crane is installed in the engine room to facilitate repair work.

The boiler room is a brick building forty-two by ninety feet, and contains six Cahall vertical water-tube boilers with Aultman-Taylor chain grate stokers. The boilers are arranged in three batteries, two 250-horse-power boilers to each battery. There is one stack for each boiler, the stacks being thirty-six inches in diameter and seventy-five feet high. The total height of the stack above the grates is ninety feet. Steam is taken from the boilers and run to a main header, from whence it is taken to the engines, there being a separator on each steam pipe to the engines.

The power line from the power-house to the machines on the dock is carried on steel lattice poles about thirty-five feet high and 100 feet apart.

The unloaders and the transfer bridge were designed and constructed by the Brown Hoisting Machinery Company, Cleveland, Ohio. All motors used on the unloaders and bridge are wound for 220 volts, and were built by the Elwell-Parker Electric Company, also of Cleveland.



[Copyright, 1904, by Waldon Fawcett.]

GRAB-BUCKET OPEN, ORE UNLOADERS AT CONNEAUT, OHIO.

The Union y Maronas Tramway Company have decided to electrify their lines in Montivideo, Uruguay, at a cost of about $800,000.

Electricity on Steam Railroads.[1]

At the present time the demands of heavy suburban service are beyond the capacity of steam locomotives, and the indications are that within a few years a large proportion of this service will be handled by electric equipment. The next class of service in which it will be introduced is for the operation of pushers on heavy grades, and from this and suburban service, extensions will undoubtedly be made to entire divisions and trunk lines. The extensions to trunk lines will not be made in the near future, as the heavy expenditures and the engineering problems involved will retard this development, but when traffic conditions demand the change it will be made.

The feature of electric traction which is at the present time receiving the most careful consideration of steam railroad men is the advisability of operating their suburban lines by means of electricity.

The excellent service which the electric street railways have provided has resulted in a wide extension in the area of the territory they serve and the building up of

[1] Abstract of a paper presented by Mr. Clement F. Street before the Western Railway Club, April 18, 1905

Digitized by Google

sections formerly looked upon as inaccessible for residence purposes. These extensions have resulted in a corresponding increase of the area served by suburban lines, and there is therefore a demand for a longer haul of the average suburban passenger. It is believed this demand for a longer haul has greatly enhanced the attractiveness of this class of service and makes it possible to realize a profit on lines formerly operated at a loss.

The efficient handling of suburban traffic requires the operation of trains at high speeds through sections which are thickly populated, and also large and expensive terminal facilities. Exactly the same requirements exist in connection with the handling of trunk line service. Both classes require a private right of way without grade crossings, a complete system of block signals, interlocking plants and safety appliances.

Some railroads have been making improvements in the equipment used in suburban service. The character of the cars employed has been improved, and in order to increase the speed at which trains can be operated there has been a large increase in the weight of locomotives. Even these costly improvements are not meeting the competition of electric lines, and if the full earning power of this traffic is developed the adoption of electricity as a motive power is imperative.

Some of the benefits which are derived from this change are as follows:

Increase in gross receipts.

Better application of power to trains.

Increased capacity of terminals.

Reduction in operating expenses.

Reduction in terminal costs.

Reduction in cost of maintenance of equipment.

Increased reliability of service.

It needs no argument to prove that a better suburban service can be given with electric than with steam equipment, and all records show that the introduction of electricity is followed by a large increase in gross receipts.

A system of traction having power units attached to the trucks of the cars is desirable for suburban service for the following reasons:

(1) A high rate of acceleration can be obtained.

(2) A change in the weight of a train does not cause a corresponding change in the rate of acceleration.

(3) The rate of acceleration can be changed to suit different conditions.

(4) Switch engines are not required.

(5) Draw-bar strains are distributed.

These are all important in the operation of suburban service and therefore it is not believed that any system of locomotives or other single power units will ever again be extensively introduced into this class of traffic.

The introduction of electricity is followed by an increase in the capacity of existing terminals for handling trains. During the rush hours of the day these terminals are generally very much overcrowded.

Trains handled by electricity require only one or two switching movements for accomplishing the results outlined. On these trains the motorman merely carries his operating lever from one end of the train to the other, and the throwing of one or two switches is the only operation required for fitting the train for a run in the opposite direction. The making up of trains and hauling of them to the depot can be performed entirely by the motor cars themselves, and switch engines for this work can be dispensed with.

The limiting feature of the capacity of a terminal is either the track room available, or the number of switching movements which can be made. If track room in the depot is the limiting feature, this limit is extended thirty or forty per cent, as the handling of electric equipment does not require more than one-half as many such movements as the handling of steam equipment.

The rapid acceleration of electric trains is another feature which increases the capacity of terminals, as it enables a more rapid movement of trains than that obtained by the use of switch engines.

The introduction of electricity on a large elevated system was followed by a reduction in the total operating expenses of from 13.2 to 9.5 cents per car-mile (twenty-eight per cent) and an operating ratio of from 58.1 to 41.2 per cent of the gross earnings. A portion of this saving is in the cost of power supply and conducting transportation, but the largest saving is in the cost of maintenance of equipment. It is believed that even a greater reduction can be made in the cost of operating suburban traffic on steam railroads, as the conditions under which locomotives were operated on elevated roads were more favorable than those at most large terminals. The cost of maintenance of locomotives was always very low for elevated roads and the weight of this equipment was only about one-fourth of that in use on a number of suburban lines. The elevated roads were operating under conditions which enabled them to reduce the terminal cost of caring for locomotives to lower figures than it is possible to obtain on surface lines.

For the care of locomotives at terminal points, roundhouses must be installed and maintained, and as these structures must be of a permanent character, their first cost is high.

Additional buildings must be provided for supplying the locomotives with coal and sand; cinder pits must be installed and a gang of men employed for removing ashes and cinders; care must be provided for the removal of ashes from the cinder pits and switch engines employed for handling the cars.

With electric cars the terminal costs are reduced by about sixty per cent and the investment in buildings and equipment reduced by eighty or ninety per cent. The following gives a general outline of about what is accomplished in this direction:

Roundhouse, eliminated; cinder pit, eliminated; washing boilers, eliminated; cleaning flues and grates, eliminated; packing cellars, eliminated; firing up engines, eliminated; turntable expenses, eliminated; wiping, practically eliminated; sand-house expenses, about equal; water supply, practically eliminated; coal trestles, eliminated.

The arrangements made for handling of coal and ashes are transferred to the central power-house, but owing to the better facilities installed, the cost of doing the work can be reduced.

The care of electric cars does not require expensive buildings and, as a rule, they are not placed under cover when out of service. Where this practice is followed, the only building required is a small inspection house provided with pits. In fact, all the arrangements made for the care of locomotives are done away with and the provision made for caring for cars under the present system, with the addition of an inspection and light repair house, will prove adequate.

There is some variation in the system of inspection in practice on electric lines. On three elevated railroads the practice is to inspect the motors, all electrical equipment and trucks every three days. At the time of this inspection the motor cases are opened, the commutators and brushes carefully inspected, new brushes applied where required and light repairs made. The amount of time required for doing this work is from thirty to forty-five minutes per car and it requires a force the equivalent of about one man for every ten motor cars in service, that is—on a line where sixty motor cars are in service, a force of six men is constantly em-

Digitized by Google

ployed in inspecting motors, electrical equipment and trucks.

On two elevated roads the practice is to make an inspection of each car before it enters the service in the morning. After it has run about half a mile an inspector boards the car and questions the motorman regarding the operation of each portion of its equipment. Motor cars in constant service make an average of 220 miles per day and after they have run about 50,000 miles are taken into the shop and thoroughly overhauled.

The cost of labor for making inspection under each system as above outlined, and also light running repairs, is from twenty to twenty-five cents per motor car per day. Assuming that six-car trains can be operated by one locomotive or by three motor cars, this gives a terminal cost of about sixty-five cents for electric equipment and $1.53 for locomotives. Where heavy service is being operated, this difference amounts to from $30,000 to $40,000 per year which is saved by the adoption of electricity.

The average cost of maintenance for electric equipment of cars per car-mile on twenty-two electric roads is 0.580 cent, which is 4.33 per cent of the total cost of operation. This cost includes the maintenance of electric heaters and electric lights, which are used on nearly all of the roads from which these records have been taken.

There is a wide variation in the cost of operation of power plants per car-mile, which varies from 1.173 up to 3.830 cents, with an average of 2.277 cents. This variation is due largely to the conditions under which the different power-houses are operated. The lowest costs are for plants having a number of separate units, and when these units are in use they are usually worked to their full capacity.

An item of considerable consequence in connection with the maintenance of steam locomotives is the fact that each one of them must receive heavy repairs on an average of about every twelve months, and as the making of these repairs requires a period of from thirty to forty days' time, a locomotive is only available for service about nine-tenths of the period of its existence.

Electrically operated cars have a material advantage over the steam locomotives in this regard. The records show that only two and one-half to three per cent of the trucks are out of service for heavy repairs, but this is not the controlling feature of the availability of the equipment for service, as from five to six per cent of the car bodies are usually out of service for painting and varnishing. The practice is, therefore, to have two or three per cent more car bodies than trucks, and when a body is taken to the shop for painting and varnishing, the trucks—if they are not in need of heavy repairs—are kept in service under another body. The trucks are all interchangeable, so that in case one of them needs repairs, it can be replaced by another and the car retained in service. The time required in well equipped shops for removing a truck and putting another one in its place is from thirty to forty-five minutes. This makes an extremely flexible system and one under which a large percentage of the equipment can be kept in continual service. The parts of electric equipment which wear out and require renewal are so few in comparison with those on a locomotive that neglect in keeping up repairs does not result in a corresponding deterioration in its condition.

The records of maintenance of electric line per mile per year shows an average of $149.11 for eighteen different roads. Some of these are operating a portion of their cars through suburban districts, and all of them operate through large cities where they must contend with a complication of telephone and telegraph wires, also crossings and curves, which necessitate a complication of guy wires. The cost of maintaining an electric line on a private right of way is lower than the average figure here given. For heavy service catenary cables are used for suspending the trolley wire, which further decreases this cost.

The records of a large elevated railway show only one-third as many delays to service owing to failure of equipment since electricity was adopted as there were when operating with steam. These records refer to actual number of delays and do not take into consideration an increase of more than twenty per cent in the number of trains operated. Some of the officials of this road state that this is the most important benefit which that company has derived from the adoption of electricity. This reliability of service is of even more importance to steam railroads than to the elevated, where suburban service is operated on the same tracks as through trunk line trains, as any delay to the suburban service is not only a cause of annoyance and expense in itself, but is also the cause of annoyance and expense in connection with the through service.

One of the causes for this reduction in the number of failures of equipment is undoubtedly owing to the even distribution of draw-bar strains. With electrical equipment these are distributed throughout the train in a manner which compels each car to do its share of the work and it is only reasonable to expect that with such a distribution there will be fewer failures.

The cost of electric power per kilowatt-hour is well established by records from a large number of power stations which have been in operation for many years. This figure, of course, varies with the price of coal. On a basis of coal at $2.75 to $3 per ton, $0.0050 per kilowatt-hour at the switchboard is a very fair figure, but tests have been made, which were as low as $0.0036. All records which have been made show very clearly that with a heavy traffic the cost of coal is very much less with electric than with steam equipment.

This is a very important item in the question of the cost of operation, but is insignificant in comparison with the large question of furnishing a railroad service which will meet demands and develop the earning capacity of a road to its fullest extent.

The cost of lighting cars by electricity on the elevated railways is only about twelve per cent of the cost of doing this work under the systems which were in use before the introduction of electricity. This is, however, one of the smallest features for consideration, as there is no other one thing which adds more to the attractiveness of any service than well-lighted cars.

The ideal method of heating cars, from an operating standpoint, is by electricity, but the cost of fuel with this system is much higher than by the use of steam. The existing systems can be used for heating at terminals and electric heaters used while the cars are in service.

Two systems of electric traction are in use in this country—the direct-current system and the alternating-current system. All medium and large-sized so-called direct-current roads are now operated about as follows: the central power station produces alternating current at high voltage, transmission lines feed this current to rotary transformers distributed along the line where it is transformed to direct current at from 500 to 650 volts and fed to the trolley wires, from which it is carried to the motors.

There are two objections to this system:

1. The limitation of trolley voltage.
2. The rotary converter.

The maximum capacity of a trolley line of 0000 copper carrying 600 volts is about reached in operating some of the heavy

Digitized by Google

interurban cars now in use. Trains such as are used on our elevated railways and in suburban service can not be operated with this equipment, and for handling such trains either a higher trolley voltage or a larger conductor must be used. A higher trolley voltage is manifestly the most desirable, but as this can not be secured with the direct-current system, the only alternative with that system is a larger conductor. Trains of this size demand a conductor of dimensions which would be prohibitive in cost if of copper, and therefore the third-rail conductor has been installed.

The objections to the rotary converter are the cost of its installation and the fact that as it has moving parts it must have constant attendance. With low voltage in the trolley wire converters must be located at frequent intervals on all large systems. At each converter station at least one man must be in constant attendance. In all direct-current systems the installation of transformer houses is an important item of first cost, and their attendance an important item of operation.

The limitations of voltage of direct current and the cost of installing and operating rotary converters have led engineers to spend a large amount of time in developing a system of electric traction which can be operated by an alternating current in the motors. The result is that in Europe a number of systems have been installed with polyphase induction motors on the cars. American engineers have refused to adopt this type of motor as they do not consider it suitable for this service. The objections to it are that it is inherently a constant speed motor, is not economical when working at less than its full capacity and its use requires at least two overhead conductors. Instead of trying to adapt this unsuitable device to traction conditions American engineers have been devoting their energies to the development of an alternating-current motor which should have all the good characteristics of a direct-current motor without its limitations. A number of different schemes have been proposed and experimented with but the only one as yet placed in actual operation is the single-phase series-wound commutator type alternating-current motor invented by Mr. B. G. Lamme, chief engineer of the Westinghouse Electric and Manufacturing Company.

With this system an overhead conductor is used and the voltage can be varied to suit conditions and requirements. The motors will operate equally well with either alternating current or direct current.

The direct-current system can not meet all the demands of heavy trunk line railway service. It should not therefore be installed on suburban lines, as any system introduced for this service should be one which can be extended to meet the requirements of all classes of service. It would be just about as reasonable to undertake to operate all of our steam locomotives with a uniform boiler pressure of fifty pounds per square inch as to undertake to operate a heavy freight service with an electric current of 600 volts. If our through passenger and freight service is ever handled by electricity, it will be at much higher voltages than those which can be obtained with the direct-current system. This system, in addition to placing a limit on the voltage, requires the use of a third-rail conductor for heavy service. This type of conductor has its place. It is giving excellent satisfaction on elevated railways, and on some lines conditions exist which will not permit of the use of any other type. Where conditions will permit of the use of either the third rail or an overhead conductor, due consideration should be given to the following objections which have been brought to the third rail.

It can not be used in terminals or yards where switching is done, and therefore this work must be performed by steam locomotives, or an overhead conductor installed, which involves two systems of collectors.

Liability of fire in case of wrecks. A number of fires have resulted from cars coming in contact with the third rail and causing a short-circuit to the track rail.

Danger to track walkers, section gangs, train men and trespassers.

The rail must be broken at grade crossings and the power cut off the trains at such points, or an overhead conductor installed.

The liability of the third rail to become displaced by a derailment.

The necessity of accurate adjustment in height.

Difficulty of keeping it free from snow and ice.

Difficulty regarding clearances. Where the third rail has been installed there has been trouble in fixing a location in which it would clear locomotive cylinders, trucks of cars, and other parts of the rolling stock.

The cost of installation is subject to small variation and must be almost as great for light traffic and easy conditions as for heavy traffic and severe conditions. Each one of these objections should be given consideration only as it relates to a particular installation which is being considered. There are places where the advantages to be gained by its use will more than offset all of these objections and it is the best form of conductor to use.

With the single-phase alternating-current system the overhead conductor is used. It has objectionable features, some of which are as follows:

Difficulty of securing head room through tunnels, under bridges and existing structures. These have been so serious as to compel the use of a third rail at some places.

Snow and ice will collect on the trolley wire.

Poles and guy wires break and allow the trolley wire to fall.

Trolley wires break.

The general appearance of both the armature and field for the single-phase motor and their mechanical construction is the same as that of those which are used with the direct-current system of electric traction, and which have been the foundation of the immense success of that system. The only difference is in the windings, which have been changed to permit of the use of either an alternating current or direct current. The machinery required for maintaining all parts of this motor is the same as that required for the direct current and the methods for making repairs have all been established by many years of service.

The static transformer has no moving parts and is therefore not subject to wear.

The reversing switch which is used for reversing the direction of the motors is an extremely simple piece of apparatus and is subject to little wear, as all of its movements are made at slow speed. It is operated by air pressure which is controlled by a magnet valve.

The operation of the master controller is effected by electric contacts at a very low voltage and there is nothing about it which is subject to wear or liable to get out of order.

In connecting a train of cars for a multiple control system, seven low voltage conductors are carried through each of the motor cars and trailers. These cables terminate in a seven-point switch and the connection from one car to the other is made by a flexible cable.

The speed of the car is regulated by an inductive regulator, which draws from the system the amount of current desired and there are therefore no rheostatic losses.

Digitized by Google

The New Plant of the Manila Electric Railway and Lighting Company.

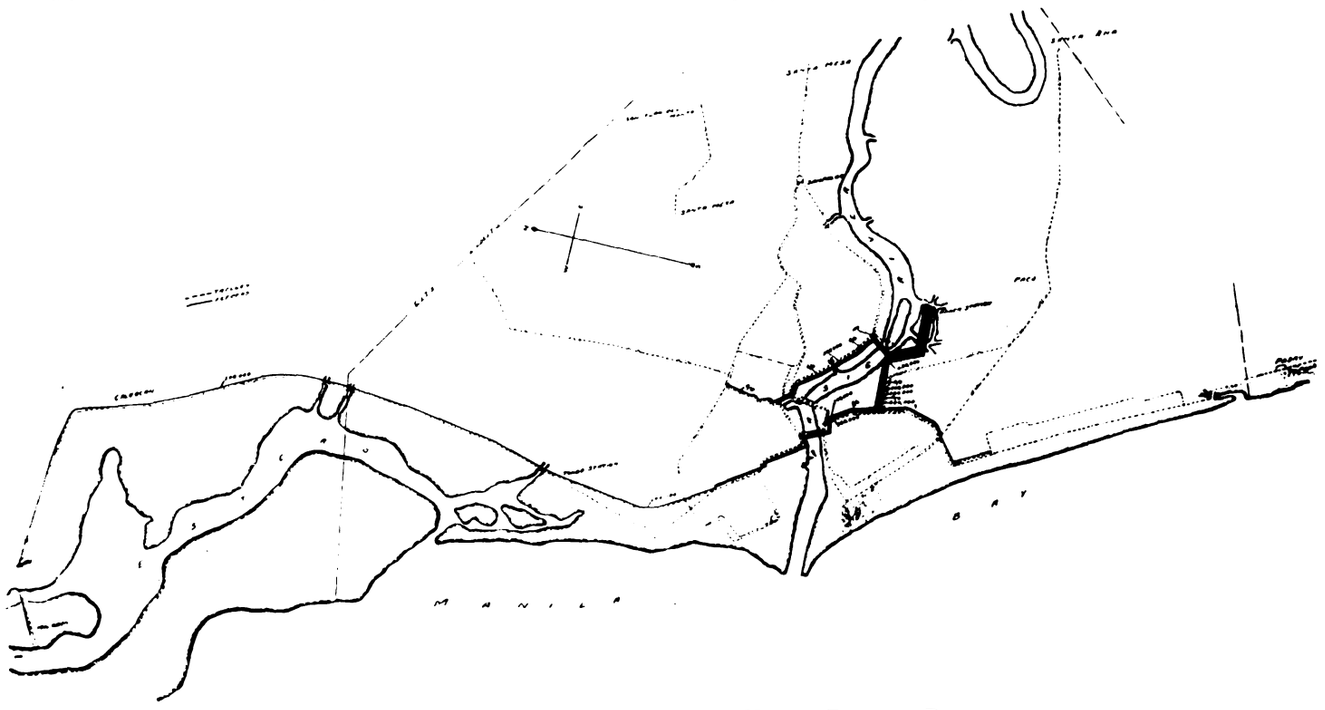
AT THE time of the accession of the Philippines by the United States, the tramway facilities of Manila consisted of thirteen miles of track, upon which were operated about a dozen small horse cars, seating from eight to twelve persons each. This line was seemingly laid out without any particular reference to the requirements of traffic, and the cars were operated with the same disregard of efficient service.

This tramway was owned and operated by La Compania de las Tranvias de Filipinas, which also owned and operated a steam line running from the city limits to Malaban, a town of 12,000 inhabitants, located about five miles north of Manila on the bay. Over this road a single train of two cars was ordinarily operated, although for special occasions, such as fiestas, cock fights, etc., four cars were required. The horse-car line consisted of very light track, the steel averaging about fifty-five pounds per yard.

Fares were collected on a "zone" basis, the system being divided into seven sections, over each of which a fare of four centavos, or two cents, was charged.

In the interests of J. G. White & Company and others, Mr. C. G. Young, general superintendent of construction for this company, went to Manila in 1902, and, after a care-

MAP SHOWING CAR LINES, MANILA ELECTRIC RAILWAY.

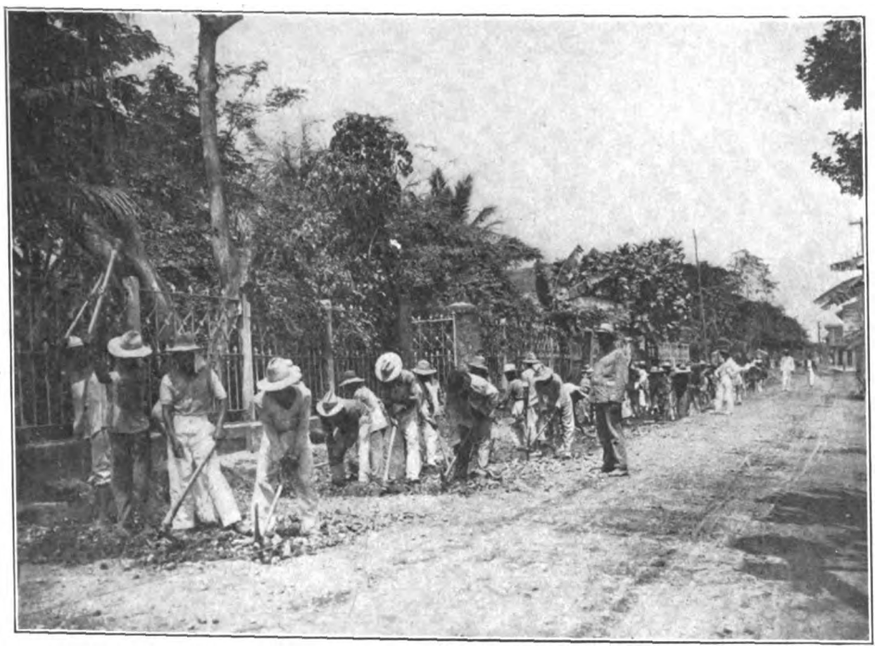


MAP SHOWING FEEDER AND TROLLEY LINES, MANILA ELECTRIC RAILWAY.

Digitized by Google

ful study of the situation, embodied in his report a scheme for the electrification of both horse car and steam roads, and the merging with these of the electric lighting system, then owned and operated a party of the city and government officials over the road.

The problem involved in the design and construction for such a system required to be overcome many obstacles peculiar



FILIPINO WORKMEN ON TRACK CONSTRUCTION, MANILA ELECTRIC RAILWAY.

by La Electricista. Soon after this franchises were acquired, through public bidding, by the above-named company and others, covering an electric railway and an electric lighting system, and immediately thereafter construction and reconstruction work was begun.

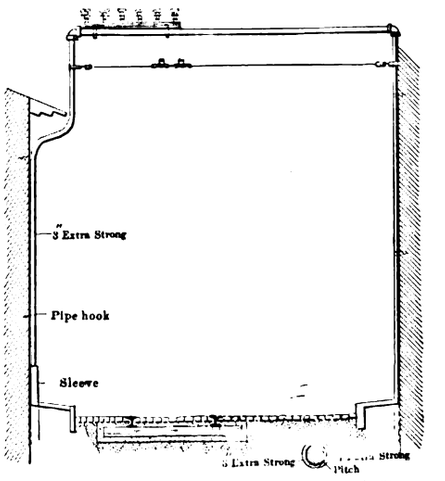
On Monday, April 10, the new electric railway system was opened with appropriate ceremonies, the first car conveying

to that location and these are, naturally, of considerable interest to engineers in the United States.

At the outset, it was found that woods commonly used for construction purposes in this country were unsuited to the climate and conditions of Manila. In addition to the rapid decay, caused by the moist climate, another factor in the shape of the "white ant" demanded consideration. This insect attacks nearly all foreign and many domestic woods, and an exhaustive study was made to determine the best materials for poles, ties, car bodies, etc. Several tropical woods, among them "jarrah," "teak" and "molave," gave excellent satisfaction. California redwood, treated with carbolineum and other preservatives, was also tried and gave excellent results in the majority of cases. The high humidity of this climate is also responsible for rapid disintegration of steel used in rails and for structural purposes. On this account, it was found necessary to thoroughly paint all rails and joints with asphaltum, and all structural steel work was covered with a special carbon paint.

STREET SCENE IN MANILA, SHOWING OLD TYPE OF STREET CAR.

The power-house is located on an island in the Pasig river and consists of a boiler room 54 by 170 feet, and an engine room forty-seven feet wide and the same length. Beneath the engine room is a basement, its



LINE AND TRACK CONSTRUCTION IN WALLED CITY, MANILA ELECTRIC RAILWAY.

floor being on the same level as the boiler room. The framework of the building is of steel. The walls and roof are built of concrete. Steam is generated in eight 400-horse-power Babcock & Wilcox boilers, arranged in two batteries of four each. The station has one stack, built of steel. It is 175 feet high and fifteen feet in diameter, and is located between the two batteries of boilers.

Coal is brought from Australia and is stored along the side of the boiler room, from which place it is distributed to the boilers by a Gantry radial crane. The crane has a radius of 135 feet, and a capacity of fifty tons per hour. Coal may be stored by the cranes to a depth of thirty feet, giving a total coal-storage capacity of 28,000 tons. Owing to the cheapness of native labor, the boilers are stoked by hand. Feed water is raised from a driven well by a compressed air system and water-

Digitized by Google

for the condensers is taken from the river on one side of the island through a concrete intake, and is discharged into a similar channel which conveys it to the opposite side of the island.

The engine-room equipment consists of three Westinghouse-Parsons turbines of 1,000 horse-power each. These are direct-connected to three 750-kilowatt, three-phase, sixty-cycle generators which will furnish current at 370 volts. The turbines are operated with a steam pressure of 200 pounds per square inch, and a vacuum of twenty-seven inches. Their speed is 1,800 revolutions per minute.

In addition to the above machinery, there is now being installed in the station a 2,000-horse-power Westinghouse-Parsons turbine direct-connected to a 1,500-kilowatt, three-phase, sixty-cycle, 370-volt generator.

Field current for the generator is furnished bv three exciter units. One of these is of fifty kilowatts capacity and is motor-driven. The other two are of thirty-seven and one-half kilowatts capacity each, and are driven by steam engines.

In the engine room there are also installed three 500-kilowatt rotary converters which convert the 370-volt alternating current to direct current at 600 volts. There is also one 300-kilowatt, 370 to 600-volt converter. Direct-connected to one of the above rotaries is a 125-kilowatt booster.

The transformer equipment in the power-house consists of four 250-kilowatt and two 500-kilowatt oil-cooled transformers. These step the voltage up from 370 to 3,400 volts.

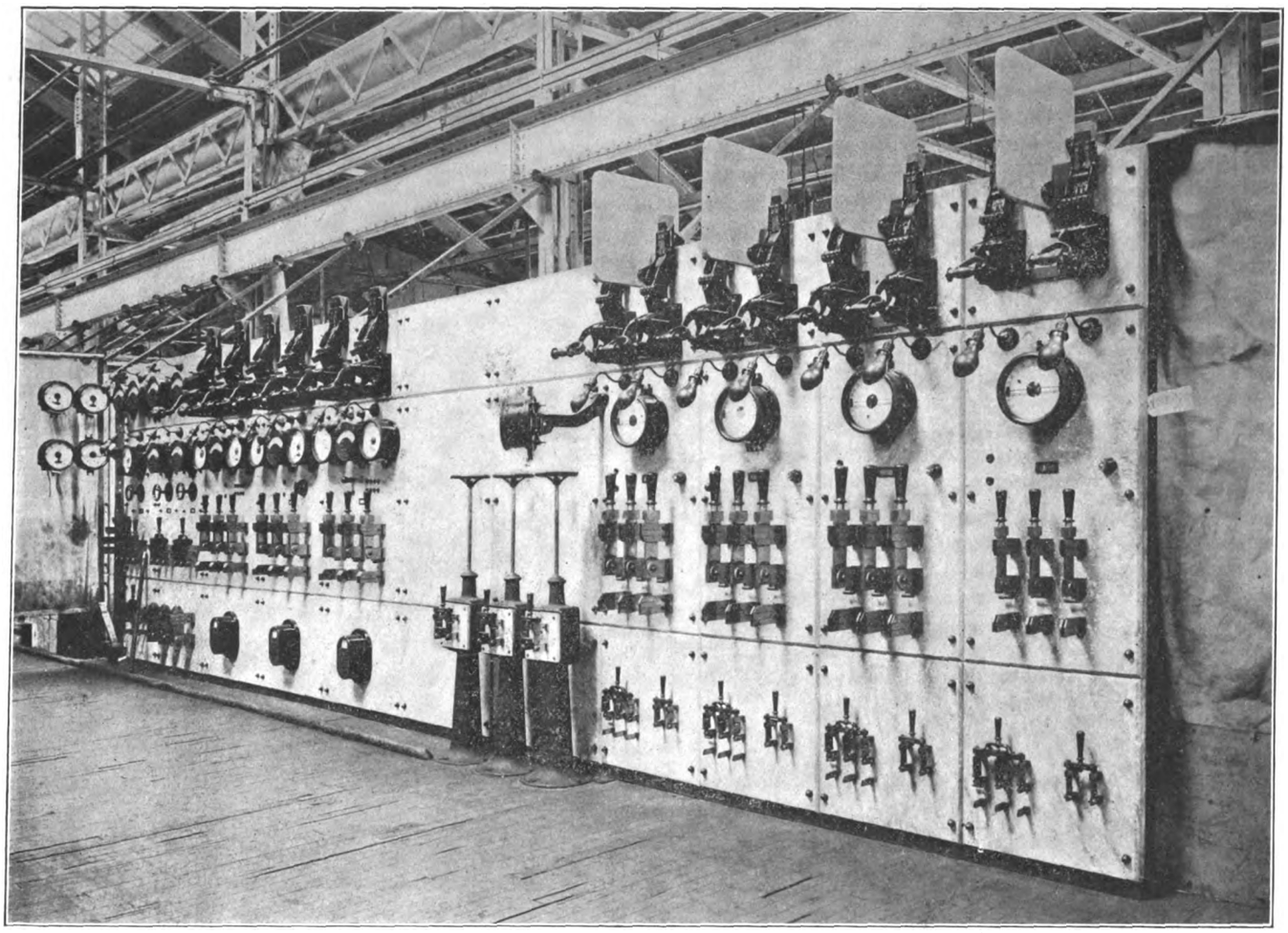
The company also supplies current for lighting and power purposes, and as all of the generators deliver alternating current, the power required for the operation of the railway system is supplied through the rotaries located in the power-house, no outside substations being necessary.

The alternating-current transmission lines are two-phase, four-wire, and the network of each is tied together in order to utilize the copper to the greatest advantage. Line lightning arresters are installed at frequent intervals, in accordance with the latest practice. The secondary distribution at 120 to 224 volts is three-wire, from which two-phase motors, arc lamps and incandescent lamps will be supplied. In the sparsely settled districts of the city only one-phase will be carried and every precaution has been taken to bring about a balanced condition of the electric system.

The railway load is approximately half the output of the station.

The load is handled and distributed from the switchboard which extends along one side of the engine room. The switchboard is 105 feet in length and consists of forty-four panels. Eight feeder lines leave the building and distribute to as many sections of trolley line. These sections are arranged in the usual manner, with tied switches, so that the copper can be used in the most economical manner, and, at the same time, any section can be isolated in case of trouble.

The feeder system contains the equivalent of twenty-five miles of No. 0000 cable. Both girder and tee rail are used, the former in the few streets which are paved with block, either granite or wood, and the latter on macadamized streets and in the open country. The girder rail is



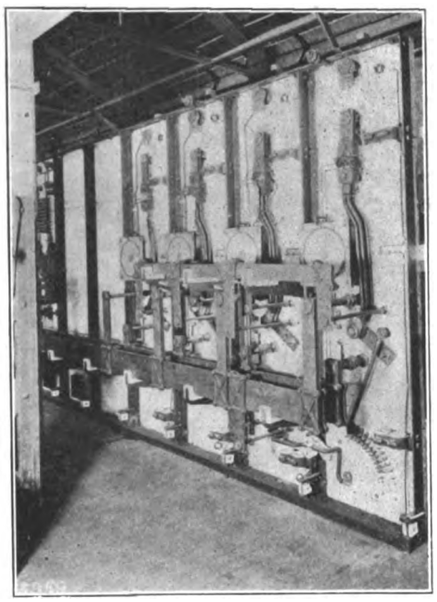
GENERATOR, EXCITER AND ALTERNATING-CURRENT ROTARY CONVERTER PANELS, POWER-HOUSE, MANILA ELECTRIC RAILWAY.

Digitized by Google

ninety-four pounds steel, the tee rail seventy pounds A. S. C. E. section.

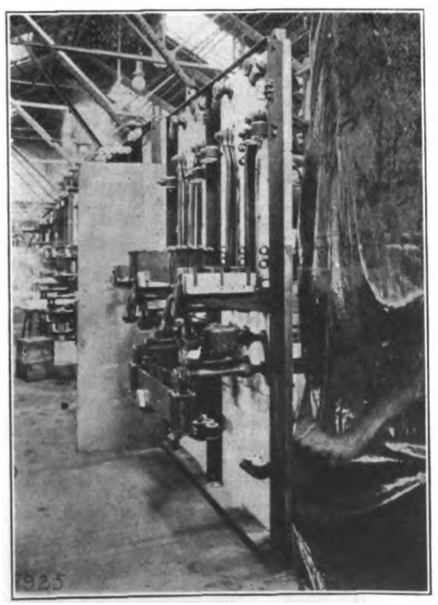
A lag-screw spike, commonly used throughout Europe, has been adopted and has proved a great success.

The system of line and track construction on single-track lines within the walled



Rear of Rotary Converter Board, Power-House, Manila Electric Railway.

city is shown in the accompanying illustration. On the double-track lines outside the walled city, the trolley and feeder wires are supported by a single row of



Rear of Transformers, Power-House, Manila Electric Railway.

ornamental posts placed between the tracks.

The rolling stock at present consists of 100 cars, the majority being of the single truck, cross-bench open type, used in the United States during the summer months, while to provide for the rainy season a number of convertible and semi-convertible cars will be used. The single-truck cars are equipped with two forty-horse-power double-truck motors, and the double truck with two fifty-horse-power double-truck motors. This large capacity was chosen, not on account of grades, for the line is comparatively level, but on account of the high temperature in which they are required to operate. The Canadian system of fare collection, by means of fare boxes, has been adopted, and the "zone" basis, within the city limits, has been abandoned. The first-class fare is twelve centavos, or six cents, while for the second-class, ten centavos, or five cents, is charged. This latter will, undoubtedly, be more popular.

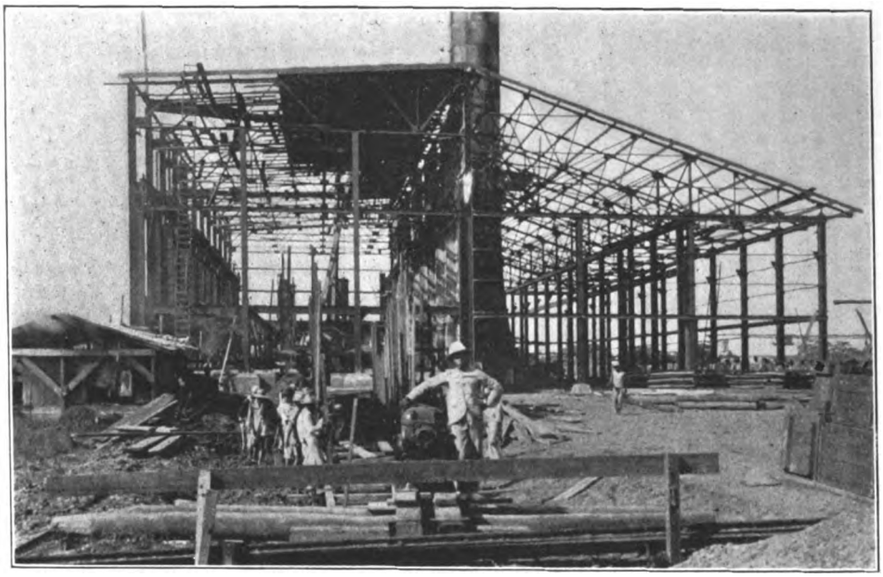
The newly adopted currency on the gold basis, with a ratio of two to one, has brought about a very stable and satisfactory condition of the monetary system.

In addition to cash fares, tickets are also used, and these will be sold in lots, at a reduced rate.

A large car shop has been provided, equipped with a full complement of tools necessary for the repair of cars and motors, and it is probable that, in the near future, the cars will be built entirely in this shop.

A large storage barn, built in the native style of a hollow square, provides storage for the cars and offices for the company. A fully equipped printing office has been installed, and tickets, time-tables, announcements, etc., will be printed by the company.

Previous to the completion of the power-house of the Manila Electric Railway and Lighting Company, artificial light was supplied to the residents of Manila by La Electricista, there being no gas company. This supplied arc and incandescent lights for both municipal and private use. Its plant at the date of Mr. Young's report was extremely inadequate in capacity and obsolete in design. Seventeen small generators were in place, and steam was generated in ten small boilers, having a total capacity of 2,000 horse-power. The generators were rope-driven by two 450-horse-power Buckeye engines, and six 300-horse-power Buckeye engines, the latter, however, were connected to jack-shafting from which the ten sixty-kilowatt Brush alternators were driven. Single-phase current for incandescent lighting was furnished at 110 volts, and 133 cycles. The power plant building is of wood



Power-House, under Construction Manila Electric Railway.

frame, with galvanized iron roof, and the architecture of the prevailing Spanish type.

The pole-line construction was seemingly high grade, consisting of iron poles with native hardwood cross-arms. However, the moist climate resulted in an extremely rapid deterioration of the metal, and many of these poles were found to be actually rusted in two. The copper was entirely inadequate, and the wiring, especially interior, was done with almost no regard for safety. Each customer was required to purchase his own meter, and current was charged for at the rate of from $1.20 to $2.45, Mexican, per sixteen-candle-power lamp per month. Meter rates were thirty cents, Mexican, per kilowatt-hour and about 18,000 incandescent lamps were in use.

Digitized by Google

Seventh General Meeting of the American Electrochemical Society.

Report of the Meeting Held at Boston and Cambridge, Mass., April 25, 26 and 27, 1905.

THE members of the American Electrochemical Society assembled Tuesday morning, April 25, at the Hotel Lenox, Boston, Mass., which had been designated as the headquarters for the seventh general meeting, to be held in that city and Cambridge during that day and the following Wednesday and Thursday.

The opening business session of the society was held at 9.30 A. M., at the Augustus Lowell laboratories of electrical engineering. At this session a number of papers were read and discussed, the meeting adjourning at 1 P. M., in order that the members might attend a reception given to the society by the Massachusetts Institute of Technology. This reception was held at the Technology Club, in Newbury street, where the members were received by President Henry S. Pritchett. The reception was followed by a lunch, and later a visit was made to the Lynn works of the General Electric Company. The society was met at the Lynn station by Professor Elihu Thomson and other members of the engineering staff, and conducted through the large works there, many interesting processes and machines being exhibited. The members were particularly interested in the work being done on steam turbines, both as regards construction and experimental investigations.

On Tuesday evening the presidential address was delivered by Dr. Henry S. Carhart. He took for his subject "Revisions of the Theory of Electrolysis." Dr. Carhart gave a brief, but very interesting review of the various theories which have been put forward to explain the conduction of electricity through electrolytes. He dwelt particularly on the work of Grotthus, who in 1805 offered the first satisfactory and usable explanation of electrolysis. Grotthus was born in Lithuania, and until his eighteenth year devoted his time to the care of his estates, his natural inclination toward science being severely repressed by his family. On reaching his eighteenth year he went to Berlin, and devoted himself to scientific investigations. From there he went to Paris, and later returned to his native country. In all, he spent three years in scientific investigations, and during this time he put forward his theory, which, for fifty years, was held to be the most satisfactory explanation of electrolysis. Grotthus's theory was extended by Clausius, and later Clausius's theory was replaced by that of Arrhenius. The difference in the three theories is this: Grotthus assumed the molecules of matter held in solution to be polarized by the charged electrodes, so that they arranged themselves in chains, the positive end of the molecule pointing toward the cathode, and the negative, toward the anode. When the force of attraction exerted by the two electrodes was sufficient to break up a molecule, its two parts separated, the positively charged part being set free at the cathode. This left the negative part free, and it, acting with the cathode, broke up the next molecule in the chain and combined with its positive portion. This action took place throughout the entire chain, leaving at the other electrode a free negatively charged part. In this way a transfer of electricity was accomplished throughout the electrolyte without it being necessary for any one particle to travel the entire distance between the electrodes. Clausius, in his modification of Grotthus's theory, assumed that the exchange just explained was going on continuously, even though no current be flowing; that, under certain conditions, a group of molecules would find themselves in such an arrangement that each would break up into two parts, which, adopting Faraday's terminology, are called ions, and that the positive ions thus formed, recombining with different negative ions, would form new molecules. This, it will be seen, is merely extending Grotthus's idea of exchange of partners, but it was thought to explain conduction through electrolysis when the applied electromotive force was less than that necessary to bring about decomposition. Arrhenius extended Clausius's theory, and assumed that, in every electrolyte, a certain number of molecules break up into ions, and that all electrolytes contain some of these free ions. This is the dissociation theory, which has given rise to so much controversy. Its advocates contend that it is not only the best explanation of electrolytic action, but it also explains abnormal osmotic pressures and the raising and lowering of the boiling and freezing points of solutions. The osmotic pressure is that pressure existing in a solution due to the presence of the dissolved material, and, according to the dissociation theory, it corresponds to the vapor pressure of the dissolved material.

Dr. Carhart mentioned the valuable work of Davy, Faraday and others. He concluded with the suggestion that the dissociation theory be given credit for the good it has accomplished, and that it be treated as a working theory until it can be replaced by one which is more satisfactory and more generally applicable.

During the evening an exhibit of electrolytic appliances, particularly electric furnaces of different types, was made by Eimer & Amend, 205-211 Third avenue, New York city. The new kryptol furnaces were shown, and attracted a good deal of interest.

Following this, an enjoyable smoker was held at the Hotel Lenox.

The second business session was held on Wednesday morning, at 9.30 A. M., in Pierce Hall, Harvard University, Cambridge. At this meeting the reports of the officers were presented. The secretary stated that the membership at the present time was 681; that the cash balance at the close of last year was $1,134; that $1,000 had been invested in a bond; that the cash balance on March 31 was $2,617 in cash, with still a large number of dues unpaid, and that the directors had authorized the purchase of a second bond, to cost $1,000. There are still numbers of the different volumes of the transactions on hand, which are for sale.

This session was followed by a reception tendered by Harvard University in Harvard Union, where the society was received by President Charles W. Eliot.

In the afternoon two parties were made up from members of the society, one visiting the Harvard buildings, and the other taking a special electric car to the coke works of the New England Gas and Coke Company, at Everett.

In the evening a banquet was held at the Hotel Lenox, where an enjoyable repast was served, followed by entertaining addresses by Dr. A. E. Kennelly, Dr. H. S. Carhart, Dr. Joseph W. Richards, Dr. H. W. Wiley and others.

The third session was held at the Augustus Lowell laboratories on Thursday morning, April 27, when all papers which had not previously been read were presented either in abstract or by title. This was followed by a luncheon at the Technology Club.

During the Wednesday morning session an amendment to the constitution, simplifying the method of counting the ballots, was adopted.

During the Thursday morning session

Digitized by Google

announcement of the election of officers for the ensuing year was made. Those elected were: president, Dr. Wilder D. Bancroft; vice-presidents, Dr. E. F. Roeber, Mr. Carl Hering, Dr. Louis Kahlenberg; managers, Dr. Charles A. Doremus, Mr. C. P. Townsend and Dr. W. R. Whitney; secretary, Mr. S. S. Sadtler; treasurer, Dr. P. G. Salom.

PAPERS PRESENTED TUESDAY MORNING.

The first paper read Tuesday morning was by Dr. W. S. Franklin and L. A. Freudenberger, and was entitled "Reversible and Irreversible Electrolytic Polarization." The authors reviewed briefly the various explanations which have been offered to explain the action of an electrolytic cell. The various quantitative ideas which are employed in the discussion of physical phenomena, from the point of view of thermodynamics, apply primarily to states of thermal equilibrium, but these quantitative ideas may be generalized so as to be strictly applicable to what are called permanently varying states. In the application of the principles of thermodynamics to actual phenomena, to things which really take place, it is essential either that the processes involved approach complete reversibility as they take place more and more slowly, or that the processes involved approach more and more nearly what may be called steady sweeps as the actual physical conditions approach more and more nearly to the ideal conditions which are assumed to exist as a basis for the application of the ideas of thermodynamics. When electrolysis takes place rapidly, one would naturally suppose it to be reversible, and it is an investigation of this question which is treated of in the paper.

The polarization of an electrolytic cell may be defined as the back electromotive force of the cell, aside from that part $R\,i$ which is due to the resistance of the electrolyte—that is, according to the equation, $E = R\,i + f\,(i) + e$, polarization may be defined as $[f\,(i) + e]$, and is equal and opposite to $E - R\,i$, where E is the total electromotive force applied to the cell. In this expression, e is that portion of the polarization of the cell which is reversible, while $f\,(i)$ is that portion which is irreversible, but which must be some function of the current. By measuring the polarization under different conditions, where the impressed electromotive-force, resistance, and the current flowing were known, one should be able to separate the two unknown quantities, and thus determine the values of the reversible and the irreversible polarizations. It must be remembered, however, that the value of the reversible polarization varies with concentration changes, with the character of the surface layers of the electrodes, and with temperature changes due to a continued flow of current. These things are not functions of the current, but they are functions of the time integral of the current, or the quantity of electricity which has passed through the cell; and the proportion of the reversible polarization which depends on these things does not change with quick changes of the current. This reversible polarization persists when the current is reversed, and contributes to the recovery of the energy previously expended in the cell.

That part of the polarization of an electrolytic cell which does not persist when the current is quickly reversed does not contribute to the recovery of the energy previously expended in the cell. This part of the polarization always opposes the current, and causes the dissipation of energy and it may be called the irreversible polarization, which, in general, may be defined as that part of the polarization which is a function of the current.

One difficulty encountered in endeavoring to separate the two parts, as indicated above, is that E is, to a certain extent, a function of the coulombs, because of local changes of concentration of the electrolyte, because of progressive changes in the character of the surface layers of the electrodes, and because of temperature changes due to continued flow of current. Some curves were exhibited by Dr. Franklin, giving the results of the experimental investigation. The curves had a rather singular form, but the results of different experiments agreed fairly well. The values of irreversible polarization, however, included the slight variations of the reversible polarization due to the concentration changes. To overcome this difficulty, another set of investigations has been started, in which the time during which the current is allowed to flow will be much decreased.

The discussion of Dr. Franklin's paper turned principally upon the definition of polarization. Dr. Franklin said that he used this term to include all the factors opposing the flow of current through an electrolytic cell, except the ohmic resistance.

The second paper presented was entitled "The Aluminum Electrolytic Condenser," by Mr. Clarence Irving Zimmerman. This is a supplementary paper to the first on the same subject, presented by Mr. Zimmerman to the society last year, a full abstract of which was printed in the issue of ELECTRICAL REVIEW for April 30, 1904. Mr. Zimmerman has extended his investigation of this interesting device, and described a number of new and striking phenomena. An abstract of this paper will be presented in an early issue.

The third paper was entitled "Notes on Economic Temperatures of Copper-Refining Solutions," by Professor C. F. Burgess. It was read by Dr. M. de Kay Thompson, Jr. Professor Burgess calls attention to the importance of taking into account the change in conductivity of copper-refining solutions. As the work to be done in refining copper consists in overcoming the polarization and the resistance of the cell, and as these factors vary with temperature, it should be possible to determine a temperature which will be most economical. Measurements have been made of the voltage required to drive a given current through a solution at different temperatures, but in drawing conclusions from these results, it must be remembered that it can not be assumed that the resistance of the electrolyte is directly proportional to the distance separating the electrodes. In fact, this resistance is made up of three factors—that of the body of the electrolyte, and that of the electrolyte at the surfaces of the two electrodes. We are not warranted in saying that the most economical temperature in a cell with plates one centimetre apart is the most economical for a cell with plates one-half inch apart. The results of experiments showing the variation in the electromotive force for different temperatures, with plates different distances apart, are given. Experiments were also conducted to determine the fall of potential throughout the cell. The latter experiment shows that the fall of potential through the electrolyte is represented by a straight line, and that there is a resistance effect at the surface of the copper electrodes, causing a fall of potential much more marked than the polarization effect. This surface resistance appears to be considerably greater at the cathode than at the anode. The agitation of the solution has very little influence on the surface resistance. This effect appears when an alternating current is passed through the cell, hence it is held not to be a result of electrolytic products.

Mr. Clinton Paul Townsend read in abstract his paper entitled "A Diaphragm Cell for Electrolysis of Sodium Chloride Solutions." Mr. Townsend described a type of cell developed for electrolyzing brine. The cell has a central compartment having cement walls, and carrying two anodes of graphite spaced so as to allow the brine to circulate between them. There

Digitized by Google

are two side compartments of iron, separated from the central chamber by a wire-gauze diaphragm covered with two or three thicknesses of very thin asbestos paper. These diaphragms are close to the anodes, leaving but a slight space between them. The side compartments are filled with oil, and have parallel and close to the diaphragm an iron plate. Through the oil are run heating pipes. During electrolysis, the chlorine set free at the anodes rises through the space between them and the diaphragms, thus causing a very rapid circulation of the brine, which flows up through this space and down between the electrodes. A similar circulation takes place in the cathode chambers, where hydrogen is set free, the motion of the oil carrying off the caustic as it is formed; and this, finally sinking to the bottom of the oil, runs off in pipes. The efficiency of the cell in the production of caustic is apparently 100 per cent. It is necessary that the current density be high. Some sodium chloride is carried over with the caustic, but this separates out on solidification.

A paper entitled "Conduction in Electrolytes" was read by Dr. J. W. Richards. Dr. Richards has investigated the conduction in solid and molten electrolytes. He finds that the resistance increases with cooling until crystallization takes place. There is no point at which a sudden change takes place. The conductivity in the molten condition is of the same nature as in the solid condition. He suggests that conduction through electrolytes may be produced by diffusion of the different phases of the electrolytes produced by the current.

During the discussion, Mr. C. I. Zimmerman said that electrolysis apparently takes place, to a small extent, in the Nernst glower. There is also an action which seems to be similar to gaseous conduction. After operating a Nernst glower on a direct current for some time, it is found that a groove appears near the negative terminal, showing that a loss of material has taken place. The air surrounding the glower is ionized, and conducts to some extent. There is also a thermoelectric effect at the terminals of the glower, heat being given off at the positive, and absorbed at the negative terminals. This effect can be demonstrated by fitting a glower with one platinum and one silver electrode. It is possible in this way to melt the platinum while the silver remains solid, although the temperature of the glower is about 2,200 centigrade.

In a paper entitled "Billitzer's Method of Determining Absolute Potentials," Dr. H. M. Goodwin described the three methods which Billitzer had used in measuring absolute potentials, which had led him to announce that the accepted value of the normal calomel element was inaccurate. In one of these methods a small platinum ball is suspended by a quartz fibre in an electrolyte through which a current is passing. If the platinum ball becomes charged, it should be deflected with or against the potential gradient. In another method, small bodies were passed through the electrolyte, and their deflection from a vertical line was measured. Attempts have been made to repeat Billitzer's work, but in no case has Dr. Goodwin succeeded in duplicating his results. The conclusion is reached, that we have at present no reason to discard the accepted value for the one-tenth normal calomel electrode. Recently, Billitzer has tried two other methods of obtaining absolute potentials, his results agreeing with the former ones.

Dr. M. de Kay Thompson, Jr., gave briefly the results of some recent experiments made to determine the potential changes going on in an Edison nickel-steel battery during charge and discharge. Curves were exhibited showing the changes at each electrode, and the resulting change of the cell. These have been obtained from different concentrations of the electrolyte. The curve for iron is very regular. That for nickel is fairly regular until the cell nears discharge, when it changes rapidly. The electrodes behave in this way until the concentration has been decreased to about twelve per cent, then the iron begins to fall off rapidly. The results would seem to indicate that a higher nickel oxide is formed on charge. This is first reduced to a lower oxide, and then to metallic nickel on complete discharge.

PAPERS PRESENTED WEDNESDAY MORNING.

The first paper to be read on Wednesday morning was by Mr. H. R. Carveth and Mr. B. E. Curry, and was entitled "Chromium and the Electrolysis of Chromic Acid." It was read by Mr. Carveth. This paper reviews the early work on the electrolysis of chromic acid, dealing particularly with that done by Geuther, who published his results in 1856. No one since then has been able to duplicate these results. Geuther's work was therefore discredited, and it has been held impossible to deposit metallic chromium from a solution of the acid. Messrs. Carveth and Curry, using commercial chromic acid, have obtained results entirely in accord with Geuther, and secured very good deposits of metallic chromium. These deposits resemble silver-plate, but are hard. It was found that it was possible to electrolyze chromic acid, obtaining the metal only when the current density is high and impurities are present, and it is thought that this probably explains the inability of previous investigators to obtain the metal. An interesting feature of this investigation is the fact that there are three, and probably more, different stages of reduction. This would indicate that, in the various solutions, there are chromium ions with four different valencies. It is thought that these deposits of chromium may be developed in electroplating. The metal, however, occludes about 250 times its own value of hydrogen, which may lead to peeling.

Dr. J. W. Richards called attention to our inadequate knowledge of the heat of formation of chromium salts, and suggested that the method of electrolysis just described might enable at least one value to be determined, which would allow the whole series to be calculated.

The second paper, entitled "The Electrolytic Precipitation of Silver," by Mr. Ralph C. Snowden, was read by Mr. Carveth. The object of this investigation was to determine the effect of current density and the speed of a rotating cathode upon the electrolytic deposition of silver, and to ascertain the possibility of obtaining a plating deposit of silver from a nitrate solution. After some unsatisfactory trials, the following method gave good results: a small rotating disc of copper, plated with silver, was placed in a porous cup which served as the cathode. The solution was silver nitrate, and the anode, silver. Endosmose was prevented by keeping the level of the cathode solution higher than that in the anode compartment, and by previously saturating the porous cup with silver nitrate solution. It was found that the size of the silver crystals decreases with an increase in the current density. A very finely crystalline deposit of silver can be obtained from silver in a solution by rotating the cathode rapidly and keeping the anode and cathode solution separated. The size of the crystals decreases with an increase in the rotation at the cathode. The addition of small amounts of organic colloids to the solution makes the deposit very amorphous, and causes the precipitated metal to assume a colloidal state. The presence of free nitric acid decreases the size of the crystals but slightly.

Two papers were then read by Mr. Alexander Lodyguine, the first of these describing some results of experiments with electrolytic deposition of metals on aluminum. It occurred to Mr. Lodyguine, some years ago, that he could make a light storage battery by depositing a thin layer

Digitized by Google

of active material on a light supporting plate. For this purpose lead could not be used, the only materials available being carbon and aluminum. Carbon, being brittle, is ruled out, and aluminum would be available only if it can be plated with some metal which will render it unaffected by the electrolyte. The aim was to cover the thin plates of aluminum with layers of antimonious lead or antimony. It was soon found that the plating could not be carried out in any electrolyte which attacks the aluminum. After many experiments, he reached the conclusion that a good solution from which lead or antimonious lead could be deposited on aluminum could not be found. The attempt to deposit antimony directly on aluminum was not tried. Other metals, however, were plated successfully, and aluminum plates covered with copper and iron were exhibited. One of these plates was first covered with copper, and then with a coat of antimony. To deposit the copper, an anode of pure copper and an electrolyte of pure water with a few drops of sulphuric acid in it were used. To deposit the antimony, a concentrated solution of proto-sulphide of sodium with an excess of the proto-sulphide in the vat was used. The anode was formed of a carbon plate placed in a porous cell, and surrounded by the tri-sulphide of antimony. The best density of current for the deposition of copper on aluminum is 0.013 of an ampere per square inch. The same density gives good results for depositing antimony on copper. The pressure was one-half volt for depositing copper on aluminum, and from 1 to 1.5 volts for depositing antimony on the copper. The amount of antimony deposited by one ampere-hour was 0.833 gramme, which is at the rate of from 1,080 to 1,620 kilowatt-hours for the deposition of one short ton of pure antimony. This, at the rate of $15 per kilowatt-year for power, gives a cost of power for obtaining pure antimony of from $2.16 to $3.24 per short ton.

The second paper by Mr. Lodyguine was entitled "Some Results of Experiments with the Reduction of Titaniferous Ores." The author called attention to the large deposits of titaniferous ores in the United States, and to the probable exhaustion of the deposits of magnetite and hematite, which are now largely used in the production of iron. To-day, iron masters will use no ore containing more than one per cent of titanium, because these ores are hard to smelt in the types of furnace now in use. The author has tried the reduction of these ores in the electric furnace, and has had considerable success. The furnace was a small one, containing only 4.4 pounds of the ore at a charge. From various samples of the ore, the percentage of pure iron recovered was from ninety-seven and one-half to ninety-eight and one-half. The slag of ferro-titanium is very rich in titanium, which can be profitably extracted. The energy required was about 11.25 kilowatts for about eight minutes, five minutes of this time being required to heat the charge, and three minutes for the reduction. Mr. Lodyguine estimates, from his experiments, that the total cost of reducing a ton of this ore is $16.15, and that the by-products are worth $7.50, making the real cost of the manufactured steel $8.65. Among the by-products of this process are ferro-titanium, which is excellent for the wheels of railroad cars, as it stands wear and tear better than any other steel. Titanium carbide is another product which is said to be harder than carborundum. It will thus be valuable as an abrasive and in the metallurgy of iron and steel. The mordants and pigments of titanium can also be obtained, and are valuable. The silicide, the boride and the nitride of titanium are excessively hard, and can even be used for polishing diamonds. Comparing his results with the cost of producing steel in the Bessemer converter, it is said that the latter is 14.84 cents per ton. This is somewhat less than the cost of producing the metal in Mr. Lodyguine's furnace, but when the value of the by-products is considered, the cost of the steel is practically cut in half.

A third paper presented by Mr. Lodyguine was entitled "Some Experiments with the Reduction of Different Oxides of Lead by Electric Current." This paper was read by title. It describes the work carried out by the author in an endeavor to recover lead from the peroxide of lead of lead storage batteries. For this purpose a mixture containing peroxide of lead, chloride of sodium, sulphuric acid and water was made up, which was electrolyzed between horizontal plates. A peculiar effect took place, for the mixture divided into layers; the upper being spongy lead, the second lead sub-oxide, then next litharge, next lead sulphate, lead chloride, and finally a layer of the lead peroxide. The rate of reduction was one ton for 435 kilowatt-hours, which, at a price of $15 per kilowatt-year, brings the cost of power for the extraction of one short ton of lead to eighty-seven cents.

A paper submitted by Dr. Louis Kahlenberg, entitled "The Specific Inductive Capacity of Oleic Acid and Its Salts," was also read by title. Dr. Kahlenberg has determined the specific inductive capacity of different samples of oleic acid, of ferric oleate, aluminum oleate, copper oleate, sodium oleate, linseed, rape seed, palm, cottonseed and other oils. The results indicate that the oleates diminish the dielectric constants when dissolved in solvents having a high dielectric constant, while they increase the dielectric constant of those solvents having low constants.

A paper entitled "The Rotating Diaphragm," submitted by Dr. Wilder D. Bancroft, was read by Mr. Carveth. If an acidified copper sulphate solution be electrolyzed between copper electrodes, and the corresponding voltages and current be noted, the resulting voltage current curve will be very nearly a straight line, passing through the origin. Interposing between the electrodes a non-conducting cylindrical diaphragm, which fills up most of the cross-section of the electrolytic cell, the resulting voltage current curve will be nearly a straight line, as before, but the pitch of the line will be steeper because of the increased resistance. Replacing the non-conducting cylinder by one of graphite, a new state of things is brought about, for the graphite conducts much better than an equal volume of solution; but now polarization takes place. When the current flowing through the cell is small, the fall of potential per centimetre is also small. Under these circumstances, practically no current will flow through the graphite diaphragm, and it will behave very nearly like a glass diaphragm. As the current through the cell is increased, a point is reached at which copper is deposited on one side of the graphite rod, while oxygen is set free on the other. Since a portion of the current is now flowing through the diaphragm, the voltage must be lower than required to give the corresponding current in the cell with a glass diaphragm. With a still higher current flowing through the cell, a point is reached at which the superior conductivity of the graphite diaphragm, as compared with an equal volume of solution, just compensates for the polarization. At this point the same voltage gives the same current, both with a stationary graphite diaphragm and with no diaphragm. With still higher currents, the voltage-current line becomes a straight line parallel to the line for a non-polarizable graphite diaphragm.

If the graphite diaphragm be reversed after copper has been deposited on one-half of it, the precipitated copper will dissolve, and copper will precipitate on the

Digitized by Google

graphite surface facing the copper anode. If instead of reversing the diaphragm it be rotated, it should behave as an ideally reversible electrode, and there should be no polarization and no precipitation of copper. These ideas were investigated by Mr. Ralph C. Snowden, and the results of his work given. The data confirm the predictions. A voltage-current line is obtained, which is straight, the line for the rotating diaphragm lying lower than the one obtained when no diaphragm is used. As rotation, in this case, prevents polarization, it was sought to determine whether polarization would cause rotation. However, the effects due to surface tension and to convection currents are so great that they mask any such effect, although it must exist.

A paper by Mr. Harrison E. Patten, on "The Heat of Solution of Aluminum Bromide in Ethyl Bromide," was read by Dr. J. W. Richards. The work was undertaken mainly to ascertain if the heat of formation of anhydrous aluminum bromide, when added to the heat of solution of this salt in ethyl bromide, would permit of calculating the voltage required to deposit aluminum and bromide from this solution. It is thought that the results show that a solution of aluminum bromide in ethyl bromide is subject to the same energy considerations as obtain in aqueous solutions, although its molecular conductivity curve is radically abnormal.

Dr. T. W. Richards called attention to the fact that the formula shown in the paper, giving the decomposition voltage in terms of the heat of formation, is that due to Kelvin, and is not the complete formula as proposed by Helmholtz.

A paper entitled "The Interdependence of the Atomic Weights and the Electrochemical Equivalents," submitted by Mr. Arvid Reuterdahl, was read in abstract by Dr. J. W. Richards. In this the author proposes an equation representing a spiral in polar coordinates, the vectorial angles representing atomic weights, and the radii vectors the number of ampere-hours per gramme unit of valence. The following laws are proposed:

The number of ions, whether gaseous or liquid, liberated by a given quantity of electricity, is a constant independent of the kind and mass of the ion.

The charge carried by a free ion, whether gaseous or liquid, is a constant quantity, independent of the kind and mass of the ion.

A paper entitled "Note on the Utilization of Blast-Furnace Gases in Connection with the Electric Smelting of Iron" was presented by Mr. Auguste J. Rossi. This paper discusses the commercial possibility of utilizing blast-furnace gases for driving gas-engine-driven generators, and the use of the electric energy thus obtained for smelting iron. It is held that the present method of utilizing these gases under boilers to generate steam wastes fully one-half of the gases. If the gas which is now being wasted in this way should be utilized in gas engines, 460 horse-power-hours would be obtained for every ton of iron produced. The author thinks that he is justified in concluding that the figure just quoted is the minimum possible in the best provisions of blast-furnace practice of the future, and it is one which, if only partly utilized, opens great possibilities for electric smelting.

Mr. H. H. Dow, in criticising Mr. Rossi's conclusions, laid emphasis upon the expensive character of gas-engine installations. He gave as an instance a particular case, in which a $16,000 gas plant was installed to do the work of a $1,000 steam plant, but the cost of operation was not reduced. Mr. Dow asked why we should go to so much expense to save gas when it is not worth much. Moreover, the gas plant replaces only the grate under the boiler, and, regarded in this light, is an expensive investment.

Mr. E. A. Sperry took the same stand, saying that, in a good many cases, the interest factor on a gas plant alone would amount to more than the cost of the power obtained in other ways. Replying to the assertion that English practice tended toward the use of gas engines, Mr. Sperry said that conditions there were different, as money is cheap and coal dear.

Dr. J. W. Richards did not sympathize with the two preceding speakers. Europe, at the present time, obtains 300,000 horsepower from its waste gases, and the economies there possible will surely be adopted within three or four years in this country. Dr. Richards said that the following fact can not be denied: coal can be used in the blast furnace, and the gases produced employed in gas engines and used for producing crucible steel at a lower rate than can be done by older processes. Using coal in a blast furnace, we obtain only three per cent of the calorific energy of the fuel. Converting it into gas, which is used in a gas engine for driving a dynamo, we obtain ten per cent of this energy at least. Dr. Richards believes that there is a vast field for producing fine steel in the electric furnace, and that the old processes are doomed within the next five years. The open-hearth and Bessemer furnaces will, however, stay.

PAPERS PRESENTED THURSDAY MORNING.

On Thursday morning the first paper, entitled "Electrostatic Method for Separating and Concentrating Ores," was presented by Professor Lucien Ira Blake, and was read by Mr. C. E. Locke. The paper describes the method devised by Mr. Blake for separating and concentrating ores. The process depends upon the repulsive action exerted between bodies electrically charged, and upon the fact that good conductors are more quickly charged than poor conductors. By grinding the ore fine, and allowing it to fall upon a charged cylinder which is revolving, the conducting particles are thrown off at an angle, while the non-conducting particles drop perpendicularly. The separators are of various types, but consist essentially of a hopper for feeding the crushed ore, and of feed plates for regulating and directing the supply to the cylinder. Below these plates is the rotating cylinder, which is of metal; and below this are the receiving hoppers. Just above the latter is a movable divider, which can be adjusted so as to divide the stream of ore at any point. A number of these machines have been in use in the West for two years, in actual commercial work. As an illustration, the following results were given as those obtained in practice with Joplin ore. This ore, as received, contained about fifty per cent of zinc, 2.5 per cent of lead, and a little less than eleven per cent of iron. After separation, the heads contained sixty-one per cent of zinc, a trace of lead, and 1.5 per cent of iron, while the tailings contained about three per cent of zinc, ten per cent of lead, and thirty-four per cent of iron. With a copper ore containing 4.6 per cent of copper, the heads, after concentration, contained about thirty-four per cent of copper; the tailings less than one per cent. The process has been tried, for various ores, and even for purifying graphite, with success.

An exceedingly interesting lecture was then given by Dr. W. R. Whitney, on "Colloids." Dr. Whitney preceded his lecture with some general definitions, saying that he preferred to consider a colloid as matter in suspension in a liquid. We can have three mixtures of solids and liquids—a mechanical mixture, such as sand and water, in which the sand rapidly settles out; a colloid in which separation does not take place, and a solution such as sugar and water, which is a true solution. Colloids do not exert osmotic pressure. The material in suspension exists in observable form, and can be seen under a microscope. It was found that each little particle is in continuous motion. Colloids migrate

Digitized by Google

when an electric current is passed through them, and they may be divided into two classes, positive and negative, according to whether they travel with or against the current. Positive colloids precipitate negative, and negative colloids precipitate positive, but those of similar class do not affect each other. All colloids are precipitated by electrolytes. The following general law is enunciated: whenever, in any liquid whatever, a substance is produced in the solid state, it will be in the colloidal state until coagulated and precipitated. Colloids may be obtained by volatilizing metals in water or adding to water a solution of some substance insoluble in water, in a solvent other than water. If an electrolyte be present, precipitation takes place, and usually this will occur, since water nearly always contains sufficient impurities to make it an electrolyte. As a corollary to the above, if, by dialysis, the electrolyte be removed from a solution, a colloid is formed.

Dr. Whitney then called attention to the wide prevalence of colloids in nature. Blood is a colloid, as are practically all animal and vegetable juices, and he pointed out that the blood of one species of animal will precipitate that of another. Precipitation of toxins by anti-toxins is another example of colloidal precipitation, and it is interesting to note, in this connection, that anti-toxins are generally introduced in saline solutions, the salt forming an electrolyte. Another interesting example of the precipitation of colloids is that of the deposition of mud at the mouth of a river, where it enters the sea. This has been attributed by some to the presence of the salts in the sea-water.

Dr. Whitney showed how a knowledge of colloids might be used to advantage in dyeing. He exhibited a piece of jelly which had been soaked in Prussian blue for a week or more. It was uncolored. He then showed another sample of the same jelly, to which had been added something which would precipitate the Prussian blue throughout the jelly. This sample of jelly had been left in the Prussian blue for a short time, and, upon cutting, it was found to be dyed entirely throughout.

During the lecture Dr. Whitney showed experimentally the migration of positive and negative colloids when a current is passed through. He showed also the reverse effect; holding the colloid stationary, the water migrated in the opposite direction, and he showed the effect of concentration of electrolytes upon the precipitation of colloids.

A paper entitled "An Electrolytic Switch" was read by Mr. William Smith Horry. This described the application of an electrolytic shunt about a switch to prevent arcing when opening the switch. The device may be considered to act either as a high resistance shunt or as a condenser in shunt.

Mr. F. J. Tone read a paper on "Silicon," describing methods by which the metal may be obtained. A furnace of the resistance type is used, the resistor being a graphite rod placed vertically in the cylindrical furnace. It is very essential that the temperature be regulated nicely, and that the metallic silicon be drawn off as rapidly as it is formed. This is accomplished by the construction of the furnace, which allows the silicon to find its way out by gravity. The process is continuous, and the metal obtained is bright and crystalline. It does not oxidize easily in the ore until heated nearly to its boiling point. It will probably find wide use in the arts, particularly in the metallurgy of iron and steel, because of its reducing power. It may be used as a substitute of aluminum in a mixture analogous to thermit. The heat of formation of silicon is more intense than that of aluminum, but, as a larger amount of oxidizing material must be used, the so-called "energy density" of the mass is less than that of thermit. One advantage of its use in this respect is the ease with which it can be reduced to a powder. The material may be used as a resistance material, and in the manufacture of explosives.

Mr. Henry Noel Potter said that while silicon is not readily oxidized in the ore, it is easily oxidized by carbon dioxide. He said that it is only just to Mr. A. B. Albro to state that he had invented the heating mixture in which silicon takes the place of aluminum, and that this has been designated as "calorite."

Professor Elihu Thomson spoke of the great possibilities of silicon. When in a granulated form, it makes an excellent resistance material; and by merely varying the pressure upon it, the resistance can be varied from 300 or 500 to 1. To obtain the original high resistance, it is only necessary to shake up the material. When the current density is too high, a slight fusion takes place, and prevents restoration to the original condition. When this is liable to happen, the rheostat should be cooled. The resistance of the material is two or three times as great as that of carbon.

Mr. A. B. Albro read a paper entitled "The Microstructure of Silicon and Silicon Alloys." The paper was illustrated by a large number of interesting lantern slides, showing the different forms of microstructure for different samples of silicon alloys, and for the same samples, but cut in different planes. In these various alloys the characteristic forms of silicon and its compounds were plainly shown.

Dr. E. Weintraub read an interesting paper discussing the physical actions taking place in the mercury arc. An abstract of this paper will appear in the ELECTRICAL REVIEW.

During the discussion, Dr. Weintraub said that the transfer of material through the voltaic arc is insignificant, and does not at all correspond to Faraday's law. Assuming, however, that the transference was by electrons, and that these have the dimensions assigned to them by J. J. Thomson, a figure for the transfer of material could be obtained of the order of that called for by Faraday's law. These results, however, are largely affected by the amount of material carried over by simple volatilization.

Dr. W. R. Whitney showed experimentally the difference between the arcs formed between pure carbons, impregnated carbons, carbon and magnetite, and magnetite and copper. He called attention to the fact that, when carbon is used, the light comes principally from the crater, while in the other forms the arc itself is luminous.

The following papers were read by title: "A Low-Voltage Standard Cell," by Professor G. A. Hulett, and "Adherence of Nickel to Nickel," by R. C. Snowden, and the meeting adjourned.

Locomotives as Fog-Makers.

An engineer asserts that the London fogs are caused largely by the discharge of steam into the air from the 300 or more locomotives operating in the London area. Averaging each engine at 500 horse-power, or a total of, say, 150,000 horse-power, and adding 500,000 horse-power from other steam-generating sources, gives a total of 650,000 horse-power of steam discharged into the atmosphere. One steam plant of 2,000 horse-power, the engineer figures, will discharge into the air twenty tons of steam per hour, or sufficient to produce a fog twenty feet thick and one mile square; and what plants with a capacity of 650,000 horse-power can do in the way of fog production may, therefore, be easily estimated. The proposed remedy is to convert this waste steam into electric power. —*Railway Age.*

Digitized by Google

The American Institute of Electrical Engineers.

The 196th meeting of the American Institute of Electrical Engineers was held in the chapter room, Carnegie Lyceum, New York city, on Friday evening, April 29. President Lieb was in the chair.

The secretary announced that at the directors' meeting held in the afternoon seventy-six associates were elected. He also announced the deaths of Mr. H. C. Smith, of Pittsburg, and Mr. C. E. Stevens, of British Columbia.

President Lieb announced that as the four papers of the evening were on kindred subjects they would be presented together, and that discussion on all the papers would be reserved until the last one was read.

A paper entitled "Some Notes on Polyphase Metering," by Professor J. D. Nies, was then read in abstract by Mr. F. W. Roller. The paper describes a series of tests carried on during the summer of 1904 for an operating company, in order to determine the most satisfactory method of metering the power delivered to certain consumers whose demands ranged from 200 to 1,000 kilowatts. The established practice of the company had been to install polyphase meters on such circuits, and in case where special accuracy was desired to put two of them in series. It was found, in such cases, that the two meters would never give identical readings, being affected differently by changes in frequency, pressure and power-factor. The difference between the readings was not constant. The behavior of the instrument indicated clearly that errors existed other than those of calibration—errors which would make it unwise to place implicit confidence in the readings of such meters, unless some means were provided whereby the readings could be continuously checked.

Errors introduced by instrument transformers have the same effect upon the accuracy of all meter systems, whether single-phase or any form of polyphase, and the consideration of them naturally precedes the consideration of the different systems. The pressure transformer differs in no way from an ordinary transformer. Its operation is similar and is governed by the same rules, and therefore the pressure delivered from the secondary coils will vary with the amount of load that is put upon the transformer by reason of the impedance drop in its coils. A number of curves were presented in the paper, showing the percentage of error introduced by current transformers into the readings of various instruments. The errors are due to the lag of the load current. Another curve illustrates the combined error produced by shunt and current transformers.

The tendency of meters of all types to run "slow" on full load and on low load was discussed, and the best ways of meeting the difficulty were taken up. It is stated that probably the best way to remedy the trouble is to calibrate a meter for its probable average load. The error occasioned by the displacement of the phase of the shunt field from its proper position—ninety degrees behind the impressed electromotive force—was also discussed.

The different methods of applying induction meters to the measurement of polyphase power were described. One method employs a single-phase meter with star box, the meter pressure coil acting as one arm of the star box. The meter readings are to be multiplied by three. This method is open to a number of objections, and is not accurate unless the load is in perfect balance. Another method of using a single meter is to insert the current coil into one of the conductors, and connect the pressure coil between that conductor and the middle point of the transformer secondary connected across the other two conductors. One method of measuring the power in polyphase circuits is to employ two separate single-phase meters, so connected that the two meters receive in their current coils the currents in two of the wires, and receive in their pressure coils, respectively, the pressure between these coils and the third wire. This method gives theoretically correct results on any three-wire circuit whatever, with balanced or unbalanced load. It has a number of disadvantages, however.

Another and better method is to use two single-phase meters, as above described, but with the difference that the meters are combined and both moving elements are attached to the same shaft. Perhaps a better plan than any of the preceding is to employ three separate single-phase meters, one for each phase of the circuit, having their pressure coils connected in star, the junction point of which is connected to the neutral formed by a star-connection of the secondaries of the pressure transformers. The summation of the three readings gives the true power on either balanced or unbalanced circuits.

The only disadvantage of the method is that it requires the presence of a neutral conductor, and therefore is not available for three-wire, three-phase service. This disadvantage does not exist in systems using pressure transformers, since the secondaries of the latter can as easily be connected in star as in ring, furnishing the required neutral.

Mr. F. P. Cox's paper on "Notes on the Use of Instruments on Switchboards" was then presented. In selecting instruments for any particular class of service, the conditions under which they are to be used must be given careful consideration. One of the most important considerations is in connection with the capacity of the instruments to be used. An ammeter whose needle constantly hovers around a zero position is of comparatively little use, and an integrating wattmeter which normally operates at ten per cent, and frequently at less than one per cent of its rated capacity, may give a false impression of the operating efficiency of the station. Under such conditions, agreement is difficult to obtain where totality meters are used and an effort is made to check them up with the sum of the individual feeders. Better results will be obtained by metering each generator, for the meters would then not be required to operate upon as low loads as they would if placed upon the feeders.

The friction of the jewel bearing was taken up, and the statement was made that it is not so negligible as has been assumed. The relations between the highest load and the smallest load with which the instrument is used should also be taken into consideration. Integrating instruments should be fully loaded, under normal conditions, as they have an inherent overload capacity not possessed by indicating instruments.

The difficulties of accurate calibration and adjustment of switchboard instruments were taken up, and the difficulties were pointed out. It was suggested that standard resistances should be introduced in switchboards for the purpose of calibration and testing.

The effect of stray fields, which are always present in central stations, was discussed, and the high errors introduced in the readings of unshielded instruments were pointed out.

Mr. Lewis T. Robinson presented a paper entitled "The Oscillograph and Its Uses." The paper gave an historical sketch of instruments for obtaining wave-forms, and described the method of Joubert, and the diaphragm instruments of Dr. Thomson and Fröloch. The Rosa curve-tracer and the General Electric wave-meter were described, together with the ondograph. The true oscillograph, due to Blondel, was then taken up and described. An oscillograph, to give satisfactory results, should have: first, a short, free, periodic time

Digitized by Google

compared to the period of the wave-forms being recorded; second, critical damping —that is, the motion just ceases to be oscillatory; third, negligible self-induction; fourth, sufficient sensibility. The instrument should be so constructed that the working parts are readily accessible, and of sufficient size so that they may be removed or repaired by persons ordinarily skilled in the handling of testing instruments. A number of records of the instrument were presented, and at the close of the meeting the instrument was shown in operation to all present.

Mr. W. J. Mowbray next presented a paper on "The Maintenance of Meters." The importance of having a meter accurate was pointed out, in view of the fact that the meter dealt with the finished product. Periodic overhauling is necessary, and is efficient in proportion to the cheapness and accuracy with which it can be done, and to the permanence of the result. Attention was called to a portable test meter which was used by the author for the accurate and rapid determination of the percentage by which a customer's meter is running fast or slow. The test-meter is similar to a customer's ordinary watt-hour motor-meter, in that it has a rotating armature, each revolution of which represents the passage through the meter of a certain number of watt-hours. The ampere capacity of the test-meter can be varied at will by means of a plurality of windings. A meter generally operates most accurately at full load, and as the load is decreased the meter is likely to become inaccurate. This is because it is impossible to entirely eliminate friction from the bearings and contacts of a meter armature, or to keep this unavoidable friction at a constant value. The test-meter can be started or stopped at will by means of a switch, the meter under test meanwhile rotating continuously. In practice, the test-meter is allowed to rotate during the interval that the meter under test makes one or ten revolutions. A comparison of the watt-hours corresponding to the latter revolutions with the true watt-hours, as recorded by the test meter, shows instantly whether the rate is fast, slow or correct.

Accurate and cheap calibration is of comparatively little value if a meter soon returns to its former condition of inaccuracy. In old meters, appliances should be provided for increasing the permanence of calibration. Owing to the advance of the art, modern meters are fairly reliable, but their improvements are not generally applicable to the older forms. Suitable appliances have, however, been developed, chiefly by the large operating companies, with the result that meters manufactured ten years ago can now be made at least equal in efficiency of operation to the most modern class. The most prominent of these appliances are the adjustable friction compensating coil, the cup or concave diamond bearing, and a means for correcting the disposition of the drag magnets relative to the field coils.

The object of changing the disposition of drag magnets is to prevent meters from running fast after being subjected to the currents resulting from short-circuits. It has been found that by changing the disposition of the magnets so that the stray flux travels across instead of along them, the tendency to demagnetization is minimized. This system of overhauling has been productive of excellent results, and is coming into extended use as the importance of maintaining meter accuracy becomes more fully realized.

The discussion of the papers was opened by President Lieb. He stated that the most important operation of electric companies was the metering of the product. The public, unfortunately, has not the confidence in meters to which the results obtained entitled the latter. There is also an unfortunate lack of legislative recognition of the conditions of proper metering. It is difficult to test a meter on a switchboard or in cellars or other places where the influence exerted by neighboring currents is great. It is also difficult to persuade a customer that a laboratory test is an accurate one, as the customer usually feels that the test should be made on the spot where the meter is working. Mr. Lieb stated that it was hard to reconcile a customer's idea of the current used with the record of the meter. The customer bases his ideas upon observation, and usually will not be persuaded that the meter record is correct.

The tendency of most electrical recording apparatus is to run slow. To what extent this apparatus does so, under commercial conditions, is hard to say, but the records are usually considerably lower than the actual amount of current used. It is usually good practice, in installing meters, to so proportion the meter capacity in installations that some meters will occasionally burn out. If no meters burn out, the installation is usually considered over-metered. This is for the reason that a meter is usually most accurate under full load or an overload.

Mr. Lieb gave some figures on the result of periodic tests of 1,000 meters under full-load conditions. The variations from accuracy of over seventy-five per cent were between + 5 per cent and — 5 per cent. Of the remaining meters outside of this variation twice as many ran slow as ran fast. Only 2.7 per cent of the meters tested were more than ten per cent fast. Of the same meters, considered under light-load conditions, fifty per cent showed a variation of between + 5 per cent and — 5 per cent from accuracy, and of the remaining meters outside of this limit, five times as many were slow as were fast.

Mr. Lieb stated that all persons who had to do with meters should study the conditions of their use, and the conditions under which the current metered is used. In testing the meters, the test conditions should be compared with the actual conditions.

Mr. C. D. Haskins endorsed President Lieb's remarks, and said that he was astonished at the attitude of laymen in regard to metering devices. He stated that laymen considered meters much worse instruments than they actually are. He called attention to the Massachusetts law regarding the testing of meters, and stated that the average error of all the electric meters tested by the state board in 1904 in Massachusetts was 1.08 per cent from unity at full load, and less than one per cent at one-fifth load. This is fifty per cent better than the accuracy shown by the gas meters which were tested under complaint in Massachusetts during the same period. The total amount of money refunded in Massachusetts in 1904, as a result of overcharge due to defects in meters, was $4.50.

Mr. Haskins stated that, in regard to Mr. Nies's paper, he did not think the conditions assumed are conditions which are really common in the use of the devices under consideration. He also thought that there might be some questions in regard to transformer accuracy, as set forth in the paper, which would not accord with the observations which have been made on such devices.

Referring to Mr. Cox's paper, he emphasized the importance of studying the relation of the stray fields about the switchboards to instrument accuracy. There are many switchboards in the United States where the effect of stray fields almost destroys the accuracy of the instruments on the boards. He also emphasized the fact that the accuracy of an indicating instrument is very nearly worthless at the low readings on the scale.

Professor Edward B. Rosa described some work which had been done at the Bureau of Standards, Washington, D. C., on the determination of wave-forms. He

Digitized by Google

stated that it is possible to attain very great accuracy in the determination of wave-forms in alternating currents. The arrangement of the apparatus, and the method of taking the readings and of calculating them, together with the results of the work, were given in detail. Professor Rosa emphasized the point made in Mr. Cox's paper, in regard to the use of switchboard instruments as precision instruments for testing, stating that they should not be so used. He stated that, at the Bureau of Standards, a test was made of a number of instruments which were from 1,000 to 3,000 amperes (direct current) capacity, and which had been used in a railway station. He found that some of the instruments varied eight per cent from the maximum and minimum values, and that others varied only two or three per cent between their values at full load and light load. The instrument varying eight per cent had been used on a test of considerable importance. He commended the suggestion of connecting a standard resistance in the switchboard in order to calibrate the instruments. In regard to instrument transformers, he stated that he had found them to be more accurate and reliable than is popularly supposed, providing that the load on the secondary is constant.

Dr. Clayton H. Sharp stated that the danger of stray fields affecting accuracy of indicating instruments on a switchboard is a very real one, and that the errors introduced may be very large. The error is apt to be greater in ironless alternating-current instruments than in direct-current instruments of the permanent-magnet, moving-coil type. The difficulty of checking instruments by the ordinary method of comparison with standard instruments is that the standard instruments themselves may be affected so as to yield erroneous results. Two methods of surmounting the difficulty were pointed out. The first is to use, in checking, an instrument which is unaffected by stray fields—for instance, a potentiometer. The second method is to use an alternating-current instrument as the standard. The moving coil of the instrument is first connected into circuit, and the orientation determined at which the moving coil is unaffected. The readings are taken when the instrument is so shifted that the moving coil lies in the direction so determined. He stated that the paper by Mr. Robinson was of great and practical importance, and that electrical engineers are indebted to Mr. Robinson for having put into available commercial form these instruments for experiment and research in variable-current phenomena.

The Iowa Electrical Association.

The fifth annual convention of the Iowa Electrical Association, a brief mention of which was made last week, was held in the Hotel Julien, Dubuque, Iowa, on April 19 and 20. In point of attendance, in enthusiasm and in definite information expressed, the convention was one of the most successful that any electrical engineering body has held. On Wednesday morning, April 19, the session was opened by the introduction of Mayor C. H. Berg, of Dubuque, who delivered a brief address.

The annual address of W. L. Bowers, of Davenport, president of the association, called attention to the necessity of increasing the revenues of the association, and asked for the establishment of an associate membership.

The first paper was read by L. D. Mathies, general manager of the Union Electric Company, of Dubuque. This paper was entitled "Methods of Obtaining Business."

On Wednesday afternoon a paper on "Commercial Lighting," by J. A. Innes, was read by the secretary. This paper elicited considerable discussion, and, in connection with it, the much-mooted question of tantalum lamps was brought up and thoroughly gone over. The Nernst lamp was the subject of considerable discussion also, and the uniformly excellent results attained with this lamp were commented upon. A paper entitled "Commercial Power" was read by Paul E. Bellamy, of Knoxville. Mr. S. Sparrow, of the Wagner Electric Manufacturing Company, described the new single-phase elevator motor which his company has recently placed on the market. A paper entitled "Boiler-Room Economics" was read by F. H. Lankashier, after which A. W. Zahm, of Mason City, read a paper entitled "Methods of Accounting."

On Thursday morning the first paper read was by L. B. Spinney, on "The Rating of Incandescent Lamps." Following this, Frank L. Perry addressed the convention, and called attention to the great value of the work which the National Electric Light Association was doing for central stations, and emphasized the advantage of the members attending the coming convention in Denver and Colorado Springs.

Following a brief address by E. B. Hillman, of Quincy, president of the Illinois State Electric Association, D. F. McGee made a report from the committee on "Hot-Water Heating."

In the afternoon a paper on "Steam Turbines," by W. C. Boileau, was taken up, followed by J. D. Boyd, of Sioux City, with a paper entitled "Gold Brick Finance." Edward Reavy then read a paper on "Meter Data."

The paper by Austin Burt, on "Facts and Factors," was followed by George S. Carson, of Iowa City, on "Association Matters."

At the closing of the session, the proposition to increase the annual dues was taken up. The dues heretofore have been five dollars per year to all members. The following grade was adopted: cities of less than 5,000 population, five dollars a year; cities of 5,000 to 10,000 population, fifteen dollars a year; cities of over 10,000 population, twenty-five dollars a year.

The nominating committee presented the following names:

Austin Burt, Waterloo, president; A. W. Zahm, Mason City, vice-president; P. E. Bellamy, Knoxville, secretary; W. A. Mall, Belleplaine, treasurer; executive committee: George S. Carson, Iowa City; L. D. Mathies, Dubuque; J. A. Innes, Eagle Grove.

A number of manufacturers of electrical and kindred apparatus made exhibitions. The following companies had representatives in attendance:

Electric Storage Battery Company, Philadelphia, Pa., J. A. White.

Simplex Electric Heating Company, Cambridgeport, Mass., W. F. Hruby.

National Carbon Company, Cleveland, Ohio, C. W. Wilkins.

Wagner Electric Manufacturing Company, St. Louis, Mo., C. E. Delafield, S. Sparrow, E. K. Seymour.

Crouse-Hinds Company, Syracuse, N. Y., F. F. Skeel.

Wesco Supply Company, St. Louis, Mo., George Knoche.

Stanley Electric Manufacturing Company, Pittsfield, Mass., A. A. Morton.

H. W. Johns-Manville Company, New York city, F. E. Johnson.

Porter & Berg, Chicago, Ill., E. R. Mason.

American Electrical Supply Company, Chicago, Ill., F. D. Phillips.

American District Steam Company, Lockport, N. Y., H. C. Eddy.

Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., C. A. Ross, W. R. Pinckhard, A. M. Miller and H. H. Coughlin.

National Battery Company, Buffalo, N. Y., E. L. Draffen.

Sangamo Electric Company, Springfield, Ill., R. C. Lamphier.

Fort Wayne Electric Works, Fort Wayne, Ind., Walter Goll.

Stanley Instrument Company, Great Barrington, Mass., F. J. Alderson.

General Electric Company, Schenectady, N. Y., W. J. Ferris, W. H. Colman, A. H. Hayward and George A. Seabury.

General Incandescent Arc Light Company, New York city, F. Raymond.

Duncan Electric Manufacturing Company, Lafayette, Ind., W. H. Sinks.

State Electric Company, Clinton, Iowa, C. C. Ewing.

Illinois Electric Company, Des Moines, Iowa, O. T. Kimmel.

Allis-Chalmers Company, Milwaukee, Wis., Fred G. Whipple.

National Electric Company, Milwaukee, Wis., Ashley P. Peck, J. F. Perry, H. M. Klingenfeld.

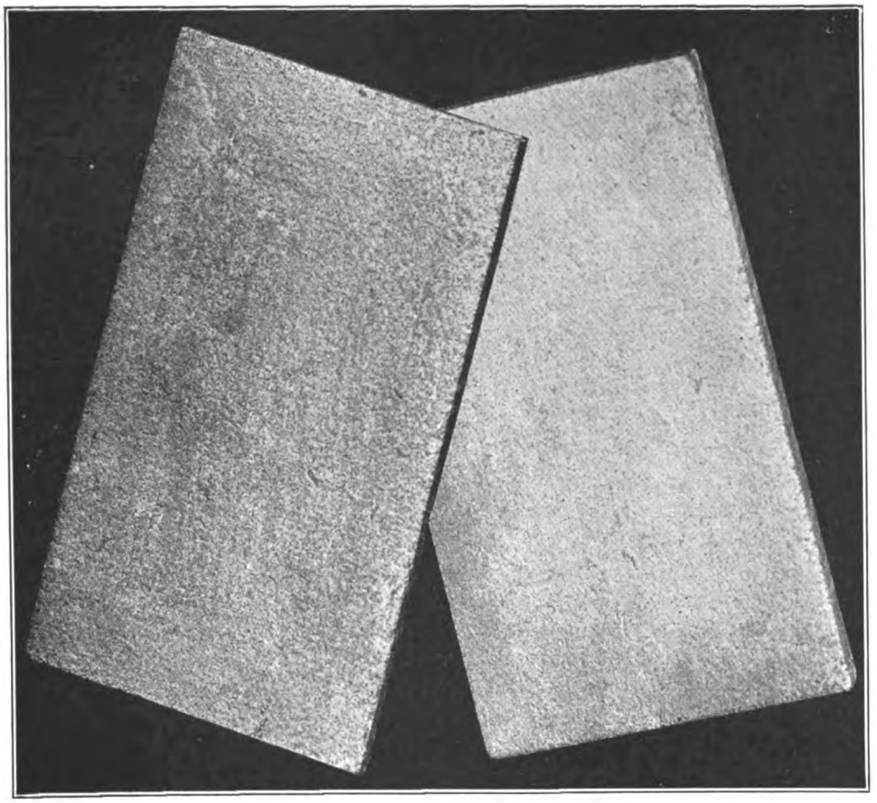
Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Asbestos Building Lumber.

The increasing use of high voltages or of heavy electrical currents in new electrical developments frequently gives rise to conditions where a strong, fireproof, non-conducting material must be employed. To meet this need, a number of materials have been brought out, one of the best known being asbestos building lumber, a material formed mainly of asbestos.



SAMPLES OF ASBESTOS BUILDING MATERIAL, ACTUAL THICKNESS OF UPPER PLATE, 0.25 INCH; LOWER PLATE, 0.5 INCH.

Asbestos building lumber is manufactured by the Keasbey & Mattison Company, Ambler, Pa. It is made from asbestos fibre and specially prepared asbestos cement. It has a light gray color, and, at a little distance, resembles a fine-grained stone. Upon closer examination the fibre can be seen, but the grain of the material is close, owing to the great pressure to which it is subjected during its manufacture.

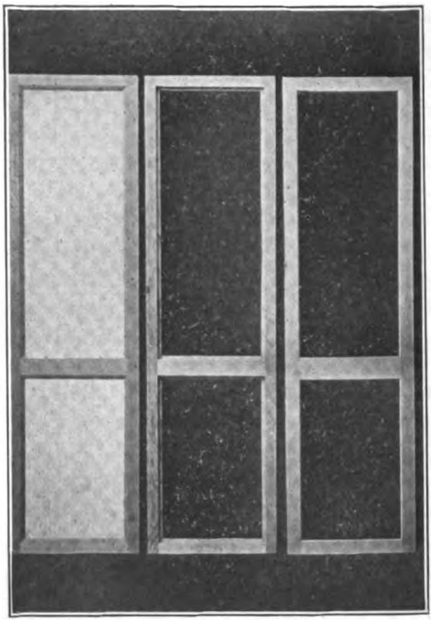
The standard form of this material is a sheet forty-eight inches long by forty-two inches wide. It can, however, be made in lengths up to 100 inches. Practically any thickness may be obtained up to one-half inch, and, shortly, sheets an inch in thickness will be supplied. When desirable, two thinner sheets may be riveted or cemented together so as to make one large, thicker sheet. The material, owing to the use of cement, is too hard to be worked by wood tools, but is easily cut by metal-working tools, and can be drilled without difficulty. Wire nails may be driven through the thinner sheets without splitting or chipping. When the facilities are not at hand for working the material, the manufacturer will cut it into any desired shape at a slight additional cost.

The material is being used for many purposes. For example, the Interborough Rapid Transit Company is employing it for protecting the bottoms of electric cars. The Brooklyn Rapid Transit Company also makes use of this material, as do the New York City Railway Company, the Montreal Street Railway Company and the Chicago City Railway Company. These applications of the material are to protect the car body from arcs which might be formed between the electrical conductors under the car, or against the overheating of the conductors themselves. The material is also employed by the Interborough Rapid Transit Company for protecting the iron structure of the subway when this approaches within a short distance of the third rail.

Another use of the material is for barriers for separating high-tension switches and between bus-bars. In this use it is replacing soapstone and slate, as it is lighter and stronger and has better arc-resisting properties.

The accompanying illustrations show the use of the material for this purpose at the Fifty-ninth street power-house of the Interborough Rapid Transit Company. The large sheets of asbestos building lumber are set in a light wooden frame, and the latter is clamped in front of the brick cell containing the high-tension switch.

The General Electric Company is also making use of this material for many purposes, because of its electrical resistance, and its mechanical strength. The same company finds the material suitable for positions where it is exposed to considerable heat and hot vapor from arcs, because it does not soften and is not disturbed. It takes paint or varnish well if it is desired to give the surface a finish. It is an excellent material for making boxes to enclose circuit-breakers on electric cars. The New York City Railway Company has put it to this use.

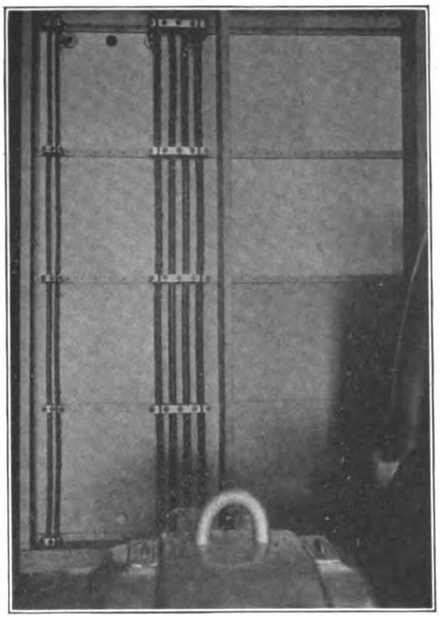


PANEL BOX FRAMES MADE UP FROM ASBESTOS BUILDING MATERIAL.

These applications of asbestos building lumber demonstrate its valuable proper-

Digitized by Google

ties, but to determine them more accurately a large number of samples have been tested in various ways by well-known authorities. Tests have been conducted by the National Board of Fire Under-

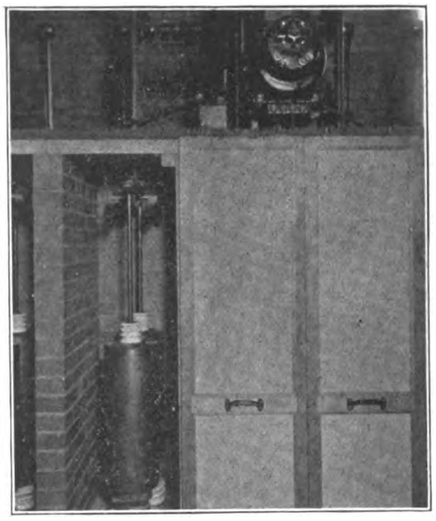


CABLE FLUE PARTITIONS OF ASBESTOS BUILDING LUMBER.

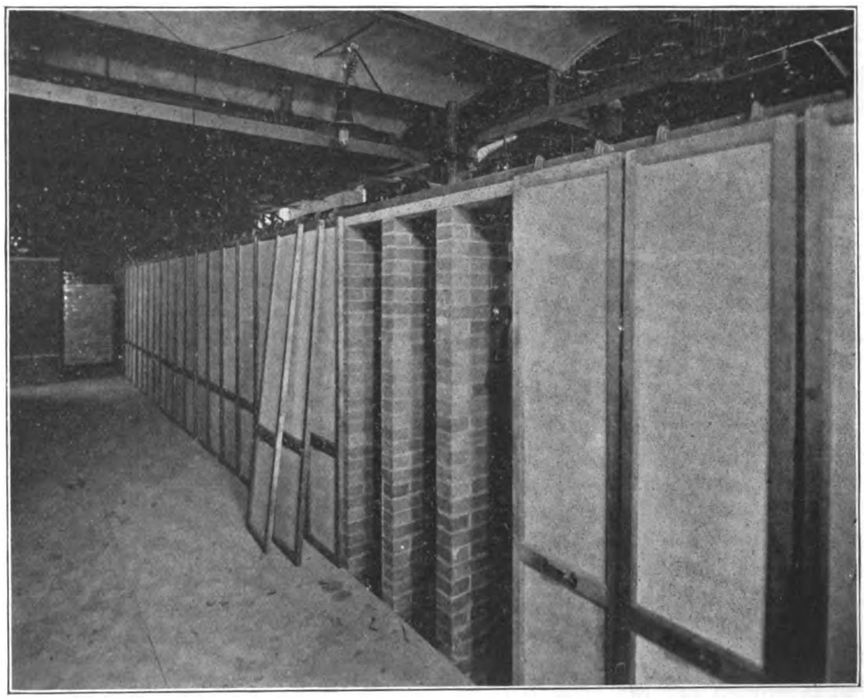
writers for the purpose of determining the action of asbestos and magnesia building lumber when subjected to intense heat. Magnesia building lumber, it should be said, is a fireproof material also manufactured by the Keasbey & Mattison Company. This is made by permeating asbestos millboard with a solution of silicate of soda and bicarbonate of magnesia, the millboard then being subjected to pressure to drive off water. The result of this treatment is to form between and around the asbestos fibre a silicate of magnesia. The appearance of this material is similar to that of asbestos building lumber, though the former is lighter and more easily worked. In fact, it can be cut with woodworking tools. The tests referred to above were made with a brick furnace having an opening at one side, this opening being closed by a plate of iron. Through the opposite wall of the furnace a gas flame was introduced, which impinged upon the iron, bringing it to a high temperature. The samples of asbestos and magnesia sheathing were mounted in front of the incandescent plate of iron, at a fixed distance from it. The material was not only brought to a high temperature, but while at this temperature cold water was thrown upon it. Under this severe treatment the asbestos building lumber stood up excellently. For example, a sheet fifteen-thirty-seconds of an inch thick, after an exposure of forty-five minutes to the flame, was heated until a backing of wood placed against it began to char. Cold water was immediately thrown upon the surface of the asbestos sheathing, and on examination of the sheet showed that it was not cracked nor warped after cooling.

Among the tests conducted by the General Electric Company was one to determine the resistance which the material would offer to an electric arc. The material was clamped to the bottom side of a heavy plank, and No. 0000 solid copper wires were attached to it. An arc was started between the terminals of these wires, and was allowed to persist until it died out of its own accord. It was found that the arc did not affect seriously the strength of the asbestos building lumber. Although the sheet was discolored slightly, it cooled hard and solid. The same company found that a voltage of 5,000 was necessary to puncture a sheet of asbestos building lumber a quarter of an inch thick, when dry.

Professor George F. Sever, of Columbia University, has conducted an elaborate series of tests on asbestos building lumber to determine its fire-resisting qualities, its mechanical strength, and its insulating properties. The results show that the resistance per inch of thickness varied somewhat with the samples, but the average is in the neighborhood of one megohm. The breakdown voltage per inch of thickness also varied with the samples, the average being about 10,000. When exposed to the heat of an electric arc, the surface was slightly affected, but no cracking occurred. The effect of vibration was also determined by Professor Sever, by subjecting the samples to a series of blows delivered at the rate of seventy per minute by a hammer weighing two pounds falling through a distance of eight inches. The thinner sheets of asbestos building lumber showed slight indentations at the surface at the end of the test. The thicker sheets showed little or no effect.



OIL SWITCH COMPARTMENT SHOWING ASBESTOS BUILDING LUMBER DOOR.



REAR VIEW OF BUS-BAR COMPARTMENT SHOWING DOORS OF ASBESTOS BUILDING LUMBER.

The mechanical properties of asbestos building lumber were determined by

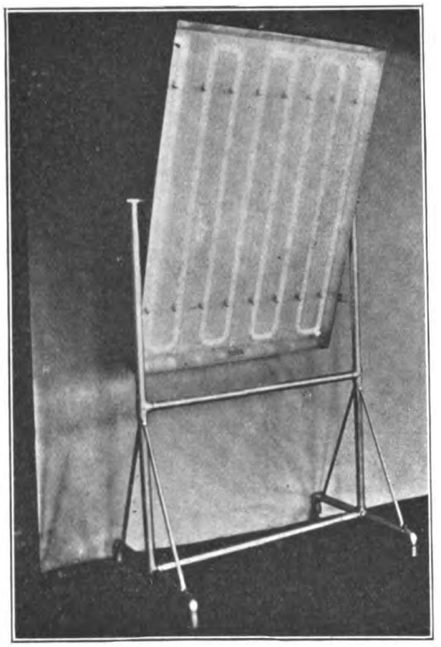
Digitized by Google

Professor Ira H. Woolson, of Columbia University. He found that the ultimate strength of the material in pounds per square inch varies from 1,500 to 27,000.

The results of the above tests indicate that asbestos building lumber is a material which can be used very effectively in electrical work. Its properties may well be taken advantage of in many ways. For example, the accompanying illustration shows its use as a fireproof reflector for the back of a Moore vacuum tube used for photographic purposes.

The works of the Keasbey & Mattison Company at Ambler, Pa., have been enlarged several times in order to supply the demand for the company's product. There is now being installed machinery for manufacturing a new class of material known as the "Century" or "Eternit" asbestos shingle, covered by letters-patent No. 769,078, issued under date of August 30, 1904, for a fireproof building material composed entirely of asbestos fibre and hydraulic or Portland cement. The Keasbey & Mattison Company has recently acquired the sole right in the United States of America for the manufacture of this material. This is similar to asbestos building lumber, except that the material is thinner and exposed to a much greater pressure. The shingles may be colored as desired. It is hoped that the factory will be able to put these shingles on the market early during the coming summer.

The sole agents in the electrical field for the introduction of this material are Messrs. Wendell & MacDuffie, 26 Cortlandt street, New York city.



ASBESTOS MATERIAL USED AS A FIREPROOF REFLECTOR FOR VACUUM TUBES.

New Electrical Apparatus.

The Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has developed and placed upon the market an automatic synchronizer, which is applicable to installations using electrically operated or electropneumatic switches or to which such switches may be added. It provides a means whereby the operation of the coupling switch will not lag behind the moment of a synchronism, and introduces an adjustment whereby the contacts close at a predetermined time before the incoming machine reaches synchronous speed. As automatic switches require a certain period of time to close, it is necessary that the closing operation begin in advance of synchronism that the switch will close at the instant synchronism is reached.

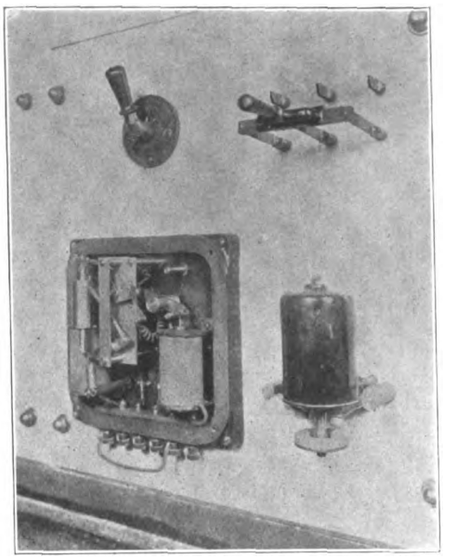


FIG. 1.—AUTOMATIC SYNCHRONIZER WITH COVER REMOVED.

If the speeds of the machines vary too much, this instrument prevents the couple taking place. The adjustment of the synchronizer may be changed to coincide with the time element of any particular form of switch which may be used.

The automatic synchronizer consists essentially of a metal case in which are mounted two solenoids, the upper ends of whose cores are flexibly connected to either end of a lever which is swung centrally on a shaft. Attached to the shaft is a suitable contact arrangement which is normally open. The function of this contact device is to close a circuit through the closing coil of an electrically operated or electropneumatic switch. Current to actuate the switch is taken from a source independent of the generators, such as the exciter. Current to energize the solenoids is derived from the bus-bars and from loads connected to the incoming generator or rotary converter through potential transformers.

In effect, the mechanism holds the contacts of the switch-operating circuit open until the incoming machine arrives nearly at synchronism, and, taking into proper consideration the time element, causes it to close at synchronism, connecting the machines together. A controlling and relay switch are interposed in circuit with the synchronizer and electrically operated switch. By means of the controlling switch the main or electrically operated switch may be tripped, but can not be closed, as the closing coil is normally out of circuit until the synchronizer is in the position assumed at the synchronous operation of the generators or rotaries, which closes the relay switch circuit and completes the path of the current through the controller and electrically operated switches.

The relay switch is provided with carbon break and is intended to relieve the

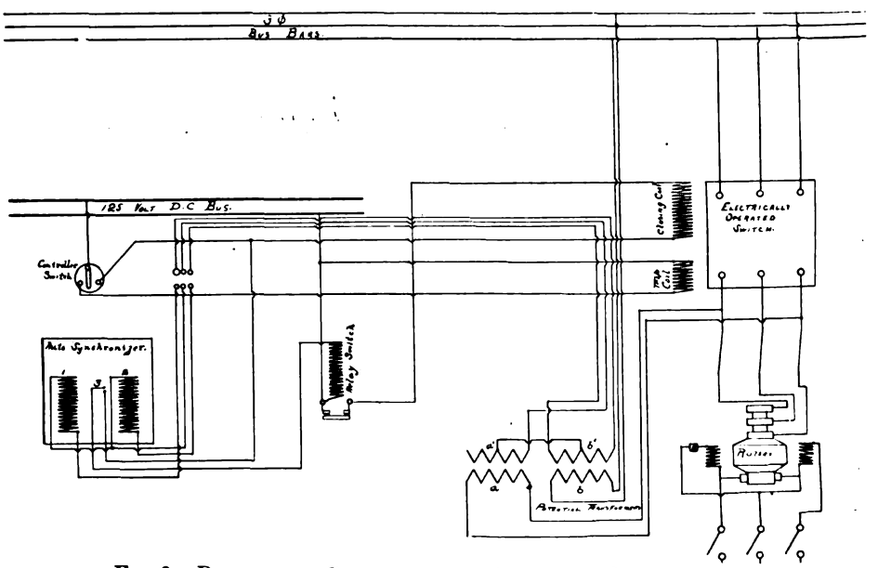


FIG. 2.—DIAGRAM OF CONNECTIONS OF AUTOMATIC SYNCHRONIZER.

Digitized by Google

contacts of the synchronizer from excessive currents.

A view of the synchronizer, with cover removed, mounted on a switchboard with its attendant instrument in the power-

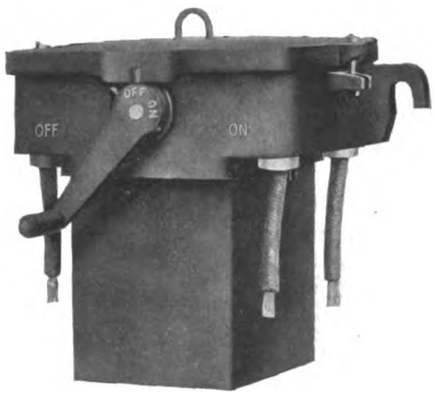


Fig. 3.—Outdoor, Type D, Oil Switch.

house of the Pittsburg, McKeesport & Connellsville Railroad, is shown in Fig. 1. A diagrammatic view of the instrument connections with a rotary converter installation is given in Fig. 2.

Taking up Fig. 2 in detail, the automatic synchronizer, controller switch, relay switch, electrically operated switch, rotary converter, potential transformers and bus-bars are indicated by diagram.

Assume that it is desired to start the rotary converter, which is accomplished by an induction motor not shown in the figure, and bring it up to approximate speed ready to connect in circuit. It will be seen that the primary *b* of the potential transformer is connected across the bus-bars, and the primary *a* of the other trans-

Fig. 4.—Safety Gap with Cover Removed.

former is connected to corresponding terminals of the rotary converter behind the electrically operated switch; that is, between the switch and rotary. It will be noted from the diagram that the coils of the automatic synchronizer are so connected as to alternately pull their cores down, the left-hand coil pulling when the phase difference is 180 degrees, and the right-hand coil pulling when the phases of the machines coincide. There is a very ingenious device connected to the contacts of the synchronizer which withdraws one of the contact brushes when the machines differ too much in speed. As the difference in speed becomes less, this device acts in such a way as to allow the contact to be made sufficiently in advance of coincidence of phases, corresponding to the time required for the switch to actuate. As the machines differ less in speed, the advance in the contact is correspondingly less. The contacts never have to break any current, and when properly adjusted they will last indefinitely.

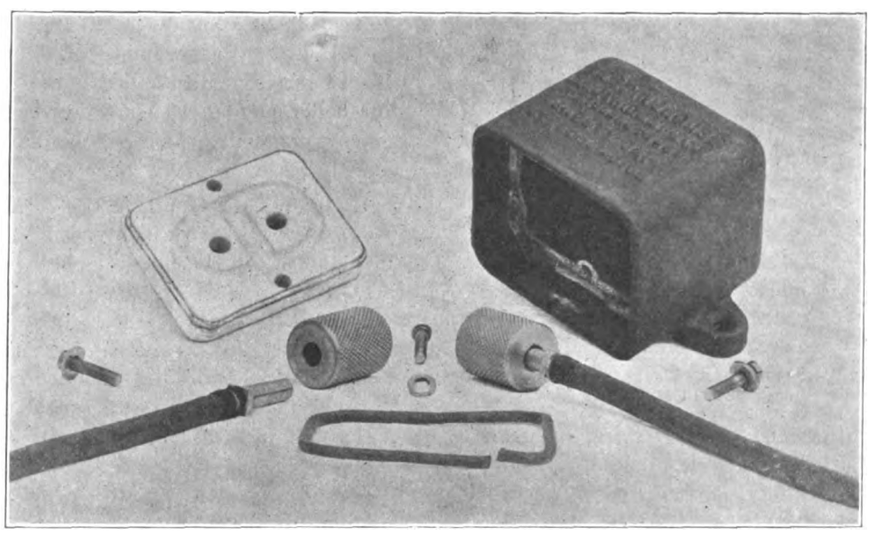


Fig. 5.—Details of Safety Gap for Outdoor Use.

The machines are coupled by this instrument without the least sparking or strain, the ammeters connected to the incoming machines showing hardly any deflection.

For rotary work a simple form of electrically operated switch has been devised to use with the automatic synchronizing system, combining the functions of switch and automatic circuit-breaker, thus omitting the knife switches and fuses. For high-voltage work automatic oil switches are used. The wiring of the various devices forms a complete interlocking system, preventing coupling of the machines under favorable circumstances, and avoiding the danger of any damage resulting.

The demands for a serviceable outdoor type of oil switch adapted for use with alternating-current series arc lighting systems, for cutting out banks of transformers, isolating underground or overhead feeders and mains from main systems and operating inductive loads of all kinds, led the Westinghouse Electric and Manufacturing Company to place upon the market a switch (Fig. 3) that is designed to meet all these requirements. It is a double-pole, single-throw switch, mounted in a weatherproof case which may be easily attached to poles or cross-arms in the case of overhead systems, or may be hung in manholes where underground systems are used. The essential features consist of knife-blade contacts submerged in oil and high insulation between poles and between frame and live parts.

Knife-blade contacts are used as they ensure the best contact for low temperature rise. Each jaw has a detachable arcing piece which takes the final break, thus preventing any possibility of arcing between the jaws and blades. These arcing pieces may be removed very easily when worn out or burned away. Suitable barriers are placed between the poles, which prevent the arcs from communicating. The switch is compact and light, weighing but forty pounds.

When so ordered a special oil may be furnished with this switch which is especially suitable for use in cold weather, as it has a very much lower congealing point than any oil now on the market which is otherwise suitable for oil-switch work. One and one-half gallons are required to fill the tank. The switch has a maximum capacity of 200 amperes at 3,300 volts.

For some years the Westinghouse Electric and Manufacturing Company has had on the market a piece of apparatus designated as a "spark-gap protector for a secondary circuit." The name "spark-gap," although not incorrect, does not suggest the application of this device, and it has

Digitized by Google

therefore been deemed advisable that it should be known as a "safety gap," since its function is to provide a safety gap or path for the escape of high-potential current from a low-potential system. The gap first mentioned as being on the market for some time is intended only for indoor use, though the electrical operation of the two types is the same.

The purpose of the safety gap is to protect the low-tension windings of a transformer against any abnormal rise of static potential, occasioned by grounds, switching of the high-voltage lines, etc. This type is particularly applicable to local

FIG. 6.—SAFETY GAP COMPLETE FOR OUTDOOR USE.

lighting and power service, and can be adjusted for a wide range of voltages.

The safety gap with cover removed is shown in Fig. 4. The gap across which the arcing occurs is here clearly shown.

This safety gap is neat and substantial in construction, occupies a minimum amount of space, and is well insulated and rain-proof. The cylinders are made of non-arcing metal, may be adjusted for any size gap by merely loosening a screw at the top of the cylinder, and may be turned as desired so as to present new surfaces for action. A porcelain base supports the cylinders and the whole is enclosed in a cast-iron box, as shown with other details in Fig. 5.

The construction is somewhat similar to that of the new type C lightning arrester. All parts are removable and can be assembled without difficulty.

For one dollar, 11,200,000 British thermal units may be obtained on the assumption that one ton of coal of a calorific value 14,000 British thermal units costs $2.50 per ton. The heat equivalent of one electrical horse-power-year is 22,400,000 British thermal units. Assuming the value of one electrical horse-power-year generated by steam to be fifty dollars, 450,000 British thermal units will cost one dollar.

An Automatic Speed Adjuster.

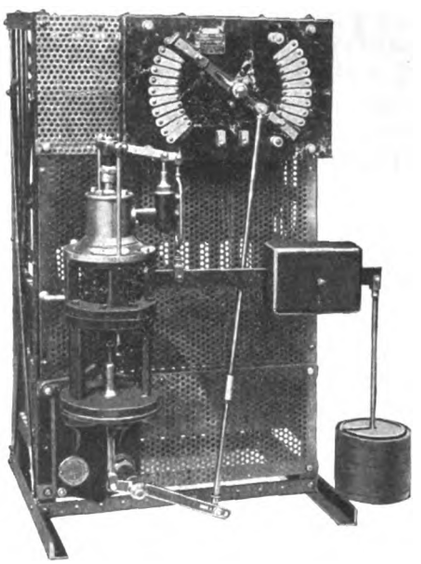
The Cutler-Hammer Manufacturing Company, of Milwaukee, has developed an automatic speed adjuster which has some very interesting features, and which has solved very satisfactorily certain problems of motor control.

The accompanying illustration shows a type of automatically operating speed regulator, applicable to a variety of sizes, whereby the speed of the motor is automatically adjusted to suit the requirements at any given time, and where the speed of the motor is varied as these conditions of demand vary.

The regulator finds an application in connection with mechanical stokers, for induced draught or forced-draught systems in boiler plants, and in pumping plants, where it is desired that the motor operate continuously and supply water continuously at certain pressures, the volume of water furnished varying with the demand.

For boiler plants, the controller is arranged to vary the speed of the motor which drives the draught fan, and the control is taken from the boiler pressure directly. The regulator proper, shown in the illustration as mounted at the lower left-hand corner of the resistance frame, consists of a pressure regulator controlled directly by the steam pressure, and a hydraulic cylinder controlled through the pressure regulator, whose piston, in turn, is mechanically connected to the rheostat lever. The steam pressure is admitted directly below the diaphragm of the pressure regulator, and the pressure of the steam on the diaphragm is balanced by the weights on the lever. The lever will, therefore, rise and fall slightly with the rise and fall of steam pressure in the boilers.

The operation of the hydraulic cylinder is controlled by a pilot valve, and the operation of the pilot valve is controlled by a floating lever between the crosshead on the hydraulic cylinder piston rod and the link from the regulator lever. The operation of the cylinder is so arranged that the piston will be forced downward when the regulator lever rises, and the relative motion of the piston rod and the link from the regulator weight lever is such that proper operation of the pilot valve stem is obtained. When the pressure rises, slightly opening the pilot valve, water is admitted to the hydraulic cylinder forcing its piston downward and thereby causing the pilot valve to close a corresponding amount. Any slight rise or fall of the pressure causes a corresponding fall and rise of the hydraulic cylinder and a corresponding operation of the rheostat lever. The parts are so proportioned that with a certain variation in pressure, the rheostat lever will travel from one end of its contact to the other, and for smaller variations, a proportional smaller travel will be obtained. The result is that as the pressure rises and falls, the rheostat lever follows the change exactly and changes the speed of the motor inversely to correct the changes in pressure. As the pressure rises, the motor is slowed down, decreasing the draught, and conversely, if the pressure falls, the motor is accelerated, increasing



AUTOMATIC SPEED ADJUSTER.

the draught. The boiler pressure may thus be automatically kept within the limit of two pounds above or below a given normal pressure absolutely automatically, and, under all conditions of demand on the boiler, the speed of the motor is adjusted within range set by the regulator to give a draught suiting the demands upon the boiler.

The speed of the motor may be controlled in several ways, either by resistance in the armature only, by resistance in the shunt-field circuit only, or by a combination of these two. These methods only have been cited as being the simplest and the methods most generally used, but, of course, by suitable arrangements any method of speed control may be adopted. For very large motors, speed control is obtained by means of solenoid switches, and the rheostat lever shown in the engraving is therefore used only to control the windings of the several solenoid switches, since it would be impracticable to handle heavy currents when the motion of the rheostat lever must necessarily be very slow and at times very small indeed.

In connection with some pumping plants conditions are sometimes obtained where

Digitized by Google

it is desired that the motor be kept running continuously, and that it shall run at speeds corresponding to the demand upon the system. Where a small amount of water is being used, it is desired that the motor be run at a slow speed, and as the demand increases by opening up more outlets, it is necessary that the motor-speed be increased to maintain a constant pressure at the source of demand. The regulator in question, in connection with a motor-driven pump, performs its functions very satisfactorily, adjusting the speed of the motor to suit the demand upon the system automatically, and maintaining the motor speed constant at a given point as long as the demand remains constant.

The arrangement of the regulator, of course, precludes the addition of the automatic release feature without some complications, except in those cases where solenoid control is used, and for small equipments it is usual to install in connection with a regulator of the character described above a standard automatic release type of starter. An automatic starter is also advisable, since the regulator automatically adjusts itself to the full speed condition when the motor is permanently shut down, and apparatus of this character is necessary in starting the motor up after same has been shut down.

National Electric Company Reorganized.

At a special meeting of the board of directors of the National Electric Company, Milwaukee, Wis., held on April 27, the resignations of S. W. Watkins, as director and president; F. G. Bigelow, as director and chairman of the board; F. C. Randall, as director, vice-president and general manager, and Gordon Bigelow, as director, were presented and accepted.

The vacancies were filled by the election of John I. Beggs, Charles F. Pfister, Frederick Vogel, Jr., and J. H. Van Dyke, Jr., as directors. John I. Beggs was elected president of the company, and J. H. Van Dyke, Jr., vice-president.

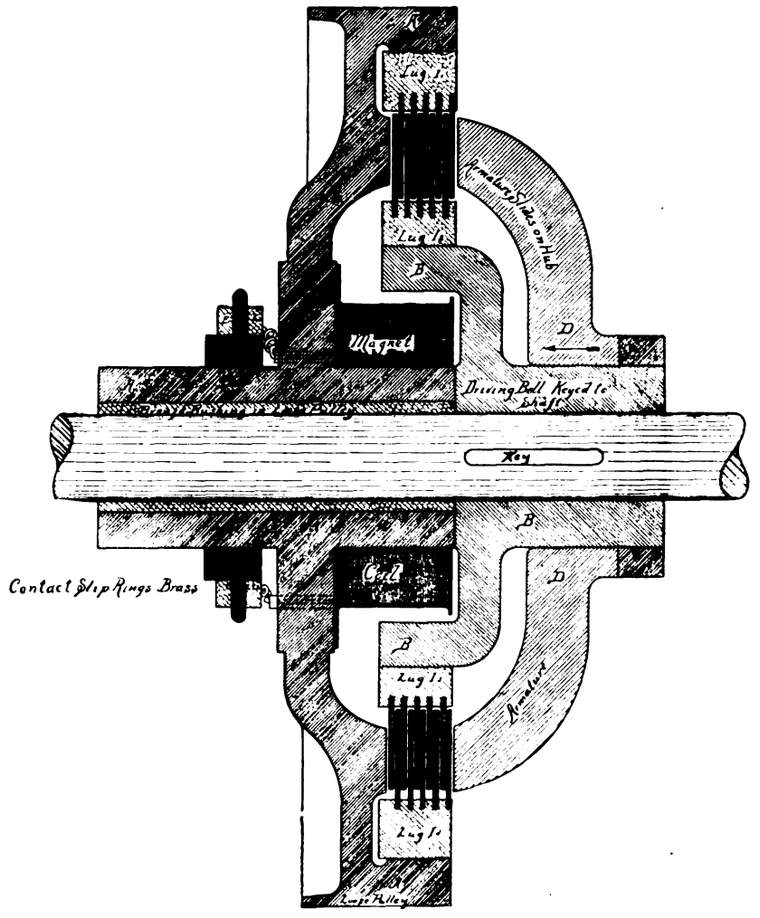
The resignations of A. N. McGeoch and B. T. Becker were likewise presented, but were not acted upon by the board.

In a public statement, Mr. John I. Beggs, the new president of the company, states that the business will be actively continued and all contracts now on the books of the company promptly completed. The indebtedness of the company is now being ascertained by the new management, and as soon as it is fully known a meeting of the creditors will be called to consider the best course to be pursued for the protection of all creditors and for the future welfare and progress of the company.

An Electromagnetic Clutch and Brake.

The accompanying illustrations show the design and method of application of an interesting form of electromagnetic clutch and brake, made by the William Electric Machine Company, Akron, Ohio. Fig. 1 gives a rather clear presentation of the various parts.

The principle of design is that of the friction disc type. The discs are clamped by magnetic action induced by the energizing coil, which is shown concentric with the shaft. The magnet coil is energized through contact slip rings, and is enclosed in an oil and waterproof case, so that the clutches can run in oil if required. In any case, ample provision is made for lubrication. The interleaved driving discs are mounted through their respective key lugs, one-half on the driving member B, and one-half on the driven member A.



ELECTROMAGNETIC CLUTCH.

As the driving discs are loosely fitted to these key lugs, the armature D, when it is magnetized by the action of the coil, slides on the hub B, and presses against the driving discs, bringing their surfaces into intimate contact. This action also reduces the reluctance of the magnetic circuit and increases the disc-clamping effect, which, of course, in its turn increases the transmitting power of the clutch.

The multiplying interleaved discs introduce into the magnetic circuit a number of minute air-gaps in series. On cutting off the current from the energizing coil, the release of the clamping effect on the disc causes these air-gaps to open up, and the rotative action of the discs on the driving member accentuates this condition. The objectional residual effect or gripping after the current is cut off, due to residual magnetism, is overcome. The special material from which the plates are made also tends to this result, so that the clutch lets go its grip as soon as the current is turned off.

The gripping property of the clutch can be increased to any point desired by decreasing the resistance in series with the magnet coil, allowing more current to flow through. A small increase of the magnetizing current greatly increases the gripping effect of the clutch. For instance, if a clutch using one-half ampere was gripping sufficiently to transmit ten horse-

Digitized by Google

power, an increase to one ampere would give a sufficient grip to transmit twenty horse-power at the same speed. The amount of current needed to energize the magnet coil is almost negligible, a fifteen-horse-power clutch at 300 revolutions per minute consuming one-third of an ampere at 110 volts.

A twenty-four-inch swing engine lathe, equipped with a set of clutches and an electric brake, has the controlling switch located on the lathe carriage, convenient to the hand of the operator.

A four-wire cable connects the clutches, brake and line to the contact points of the controlling switch. No starting resistance is used in the controller shown in connection with the clutch coils. Except in cases where a very slow speed is desired, a resistance is not necessary.

The introduction of the brake is not necessary to the working of the clutches. It is, however, of great benefit in lathe operation. Instead of locking the lathe spindle by means of the back gear when taking off or putting on a face-plate or chuck, the controller lever is moved over to the brake contact, when the brake holds everything immovable. The brake contact point is between the two clutch contacts, and it is momentarily thrown into action while moving over the controller lever from the go-ahead to the reversing clutch, or *vice versa*; and, as a result, the brake takes up the momentum of the countershaft and lathe, and prevents any slipping and wearing of belts, with the resulting strain.

Annual Report of the General Electric Company.

The thirteenth annual report of the General Electric Company, for the year ending January 31, 1905, has been published.

The profits for the company for the past year (including $281,927.34 from securities sold, and $465,716.73 from royalties, dividends, sundry profits, etc.—after deducting all general and miscellaneous expenses and allowances for depreciation and losses, and writing off $593,624.08 from patent account, and $1,778,491.87 from factory plants and machinery, were $6,719,545.78

Less net debit to profit and loss, in revaluing the assets of the Stanley Electric Manufacturing Company and other acquired interests.....	759,654.05
	$5,959,891.73
Paid in dividends during the year.....	3,684,384.00
Surplus for the year.....	$2,275,507.73
Amount of surplus at the end of last fiscal year was.....	7,293,688.75
Total surplus January 31, 1905.....	$9,569,196.48

The sales billed by the company to its customers for the past year were about $2,500,000 less than for the previous year, showing a shrinkage in business done of about six per cent.

The total sales (amount billed to customers) during the year were.....	$39,231,328
The total orders received were	35,094,807

Among the important contracts secured by the company are:

Contracts with the New York Central Railroad for thirty ninety-ton electric locomotives; for 40,000 kilowatts capacity steam turbines; the entire switchboard plants for the Mount Morris and Yonkers power stations.

Contracts with the Public Service Corporation of New Jersey for steam turbines and rotary converters with complements of transformers, switchboard apparatus, etc.

Contracts with the Interborough Rapid Transit Company, of New York city, for additional control equipments and motors for operation of the subway trains.

Contracts for car equipments with the New York City Railway Company, the Philadelphia Rapid Transit Company, the Chicago Union Traction Company, the Boston & Northern Street Railway Company, the Old Colony Street Railway Company, the United Railroads of San Francisco and other traction and street railway companies.

Contracts for generators to develop water powers in ten of the United States and in Mexico and other foreign countries.

Contracts for 154 steam turbines with eighty-six corporations and individuals.

On February 1, 1905, the company had sold a total of 289 Curtis turbines capable of generating in daily operation from 450,000 to 500,000 kilowatts. Ninety per cent of all turbines installed and in actual operation November 1, 1904 (three months prior to the close of the fiscal year), have been accepted by the customers and payments made. The company has sold a large number of these turbines to various customers in Canada, Europe, South America, Japan, New Zealand, Mexico and other parts of the world.

The total number of cars equipped with the Sprague-General Electric control system, on January 31, 1905, was 2,997 cars, as against 2,595 cars the year previous.

About $2,000,000, exclusive of the cost of patterns, special tools, etc., was expended for real estate, erection of new buildings, extensions to existing buildings, and for additional machinery.

CONSOLIDATED BALANCE SHEET OF JANUARY 31, 1905.

Assets.			Liabilities.		
Cash.....		$6,529,115 89	3½ % gold coupon debentures.....	$2,049,400 00	
Stocks and bonds.....	$14,488,269 16		5% gold coupon debentures..	78,000 00	
Real estate (other than factory plants).....	359,979 97		Accrued interest on debentures.....	650 00	
Notes and accounts receivable....	16,747,449 39		Accounts payable.....	1,345,144 72	
Work in progress	2,009,805 25		Unclaimed dividends...	2,010 79	
		33,605,503 77			$3,475,205 51
Merchandise Inventories:			Deferred liability on account of purchase of Curtis turbine patents, payable on or before February 1, 1906.....		342,000 00
At factories...	$10,330,797 49		Capital stock.....		48,247,943 33
At general and local offices.	1,519,181 76		Surplus.....		9,569,196 48
Consignments	148,806 41				
		11,999,725 66			
Factory plants	$7,500,000 00				
Patents, franchises and good-will....	2,000,000 00				
		9,500,000 00			
		$61,634,345 32			$61,634,345 32

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1905.

Expenses.		Earnings.		
Cost of sales, etc.....	$33,528,135 86	Sales.....		$39,231,328 23
Interest on debentures....	75,672 14	Royalties, dividends and interest on stocks and bonds and sundry profits.....	$465,716 73	
Profit for the current year	6,719,545 78	Interest and Discount....	344,381 48	
	$40,323,353 78			810,098 21
Net amount in revaluing the assets of the Stanley Electric Manufacturing Company and other acquired interests.....	759,654 05	Profit on sales of stocks and bonds.....		281,927 34
Dividends paid in cash....	3,684,384 00			$40,323,353 78
Surplus at January 31, 1905, carried forward to next year...	9,569,196 48	Surplus brought over from last year.....		$7,293,688 75
		Profit for the year ending January 31, 1905.....		6,719,545 78
	$14,013,234 53			$14,013,234 53

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MERGER OF THE YORK (PA.) STREET RAILWAY SYSTEMS—Plans have been completed for the reorganization of the York Street Railway Company and its allied corporations. The plans will involve an investment of $5,000,000. It is proposed to unite all the suburban and city lines, and to complete, at an early date, all the rural lines radiating from the city. The extensions will aggregate over 100 miles when completed.

DEVELOPMENT OF WATER POWER IN OREGON—The Citizens' Light and Traction Company, of Salem, Ore., has taken steps to build a railway line from Salem to Portland. The company is perfecting plans for the establishment of a power-generating plant on the upper Santiam river, with a minimum capacity of 15,000 horse-power. The proposed plant will be located not more than twenty-two miles from Salem, and will cost about $300,000.

LARGE ELECTRIC RAILWAY SYSTEM IN MONTANA—Franchises have been granted by the commissioners of Cascade County, Mont., to Dr. Ernest Crutcher, of Great Falls, Mont., and his associates, allowing them to construct electric railway lines on all the highways in the county. Similar franchises are to be applied for in Teton, Fergue and Lewis and Clark counties, and a gridiron of electric roads will be constructed in the northern part of the state. It is stated that the company has financial backing to the amount of $3,000,000.

COMBINATION OF LIGHTING COMPANIES IN SAN DIEGO, CAL.—The Consolidated Gas and Electric Company, of San Diego, Cal., has secured a majority of the stock of the San Diego Electric Light Company. The Consolidated company is capitalized at $1,500,000, and owns about thirty electric light and gas plants in various parts of the country. The directors are George Chaffey, Walter S. Newhall, J. W. Phelps, John G. Mossin, Lynn Helm and E. S. Williams. The Consolidated company plans to extend the service to various parts of the city, also to University Heights, La Jolla and Pacific Beach.

EXTENSIONS OF THE INDEPENDENT TELEPHONE SYSTEMS IN NEW YORK STATE CONTEMPLATED—The Independent Telephone Securities Company has given a mortgage for $15,000,000 to the Security Trust Company, of Rochester, N. Y., to secure a bond issue for that amount. This sum is to be utilized in buying up new lines. The company controls independent telephone companies in Otsego, Herkimer, Oneida, Lewis, Jefferson and Oswego counties. It controls 1,000 miles of wires, and has 250 stations. The directors are Thomas W. Finucane, Frederick W. Zoller, George R. Fuller, Rochester; Charles H. Poole, T. Harvey Feris, Utica.

WIRES TO BE PUT UNDERGROUND IN SAN FRANCISCO—The supervisors' finance and electricity committee of San Francisco has decided to require all overhead wires in districts 1, 2 and 3 to be placed underground before August 1. The wires in district No. 4 are also to be placed underground, the time limit to be determined later. All poles in the districts named must be taken down within ninety days after the city wires which they now support have been removed. Messenger service and burglar-alarm wire systems are strung principally along housetops, and the committee has recommended that an ordinance be prepared providing that the companies owning these wires be compelled to remove them within one year.

NEW COMPANY TO DEVELOP NIAGARA FALLS—A company known as the Niagara-Welland Power Company has been formed to develop power at Niagara Falls. The capital is $5,000,000, and the company has unlimited bonding privileges. The company is operating under a charter obtained in 1894 from Ottawa, and which was purchased from the original incorporators a short time ago. Harry Symons, of Toronto, is president, and Roderick J. Parke, also of Toronto, is consulting engineer of the new company. It is proposed to build, at a cost of about $5,000,000, a power plant at St. Catherines, capable of developing 100,000 horse-power, and with provision for an increase to 200,000 horse-power. The company's transmission lines will distribute power to all the towns in western Ontario. Surveying parties are now locating the routes of the transmission lines for a distance of 200 miles. The survey of the power canal is practically completed, and the company is making preparations for receiving bids for the construction of the canal and power-houses.

TELEPHONE AND TELEGRAPH.

TOPEKA, KAN.—The Independent telephone line is being extended to Indian Creek.

HOUSTON, TEX.—Extensive improvements are being made to the telephone system at Madisonville.

MITCHELL CREEK, PA.—The Farmers' Mutual Telephone system is to be extended from Mitchell Creek to Tioga.

CLINTON, N. J.—The Farmers and Merchants' Telephone Company is extending its line from Little York to Spring Mills.

BIRMINGHAM, ALA.—The Southern Bell Telephone Company will install an exchange at Jacksonville in the near future.

EDWARDSVILLE, ILL.—A branch exchange of the Central Union Telephone Company has been established at Leclaire.

DES MOINES, IOWA—The Mutual Telephone Company plans the expenditure of $75,000 in the extension of rural lines in Polk County.

BALLARD, WASH.—The Sunset Telephone Company has been granted permission to erect poles and string wires in new territory.

WABASH, IND.—A complete network of telephone lines is being placed over Waltz township by the Lafontaine Telephone Company.

CLARKSBURG, W. VA.—The Consolidated Telephone Company has completed arrangements for a copper circuit from Philippi to Grafton.

SCRANTON, PA.—A new telephone line to connect Hawley and Honsdale, *via* Wangum and Hoadleys, will be built by the farmers along the proposed route.

PINEDALE, WYO.—A telephone line will be built this summer from Pinedale, through Daniel and Big Piney, to Opal, where it will be connected with the Bell lines running north, west, east and south.

DANSVILLE, N. Y.—At a meeting of the Dansville village trustees a franchise was granted to the Livingston County Home Telephone Company, whose lines will connect with the Inter-Ocean Telephone and Telegraph Company within sixty days.

TROY, N. Y.—A new telephone line will be built, covering the western part of South Cambridge, Easton and Schaghticoake. The company will have direct communication with the Hudson River Telephone Company's central office at Johnsonville.

RUSHVILLE, IND.—At the annual meeting of the Rushville Cooperative Telephone Company Owen L. Carr, John H. Fraxee and John Kelly were elected directors. The reports submitted by the officers showed the company to be in a good financial condition.

CRIPPLE CREEK, COL.—The Colorado Telephone Company has filed a certificate of amended articles of incorporation in the county clerk's office which allows of the extending of the business into New Mexico, and designates the principal office of the company as Denver.

DALEVILLE, IND.—At its annual meeting the Daleville Telephone Company elected the following officers: president, Grant Isanogle; vice-president, Albert Walters; secretary and treasurer, F. E. Barber. The company has 144 telephones in operation at the present time.

HERKIMER, N. Y.—A mortgage for $125,000, given by the

Digitized by Google

Interstate Telephone Company, of Little Falls, to the Empire State Trust Company, of New York city, has been filed. The mortgage is given to secure an issue of $125,000 of bonds. The money secured from the sale of the bonds is to be used in extending the lines and business and in constructing and reequipping certain portions of the present system.

ELLICOTT CITY, MD.—The Chesapeake & Potomac Telephone Company has opened a new line to Clarksville, Dayton and Highland, in Howard County. Another line is also being installed toward Guilford. The same company already covers the western section of the county from an exchange at Sykesville. The Ellicott City exchange covers the remainder.

ST. PAUL, MINN.—An order for the foreclosure of a mortgage on the property of the Chicago & Northwestern Telegraph Company has been filed by Judge William Lochren in the federal court at Minneapolis. The property of the company, consisting of a line from Minneapolis to Milwaukee and from there to Chicago, will be sold to satisfy the creditors, who have $102,630 due them.

PROVO, UTAH—The Independent Telephone Company, of Salt Lake City, has been granted a franchise by the city council. The franchise is for thirty years from date of its acceptance. The city has the use of ten telephones free, and the police department has free tolls within a radius of ninety miles. Work must be commenced within sixty days from the granting of the franchise.

FONDA, N. Y.—The Glen Telephone Company on May 1 raised the rates of telephones in Fonda. All business telephones are now $2 per month, instead of $1.50 as formerly. Those who sign the new contract will have the privilege of talking to Glen, Auriesville, Fort Hunter, Tribes Hill, Johnstown and Gloversville. The price of the residence telephones will not be increased, but the subscribers will have the privilege of talking to residents in Fonda and Fultonville only.

SALT LAKE CITY, UTAH—At the general offices of the Rocky Mountain Bell Telephone Company the announcement is made that more than $500,000 will be expended by the Rocky Mountain Bell Telephone Company in Utah, Idaho, Montana and Wyoming during the year 1905. This money will be used in building extensions in sections where a telephone service is desired and in adding more mileage generally to the system. To Utah has been appropriated $250,000. In Montana $150,000 will be expended; in Wyoming $70,000, and in Idaho more than $50,000.

NEW INCORPORATIONS.

MAJENICA, IND.—Majenica Telephone Company. Increased to $10,000.

INDIANAPOLIS, IND.—Denver Cooperative Telephone Company. Increased from $3,000 to $10,000.

PORTLAND, ME.—Western Electrical Construction Company. $500,000. Incorporators: M. W. Baldwin, J. J. Herman.

CHALMERS, IND.—Chalmers Cooperative Telephone Company. $4,000. Incorporators: J. T. Higgins, Wallace Nance, W. P. Brook.

CALLENDER, IOWA—Callender Mutual Telephone Company. $10,000. Incorporators: J. C. Peterson, C. O. Molstedt, N. O. Slinde.

MARKLEVILLE, IND.—Markleville Telephone Company. $10,000. Incorporators: James Stickler, Robert Collier and Robert Palmer.

WILMINGTON, DEL.—American Illuminating Engineering Company. To light streets, houses and places of amusement. $40,000.

BUCKFIELD, ME.—Buckfield Water, Power and Electric Light Company. $25,000. Incorporators: C. N. Taylor, of Wellesley, Mass.; H. A. Irish, F. R. Dyer, both of Buckfield.

BOISE, IDA.—The Utility Power Company, Limited. To generate power. $300,000. Incorporators: J. L. Weaver, Frank Martin, L. J. Weaver, of Boise, and Henry Fitch and B. A. Dare.

SPEARFISH, S. D.—Black Hills Traction Company. To build a trolley line between Spearfish, Belle Fourche, Deadwood and Lead. $400,000. Incorporators: John Wolzmuth, R. F. Crawford, R. B. Hughes, M. M. Brenn and Henry Keats, all of Spearfish.

ELECTRIC RAILWAYS.

BELVIDERE, ILL.—The city council has passed an ordinance, granting a franchise of twenty years' duration to the Elgin-Belvidere Electric Railroad Company to operate cars on a line entering the city on Logan avenue.

NORWALK, OHIO—D. D. Washburn, of Greenwich, representing Cleveland capitalists, has filed an application for a franchise for an electric line through Greenwich and along county roads. The line will run from Norwalk to Mansfield.

ROCHESTER, N. Y.—The state board of railroad commissioners has authorized the Rochester Railway Company to increase its capital stock of from $5,000,000 to $5,500,000. The decision to increase the capital stock of the company was reached at a recent meeting of the stockholders.

KENNETT SQUARE, PA.—The section of the Kennett, Wilmington & West Chester trolley road in Pennsylvania has been sold at public sale by Bayard Henry, the receiver. There was but one bid, $200,000, and the property was sold to Vogeler, Kessler and Hertzler, a committee representing the bondholders. The portion in Delaware, four miles in length, was purchased by the same parties for $60,000

GLASGOW, KY.—Articles of incorporation have been filed with the county clerk of LaRue County for an electric railway between Hodgenville and New Haven, *via* Buffalo. The promoters of the line are nearly all Hardin County men. The capitalization is $5,000, to be increased according to the amount needed for the completion of the proposed line. Work will begin early in May, and will be rapidly pushed until completed.

NASHVILLE, TENN.—It has been announced that all the money necessary to build and equip the proposed electric railway from Shelbyville, Tenn., to Fayetteville, and thence to connect with the southern road at Huntsville, has been raised and that the line will be built. Rights of way are being secured. Work will be begun at once in tunneling Lookout mountain, near Chattanooga. It will require about two years to complete the work. W. J. Oliver & Company, Knoxville, have the contract.

NASHVILLE, TENN.—The board of directors of the Nashville Interurban Railway has filed an amendment to the charter of the company, authorizing an increase in the capital stock from $50,000 to $400,000. Members of the board state that it is the purpose of the company to take up the matter of finances and construction immediately, and that it hopes to have one of the lines completed by next fall. The company is a consolidation of the two companies which proposed to build electric lines from Nashville to Columbia and Gallatin. W. J. Whitthorne, Joseph Frank, John A. Pitts, H. E. Howse, D. K. Spillers, N. Baxter, Jr., J. H. Connor and John T. Landis compose the board of directors.

MEMPHIS, TENN.—The Queen City Electric Light and Power Company has given a deed to the Clarksville, Tenn., Street Railway Company, transferring all of its interests in that city to the latter. The purpose of the transfer is consolidation of interests on the part of the two companies in order that certain improvements, long contemplated, may be put into effect. The first extensions will be made in Clarksville proper, and following this the line will be extended to New Providence, and thence to Dunbar Cave, with probability of a later extension to Guthrie, across the Tennessee-Kentucky state line. The company has made arrangements for floating its bonds, and the improvements are to be undertaken as soon as possible.

HARTFORD, CT.—The railroad committee has made a favorable report on a bill authorizing the Willimantic Street Railway Company to extend its lines through Coventry, South Coventry and Bolton to Manchester, where a junction will be effected with the Hartford, Rockville & Manchester Tramway Company. The first extension to be constructed will be the line from Willimantic to South Coventry. A favorable report has also been made on the resolution incorporating the Shore Line Electric Railway Company. The corporation is authorized to construct and operate a street railway from Stony Creek, in Branford, through Guilford, Madison, Westbrook, Old Saybrook and Essex, to Ivoryton. If the line is built it will run through an important territory which is now isolated from street railway accommodations.

Digitized by Google

PERSONAL MENTION.

MR. V. R. LANESTREIN has resigned his position as manager of the Evanston exchange of the Chicago Telephone Company.

MR. CHARLES A. CASPERKE has been appointed local manager of the Cumberland Telephone and Telegraph Company at Jeffersonville, Ind. He succeeds Mr. George E. Bernecker.

MR. EDWARD J. GREENLEAF, district manager of the Hudson River Telephone Company at Middletown, N. Y., has been transferred to Kingston as district manager at that place.

MR. A. W. LINN has resigned his position as superintendent of motive power for the Pueblo Light and Power Company, to accept the position of general manager of the street car system at Seattle, Wash.

MR. F. O. RAYMOND, of Allentown, Pa., has been appointed manager of the Pittston office of the People's Telephone Company. He entered upon his new duties May 1, succeeding Mr. James F. Boyle, who has been transferred to Scranton.

MR. JOHN M. MACK has resigned as president of the Keystone Telephone Company, of Philadelphia, Pa. Mr. Mack has been president of the Keystone company since its organization five years ago. He is succeeded by Mr. Jacob E. Ridgway.

MR. E. F. LATIMER has been appointed assistant to the electrical superintendent of the Connecticut Railway and Lighting Company. He formerly held the position of superintendent of the electric light department of the same company in Norwalk.

MR. JOSEPH E. DOZIER, manager of the South Boston exchange of the New England Telephone and Telegraph Company, has resigned his position to become the general manager and chief electrician of the Nahant & Lynn electric street railway.

MR. F. H. JONES, formerly manager of the air-compressor department of the International Steam Pump Company, has assumed the duties of general sales manager, and will take up the organization of a comprehensive general sales department.

M. EMILE GUARINI has been appointed professor of electrical engineering at the technical school of Lima, Peru. M. Guarini has been a frequent contributor to the columns of the ELECTRICAL REVIEW and to other technical papers throughout the country.

MR. CHARLES H. HODSKINSON, of the Boston Edison Company, has been appointed to look after transportation matters in New England for the twenty-eighth convention of the National Electric Light Association to be held at Denver and Colorado Springs, Col., June 6 to 11.

MR. GASTON HARBISON has assumed charge of the advertising and publicity department of the National Battery Company, of Buffalo, N. Y. Mr. Harbison, for the past seven years, nas been employed in the sales department of the Electric Storage Battery Company, in its Cleveland, Baltimore and Philadelphia offices, during which time he has had valuable experience in the storage battery field.

MR. W. B. BROCKWAY, secretary and treasurer of the Street Railway Accountants' Association of America since its organization in 1887, has been made the recipient of a set of resolutions voted at the meeting of the executive committee in February. These are commemorative of Mr. Brockway's work for the association, and are by reason of his recent resignation from the office of secretary and treasurer.

MR. A. G. WESSLING, of the Bullock Electric Manufacturing Company, Cincinnati, recently visited Cornell University, Lehigh University, Columbia University, Harvard University, Massachusetts Institute of Technology, University of Michigan, Purdue University, University of Illinois, and Rose Polytechnic Institute, at each of which he delivered a lecture on "Methods of Control for Variable Speed Motors," with especial reference to driving machine tools.

MR. J. WALTER GILLETTE has resigned the management of the Schuylkill Valley Illuminating Company, the Consolidated Schuylkill Gas Company and the Montgomery & Chester Electric Railway Company, of Phœnixville, to assume the duties of general sales manager for the National Battery Company, of Buffalo, N. Y. Mr. Gillette has had a wide and varied experience of twelve years in designing, constructing and managing electric light and railway properties in the States and South America. The National Battery Company is particularly fortunate in having secured, in Mr. Gillette, a gentleman of rare initiative and executive ability.

ELECTRICAL SECURITIES.

The liquidation of a week ago not only continued, but was even larger in volume during the past week. General declines forced a number of prominent stocks even below the level of last December. Professional bear operations, however, have been a considerable factor in the decline. There is little doubt expressed anywhere that the retrogression is only temporary, and that, within a short time, prices will again seek much higher levels. Notwithstanding the very general tendency to accept statements of shrinkage or abatement of prosperity, it appears to be a fact that great industrial activity is being maintained, and this activity shows little sign of decreasing. Railroad earnings for the month just closed show an average gross gain of at least ten and one-half per cent. There is also considerable building going on throughout the western part of the country, and although the public appears to be tardy as far as investment in speculative interests is concerned, there is apparently very little withholding of money for genuine building for the future.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 29.

New York:	*Closing.*
Brooklyn Rapid Transit	59¼
Consolidated Gas	201½
General Electric	171
Interborough Rapid Transit	201
Kings County Electric	200
Manhattan Elevated	161½
Metropolitan Street Railway	115
New York & New Jersey Telephone	170
Westinghouse Manufacturing Company	190

The annual stockholders' meeting of the Interborough Rapid Transit Company will be held May 10, at twelve o'clock noon.

Boston:	*Closing.*
American Telephone and Telegraph	142
Edison Electric Illuminating	253½
Massachusetts Electric	66
New England Telephone	139
Western Telephone and Telegraph preferred	98

The statement of operations of the Massachusetts Electric Companies for the quarter ended March 31 is as follows: gross earnings, $1,271,245; operating expenses, $1,103,538, leaving net of $167,707; interest and taxes, $389,345, making a deficit of $221,638, as compared with $415,911 for the same period of 1904.

The New England Telephone and Telegraph Company has issued its report for the year ended December 31, as follows: gross, $7,323,561; expenses and taxes, $5,880,319; net, $1,443,242; dividends, $1,320,447, leaving a surplus of $122,795, as compared with $118,137. At the annual meeting of the stockholders the old board of directors was reelected.

Philadelphia:	*Closing.*
Electric Company of America	12
Electric Storage Battery common	80¼
Electric Storage Battery preferred	80⅛
Philadelphia Electric	11½
Philadelphia Rapid Transit	31½
United Gas Improvement	120

The Electric Storage Battery Company has issued its annual report for the year ended December 31, 1904. The income account is as follows: net, $465,402; other income, $5,163, making a total of $470,565. Deducting dividends and other charges, the surplus for the year is $164,182, which, added to the previous surplus, $608,039, makes the total surplus $772,222. At the annual meeting of the Electric Company the following directors were elected: A. Louden Snowden, H. H. Catherwood, George Brinton Roberts, Edward D. Toland, H. J. Hartman, James E. Hays, Samuel Gustine Thompson, Frederick M. Walton.

At the annual meeting of the United Gas Improvement Company old directors were reelected. The net earnings of the company for the year ended December 31, 1904, were $4,470,843, as compared with $4,027,529, an increase of $443,314.

Chicago:	*Closing.*
Chicago Telephone	142
Edison Electric Illuminating	160
Metropolitan Elevated preferred	61½
National Carbon common	65
National Carbon preferred	116
Union Traction common	8
Union Traction preferred	37

Howard G. Hetzler has been elected president and a member of the board of directors of Metropolitan Elevated.

National Carbon directors have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable May 16.

Digitized by Google

INDUSTRIAL ITEMS.

THE SALT LAKE HARDWARE COMPANY, Salt Lake City, Utah, is calling attention to the Keeler assay balance in a number of interesting and instructive leaflets.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., will be pleased to send bulletin No. 51, descriptive of small belted machines, on request. This bulletin, in addition to the text, illustrates various applications of these machines.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., has issued publication No. 66, entitled "Plants and Types." The book consists of thirty pages of photographs of various installations made by the company, and of different types of apparatus manufactured by it.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, reports a continually increasing sale of "Buckeye" lamps in Mexico. Its entire business in the republic is handled directly by Mr. Charles E. Sharp, Security Building, St. Louis, Mo., as general agent and distributor.

THE PHELPS COMPANY, Detroit, Mich., manufacturer of the "Hylo" lamps, has brought out a novel advertising scheme. It is distributing to its agents a rubber stamp which tells the merits of the "Hylo" lamp, with the request that all letters be stamped with it for one month.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has issued bulletin No. 143, entitled "The Design of Generators for Electric Power Transmission Work." The bulletin consists of an article by David B. Rushmore, reprinted from *Engineering News*, October 27, 1904.

THE REEVES ENGINE COMPANY, Trenton, N. J., owing to its rapidly increasing business, has found it necessary to take more commodious offices. After May 1 its New York offices will occupy a suite of rooms on the seventh floor of the building in which it is now located, at 85 Liberty street.

CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York city, has issued a twenty-five-page pamphlet describing the "Monarch" engine-stop and speed-limit system. It also describes the "Monarch" automatic vacuum breaker, the "Monarch" automatic circuit-breaker trip, and the "Monarch" motor stop.

THE ELECTRO-DYNAMIC COMPANY, of Bayonne, N. J., has issued a number of bulletins relating to the "Interpole" variable speed motor. These bulletins describe the motor and the various accessories to it, such as controllers, starting boxes, etc. A number of price-lists and tables of dimensions and capacities are among the bulletins.

THE NEWHALL CHAIN, FORGE AND IRON COMPANY, 9-15 Murray street, New York city, will be pleased to send its new catalogue, No. 99, descriptive of cross-arm braces, guy clamps, toggle bolts, expansion bolts, cable clamps, insulator pins and other hardware. There is also given a table of approximate weights of cross-arm braces per 100 pair and 1,000 pieces.

THE C. W. HUNT COMPANY, West New Brighton, Staten Island, N. Y., has issued catalogue No. 055, describing coal-handling machinery for power stations, boiler rooms, coaling stations, gas companies, etc. It describes steeple towers, parabolic boom towers, mast and gaff systems, and the automatic railway built by the C. W. Hunt Company. A large portion of the catalogue is devoted to various accessories, such as hoisting winches, screens, cutoff gates, hoisting blocks and Hunt wire rope.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., following closely upon the expiration of some of the Tesla polyphase patents, on May 1, has issued a notice calling the attention of the public to numerous other patents relative to polyphase induction and synchronous motors, dating from December 3, 1889, to May 4, 1904, which it proposes to protect from infringement in the future as in the past. Twenty-four patents in all are enumerated, among them many of the most important of the Tesla patents, and patents to Stanley, Hutin and Leblanc, Lamme, Nolan, and Dusinberre, covering various features of alternating-current systems.

THE COOPER HEWITT ELECTRIC COMPANY, 220 West Twenty-ninth street, New York city, is distributing bulletins Nos. 6 and 7. These are descriptive of direct-current lamps and of recent installations. Particular attention is called to the lighting of printing establishments and to the commendatory communications from satisfied users of these lamps. The company is now placing on the market the Cooper Hewitt vapor converter for charging storage batteries from alternating-current circuits. A bulletin descriptive of this converter will be ready shortly. The company states that mercury vapor lamps for alternating-current circuits will be in commercial condition very soon.

FRANK B. COOK, 249 West Lake street, Chicago, Ill., has received from the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y., an order for the equipment of protective apparatus for the new Dixon, Ill., exchange which has just been installed. Mr. Cook in the last month has received orders for over 20,000 pairs of his No. 8 self-soldering protectors. Mr. Cook also has received a great many orders for his pole cable terminals, one of the largest being from Jones & Winters, for the new exchange at Green Bay, Wis. This order is for 111 terminals, part of them being Cook's new M-2 pole top terminals, and the others the type SM pole cable terminals with mica fuses, for use without potheads.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of new bulletins. These are No. 4404, describing slow and moderate-speed direct-current motors; No. 4405, entitled "Starting Compensators for Alternating-Current Motors;" and No. 4406, which describes a new type of induction motor brought out by the company. The General Electric Company has also issued publication No. 3287, entitled "Electricity on Steam Railroads for High-Speed Service." This describes the various electric locomotives which have been built by the General Electric Company for various railroads in the United States, including the recent New York Central locomotives. The results of some of the tests made on this locomotive are given.

THE NATIONAL ELEVATOR AND MACHINE COMPANY, Honesdale, Pa., has recently occupied new offices in New York city at 400 West Twenty-third street. H. F. Gurney is president, and E. R. Carichoff is the consulting engineer of the reorganized company. These gentlemen are well known in the elevator field, and have a wide experience in the elevator business with several companies. It is believed that changes in the electric elevators can be made resulting in greater simplicity and reliability, and the company is preparing to bring out new designs to this end. Under the new management the company has closed the following contracts: five elevators, West Side Construction Company for apartment house in 121st and 122d streets, between Broadway and Amsterdam avenue. Three elevators, Paterno Brothers, 115th street and Morningside Drive and 114th street and Riverside Drive. Four elevators, West Side Construction Company, Ninety-third street and Riverside Drive, nine-story apartment house. Two elevators each for the following: Paul B. Pugh, 109th street and Riverside Drive, ten-story apartment house; Ferguson-Miller Construction Company, 113th street and Amsterdam avenue; the Bracket Realty Company, 137-139 East Twenty-fifth street; the Bradhurst Company, 301 West 150th street. One elevator for each of the following: P. McMorrow, 419 West 120th street; Presbyterian Board of Foreign Missions, 5 West Twentieth street; Julius S. Sandler, 122d street and Amsterdam avenue; Corporation of Trinity Church, 201 Fulton street; William F. Rohrig, Ninety-sixth street and Madison avenue; Harry S. Houpt, Forty-ninth street and Seventh avenue; George L. Walker & Company, 139th street and Broadway; Knight & Dongan Construction Company, 139th street and Broadway; Greenwald Brothers, Eighty-seventh street and Broadway; Brush Electric Illuminating Company, 1170 Broadway; F. E. Rosen & Company, 315 Grand street.

NEW MANUFACTURING COMPANIES.

ALBANY, N. Y.—The P. S. Dorlan Company, of Troy, has filed articles of incorporation. It will deal in electrical goods and supplies. The capital is $10,000, and the directors are Philip S. Dorlan, Lillian Dorlan and Robert A. Compton, of Troy.

JACKSONVILLE, FLA.—The Standard Electric Company has been incorporated to deal in electrical supplies and to do a general contracting business. The officers are: president, W. G. Toomer; vice-president and general manager, C. O. Patterson; treasurer, H. C. Hade; secretary, Froman Smith.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 19. NEW YORK, SATURDAY, MAY 13, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY, ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Silicon and Its Alloys ... 751
Weather Reports by Wireless ... 751
Some of the Unsolved Problems in Electrical Engineering ... 752
Ornamental Trolley Poles ... 752
Telephone Service During Thunder-Storms ... 753
Doubling the Capacity of a Street ... 753
A New Era of Railway Operations ... 753
Electric Traction on the North Eastern Railway ... 754
A Simple Condenser with a Variable Capacity for Experiments in Syntonization ... 757
A New Oscillograph Wave Tracer ... 760
Lightning Rods ... 760
The International Railway Congress ... 761
The American Railway Appliance Exhibition ... 762
The National Electric Light Association ... 766
Annual Meeting of the American Institute of Electrical Engineers ... 766
Dinner of Indianapolis Telephone Companies ... 766
The Mercury Arc, by E. Weintraub, Ph. D ... 767
The Telephone System of To-day, by C. J. H. Woodbury ... 770
BOOK REVIEWS ... 774
A Projection System for Lecturers ... 774
Electrical Mining Notes, by Sydney F. Walker ... 775
Electrical Notes from Europe ... 776
Municipal Light and Power in Tacoma, Wash., by Howard Joslyn ... 778
The Measurement of High Temperatures ... 780
The Ohio Society of Mechanical, Electrical and Steam Engineers ... 781
A Compound Dynamo Brush ... 781
ELECTRICAL PATENTS ... 781
Lectures on Electricity in 1751 ... 788
Dinner to the Swedish Delegates to the International Railway Congress ... 788
Annual Meeting of the Technical Publicity Association ... 788
An Electrical Speed Indicator ... 788
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 784
INDUSTRIAL SECTION:
New Westinghouse Electrical Apparatus ... 786
Watertown Four-Valve Engine ... 788
Consolidation of the Stanley Electric Manufacturing Company and the General Incandescent Arc Light Company ... 788
Dixon Crucible Meeting ... 788
Newcode Receptacle ... 789
The Luminous Radiator ... 789
Combination Gasoline Soldering-Iron and Blow-Torch ... 790
A New Outlet Box ... 790
The Stirling Company's Book on Boilers ... 790
An Automatic Starter for Induction Motors ... 791
Contracts for Pumping on a Large Scale ... 791
Visit to the Works of the Ingersoll-Sergeant Drill Company ... 791
CURRENT ELECTRICAL NEWS ... 792

SILICON AND ITS ALLOYS.

It is interesting to note how new processes give rise to new products which themselves may revolutionize older processes. For example, until recently metallic silicon was a chemical curiosity because of the difficulty of preparing it. Now that the electric furnace is available, metallic silicon can be obtained commercially, or silicon alloys can be made as easily. It is therefore probable that this metal, but recently added to our available materials, will become an important article of commerce. It is light, does not easily corrode; hence may be useful for such purposes as its chemical properties make it suitable. Its high heat of formation makes it a valuable reducing agent, and makes possible its use in the compound known as "calorite" for obtaining high temperatures easily. This use of silicon is similar to Goldschmidt's thermic process, which is becoming widely used for repairing castings and other similar work.

Another use of silicon or silicon alloys is in the production of special qualities of steel. The presence of silicon increases the permeability of steel, a valuable feature in the manufacture of steel for electrical apparatus. When the effects of silicon are better understood, it may enable us to make important changes in our methods of constructing electrical machinery.

There are other valuable properties of silicon compounds which will probably be made use of: certain of its compounds are excessively hard and will be a valuable aid to the lapidary. No doubt other arts will soon see where they can make use of these materials to good advantage, as soon as they realize that they are available and know the properties that they possess.

WEATHER REPORTS BY WIRELESS.

It is announced in the daily press that the United States Navy Department has arranged to receive weather reports by wireless telegraphy from all merchant ships fitted with the necessary apparatus. These vessels will make daily reports on the weather whenever they are in touch with the government receiving stations which are now being established along the coast from Portland, Me., to New Orleans, La. The stations will form a continuous chain along the Atlantic coast and the gulf, so that it will be possible for every vessel coming within a certain distance of the coast to get into communication with some station. At the same time, in addition to receiving reports from the vessels, they will, if they desire, be given the bureau's weather forecast by the land stations.

The transmitting of weather reports to and from vessels by means of wireless telegraphy was suggested some time ago as being one of the very useful purposes to which this system of telegraphy could be put. Notwithstanding all the criticism—humorous and otherwise—to which the weather reports are subjected, they form an exceedingly valuable part of the daily news; and in spite of all the ridicule, it is true that, should the weather bureau suspend the service, there would be a loud complaint from the entire country. A forecast of the weather should be even more valuable to ships at sea; but, until the development of an operative system of wireless telegraphy, there has been no means of communicating with them and warning them of approaching storms. Mishaps at sea are fortunately not frequent to-day, due to the strength of the ocean-going vessels and the skill of their officers; but a forewarning of a coming storm might enable many a vessel to avoid it or to suffer but little inconvenience from it. Heretofore the captain has been forced to depend upon his instruments and an acquired knowledge of weather signs. With the new service he will be warned of a storm long before it has approached his vessel or there is any local sign.

Digitized by Google

SOME OF THE UNSOLVED PROBLEMS IN ELECTRICAL ENGINEERING.

The aim of every engineering project is to accomplish a result never before attained, or to reach an old result by a newer, better or cheaper process. In either case, the ultimate success depends upon the return in dollars and cents. But however strictly this requirement applies in practice, it does not prevent us from looking forward and seeing what is desirable, and trying to imagine how our present methods could be changed for the better.

In an address recently delivered before the Institution of Civil Engineers, of Great Britain, Colonel R. E. Crompton indicated a goodly number of problems which are awaiting solution. Certain of these are of great importance, such, for example, as the direct production of electricity from fuel, or the invention of a more efficient electric lamp. These problems, as well as certain others, still baffle us, though we have spent much time and thought upon them. Occasionally we have thought there was hope, but in each instance we have been disappointed. We must never forget that an engineering solution must be obtained, as well as a physical one. A method of producing electricity directly from fuel would be of little value if it could not be applied commercially.

There are other problems confronting us which have received less attention. For example, the lecturer dwelt at length upon the "core and coil problem," as he put it—that is to say, the problem of improving electrical machinery. We want a method of producing castings which will be absolutely homogeneous and always of the same quality. To-day we build up our transformer or generator cores of laminated sheets—a method which is expensive and undesirable mechanically. If we could only make castings having high permeability and high resistance, we might be able to abandon the laminated construction. Some little work has been done in this direction, but no practical results have yet been obtained. In the coils themselves, which consist almost always of copper strips or wires wound with some non-conducting material, there is a great chance for improvement. The non-conducting materials used to-day are, as a rule, destroyed by heat. What we want is a fireproof coil.

The storage battery problem was dwelt upon also. We are still forced to depend upon the lead cell, in spite of the undesirable mechanical properties of this material. A cheaper and better storage battery is needed, not only as an auxiliary for station work, but for the electric automobile. Until a light and indestructible, or light and cheap, battery is available, the field of the electric automobile will be restricted. The last two or three years have given us the single-phase motor, which promises to extend greatly the range of the electric railway. There are, however, some other railway problems which might be solved by electrical means. It is suggested that the successful development of an electrical gear for changing speed and torque would be acceptable, not only for railway work, but for rolling mill and other purposes.

Although the electric furnace has made what seems to us to be great strides, it is probable that what we have done is almost insignificant to what will eventually be accomplished by means of it. We have improved old processes by means of the electric furnace, and added to our useful materials; and there is no doubt whatever that we will not only extend its application in furnace work generally, but that we will produce many more new and useful substances which are at the present time not obtainable.

Among a number of other interesting problems, Colonel Crompton referred to the transmission of power by means of Hertzian waves. It is a question whether we are ready for general transmission of power without having to resort to wires, but there is one particular phase of this application—that is to say, wireless telegraphy—where improved methods of transmitting power in small quantities are all-important.

Evidently, from what has been said above, there will be no lack of new fields to conquer for a long time to come. The young inventor will always find some line of work to which he can devote his enthusiasm and energy, with the hope of accomplishing important results. In fact, in not one of the many applications of electricity have we reached a point where we can sit back and say that we have perfected the method and there is no possibility of improving it.

ORNAMENTAL TROLLEY POLES.

The term "trolley pole" is used in two ways—one to designate the light iron pole which supports the collecting device upon the top of an electric car; the other—a less correct use—is where the same term designates the supporting pole for the overhead conducting system. The general public has, however, grown to identify the word "trolley" with an electric traction system. We have "trolley wheel," "trolley wire" and "trolley car," the last expression being used to designate an electric car in general, without reference to its method of obtaining power.

Ever since the electric car was adopted for city service, there has been a continual fight between the city through which the road is to run and the company building it. The latter naturally wishes to adopt the least expensive but satisfactory system, which is undoubtedly the overhead trolley. The former, being less concerned with the expense of the road, but having in mind the beauty of its streets, objects to the overhead construction and asks for an underground line. This being impracticable commercially, the city, except in a few cases, is forced to give in and allow the overhead wires, if it is to have the benefits of a system of rapid transit. But, having given way so far as the system is concerned, there is no reason why the city should not demand that the system installed should be made as little disfiguring as possible. If poles are to be put in, why should they not be ornamental rather than disfiguring? Any unnecessary obstruction in the streets should not be allowed, of course, and such as is necessary should detract as little as possible from the appearance of the streets. This plan is being carried out, to some extent, with regard to street lamps, for effort is made to obtain simple yet ornamental poles. Why should not the same rule be applied to the so-called trolley pole? The usually adopted type is anything but attractive,

Digitized by Google

though it could be made presentable at slight expense. Then, too, attention should be paid to the method of setting the poles. It used to be customary to give the pole a very decided lean away from the track, the idea being to allow for the spring of the pole due to the pull of the span wire; but this practice was often carried to excess, so that the poles leaned too far out, making anything but an attractive appearance. An ornamental iron pole, well set, would be far less disfiguring than the ugly device now in use, and which so frequently leans at such an angle as to be at odds with everything else on the street. There would be less objection from property holders to the erection of the poles if they knew they would not be a continual offence to the eye.

TELEPHONE SERVICE DURING THUNDER-STORMS.

During a recent investigation into the cause of a fire at a London exchange, one of the telephone experts said, in answer to a question, that it was better for the telephone subscriber not to use his telephone during a thunder-storm, and that it would be advisable for the exchange to discontinue its service until the storm was over. This is a rather surprising statement for a telephone man to make at this day, particularly as he can not show any records in support of his statement. We believe that if statistics were available, they would show that there is no more danger from lightning in using a telephone or operating an exchange than one is unavoidably exposed to anyhow, and the proposal to shut down the exchange until the storm is over would not be listened to for a moment in any important city on this side of the water. It is bad enough to have an interruption once in five years, say, due to some unexpected cause, but to shut off telephonic communication every time it thunders is not to be thought of.

DOUBLING THE CAPACITY OF A STREET.

An interesting and striking suggestion was made recently by a well-known engineer. It was that the traffic-carrying capacity of New York's great highway, Broadway, would be doubled if horse-drawn teams were excluded from it, and all traffic carried by mechanically propelled vehicles. Startling as this suggestion is, a little consideration would seem to show that it is really a conservative statement. It was based largely upon the saving in space obtained by cutting off the horses, but the saving in time, and therefore the increase in capacity due to the method of propulsion, should be as important. This saving would be effected by an allowable increase in speed, and by the greater facility with which such vehicles are controlled. At the same time, greater loads can be carried for a given area occupied by a vehicle. The engineer referred to above said that he believed it would be but a short time before the horse became a rare object in New York.

The suggestion just quoted is well worthy of being considered seriously. It would seem to be the simplest solution of the important problem of increasing the traffic-carrying capacity of the streets of the metropolis. At the same time, other advantages would be gained; for instance, a decrease in the wear and tear of the streets, an improved hygienic condition, less noise.

A NEW ERA OF RAILWAY OPERATIONS.

The problems confronting the railway companies of the world have an unusual interest to the general public, as is shown by the fact that more attention is paid by it to the conditions existing and the proposed solutions than to the changes going on in most other fields of human activity. The reason, of course, is the personal interest which everybody feels in some particular line of transportation. Nearly every one to-day depends more or less upon some railroad, either for transporting his goods or himself.

Some years ago the greatest interest was centered in the city railway lines during the transformation to electrical operation. Now that this has been practically completed, and as the electric system has not been satisfied with the city district, but has extended into the country, and has entered into competition with the steam roads, the question naturally is, what are the steam roads going to do? Will they electrify? Until recently there were two sharply divided classes. The first—and by far the larger one—held that the electric motor could not perform the work of the steam locomotive. The other, and smaller, class took decidedly the opposite stand, and boldly asserted that not only could the electric motor do the work of the steam railroad, but that, within a few years, it would be doing it, and the steam locomotive would disappear. Naturally neither one of these two extreme views was the correct one. It is to-day generally acknowledged that, so far as the actual moving of the trains is concerned, the electric motor can do the work better than the steam locomotive. But there are other phases of the problem which are just as important—in fact, usually the most important one is, will it pay to convert the steam roads to electric? The whole situation is excellently summed up in a few words spoken by Mr. George Westinghouse during the opening exercises of the American Railway Appliance Exhibition, held in Washington in connection with the International Railway Congress. He stated the case as follows:

A new era in railway operations has dawned with its many new problems. I refer to the growing use of electricity for the movement of trains. There have already been such demonstrations of the benefits to be derived from the substitution of the electric motor for the steam locomotive that it requires no great prophet to predict the extensive growth of electric traction upon the great railways of the world and the eventual replacement of the steam locomotive. Fortunately, the time element, which is such a controller of events, and the financial problems involved, will ensure gradual development and extension of the use of electricity.

With these changes have come vastly different engineering problems and new sources of danger, which should, and will, command and receive that attention which is essential to the surmounting of every difficulty as it arises.

This covers the situation exactly. It will be seen that Mr. Westinghouse has no lack of confidence in what the electric motor will do; yet he, at the same time, recognizes that time is necessary to bring about the evolution.

Digitized by Google

Electric Traction on the North Eastern Railway.

A Very Successful Electrical Passenger and Freight Service Instituted in Place of Steam.

THE electrification of the lines of the North Eastern Railway Company at Newcastle-on Tyne, and neighborhood, England, presents a very recent example of the application of electricity for the moving of both passenger and freight traffic. The work of electrification and the equipping of the apparatus was carried out by the British Thomson-Houston Company, Rugby, England, to whom we are indebted for data and illustrations. The trains are worked by continuous current obtained from a single conductor rail placed in the six-foot way, with the track rails forming the return. The conductor rail is of special high-conductivity steel, of Vignoles section, weighing eighty pounds to the yard. The rail is carried on reconstructed granite insulators supported upon cast-iron pillars. These are placed 19.25 inches outside the gauge line. The separate conductor rails are normally placed between the double tracks; at junctions, crossings, etc., the conductor rail is transferred to the outside of the track. At stations, and at level crossings, the conductor is protected by two creosoted boards, bolted against distance pieces on each side of the rails.

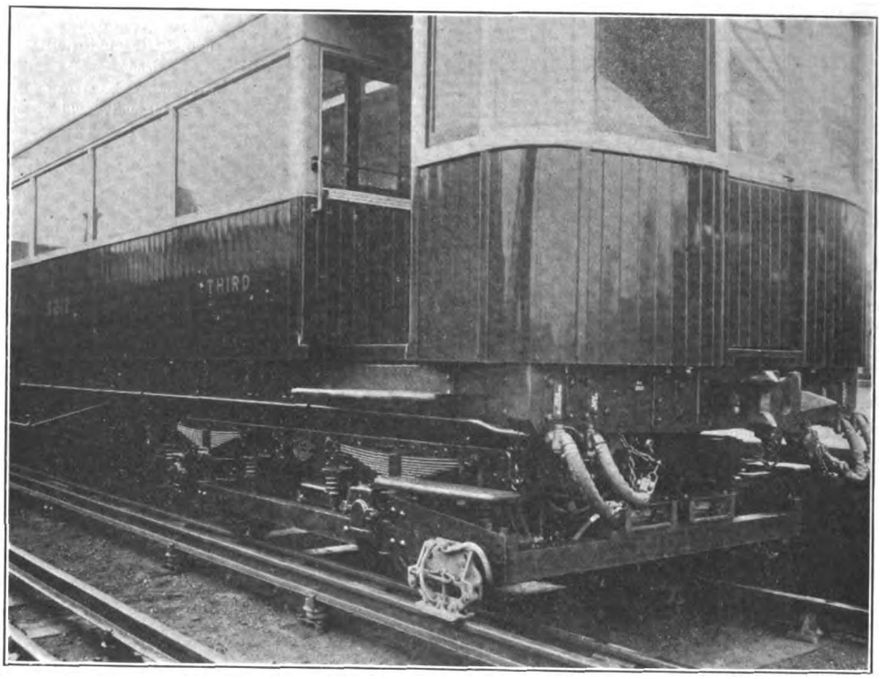
The North Eastern Railway Company buys its energy from the Newcastle Electric Supply Company. This company's Carville station, which supplies the energy for the railway, has been fully described in the ELECTRICAL REVIEW, December 24, 1904.

The motor coaches and trailer coaches are of the open corridor type. Each coach is carried on four-wheeled bogie trucks. The coaches are both lighted and heated electrically. The motor and trailer trucks are of pressed steel, with steel side frames, bolsters, cross-bars and end-bars. The wheel base is seven feet. The swinging bolster is of ash, is stiffened on the sides with steel angles, and is supported upon two nests of springs, each nest consisting of one inside and two outside springs. The axle-boxes are of cast steel, with seatings on the top for laminated bearing springs; the horn blocks of the axle-boxes are of cast steel, and they are tied together at the bottom by a steel strap. The journals are eight inches by 4.5 inches, and the end journals are of the best gun-metal. At the driving and gear-wheel seats the axles are 5.75 inches in diameter, and at the centre and at the motor suspension bearings the axles are 5.25 inches in diameter.

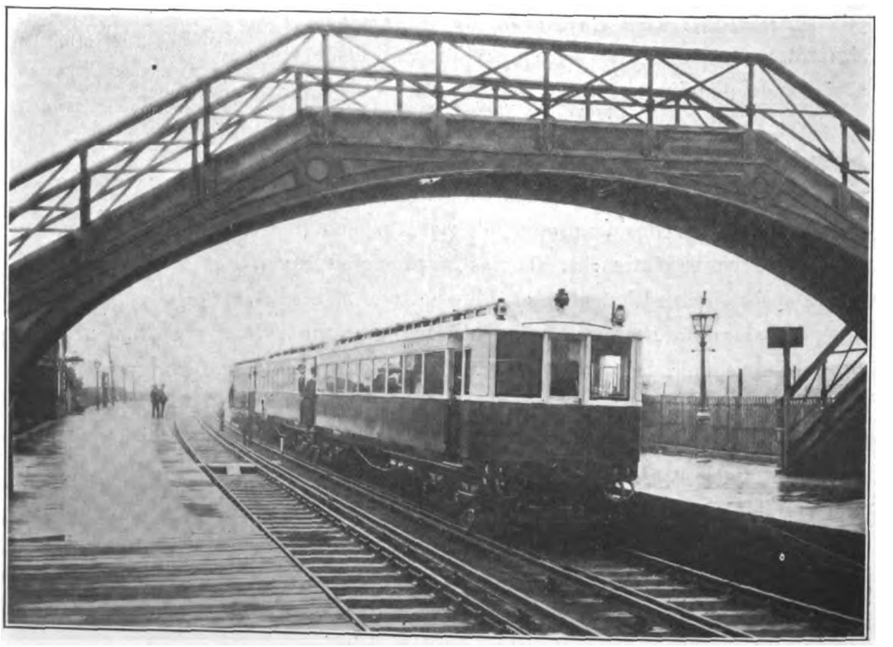
The wheels have wrought-iron or mild steel centres, and Siemens-Martin steel tires, thirty-six inches in diameter on the tread. The tires are 5.5 inches wide, formed with a lip on the front side, and they are held in place by a retaining-ring on the opposite side after being forced on.

The collector shoe is carried by an oak beam from each side of the motor truck. Brackets are cast on the ends of the journal boxes, and these carry the beam at the proper height above the track. Each shoe is protected by a magnetic blow-out ribbon fuse. There are four contact shoes, one at each side of each bogie truck.

The motors are suspended from angle



FRONT VIEW OF MOTOR CAR, SHOWING COLLECTOR SHOE RUNNING ON THIRD RAIL, NORTH EASTERN RAILWAY.

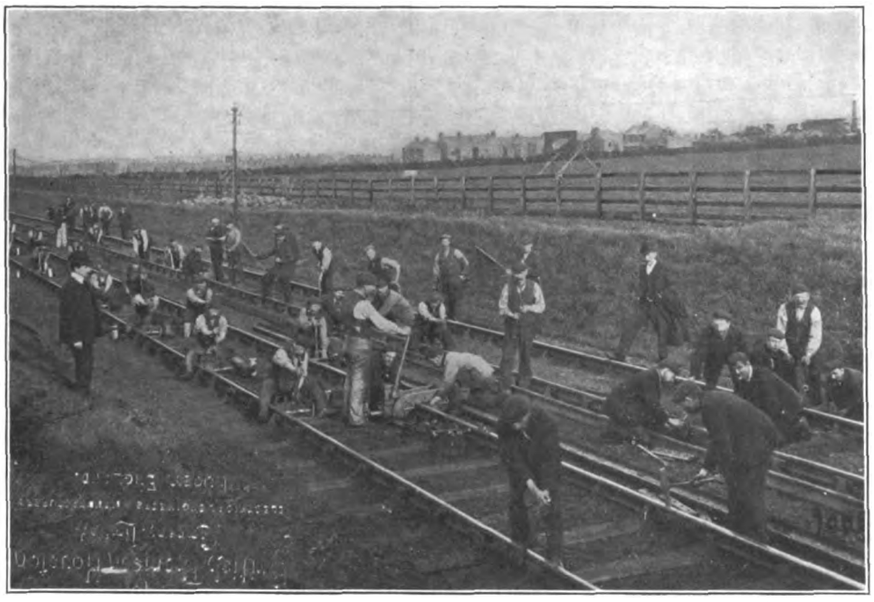


MULTIPLE UNIT TRAIN, NORTH EASTERN RAILWAY.

Digitized by Google

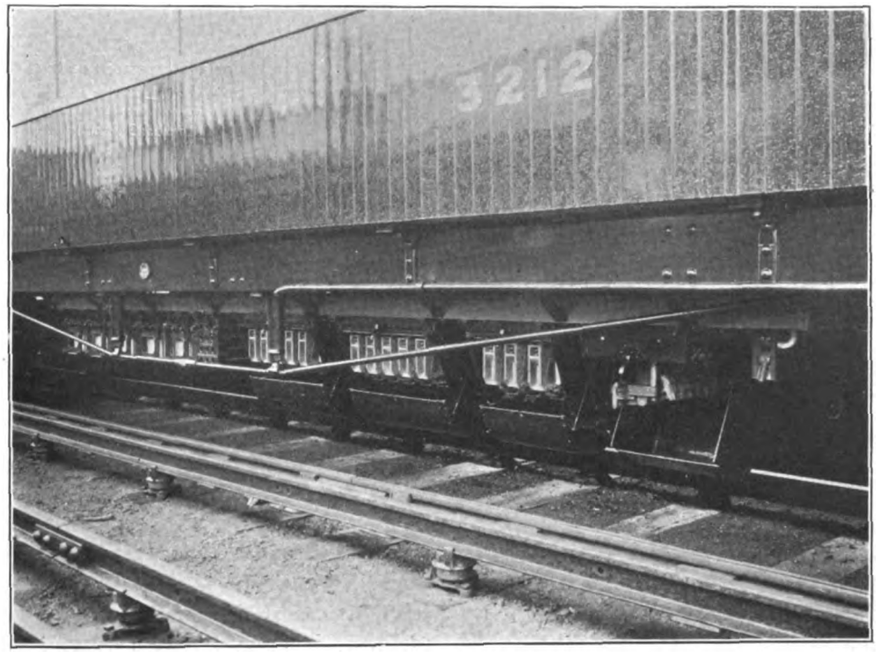
brackets bolted to the transom, on which rests the supporting nose cast on the motor frame. A stiff strap, bolted to the angle bracket, holds the nose rigid.

Two G. E. 66 motors, each rated at 150 horse-power, are placed on each motor coach. Both motors are carried on one bogie truck.



Bonding the Tracks, North Eastern Railway.

The ordinary unit train consists of two motor coaches with one trailer coach between. The Sprague-Thomson-Houston system of multiple-unit control is used. Beneath each motor coach are fixed the contactors for making the necessary connections with the motors and for cutting in and out the resistances, step by step. The contactors are operated by current derived from a nine-wire multiple cable running from end to end of each motor coach, and fitted with a proper socket and plug coupler at each end. The trailer coaches are also fitted from end to end with these multiple cables and the system is thus made continuous throughout the train. The rate of acceleration of the train is maintained constant until the full multiple position of the controller is reached. The driver is only required to throw his lever to full multiple or full series position and hold it there until he wishes to shut off the current. The entire train is synchronously controlled from the forward car.



View Showing the Contactors underneath the Cars, North Eastern Railway.

For the freight traffic powerful electric locomotives have been developed by the British Thomson-Houston Company. These are of the double bogie type with central cab and sloping ends and weigh in running order fifty tons. The motors are the G. E. 55 type with two-turn armatures and 3.28 gear ratio, one being mounted on each of the four axles. The control adopted is the Sprague-Thomson-Houston multiple unit system and is similar to that used on the passenger trains. The following gives the leading dimensions:

Gauge	4′ 8½″
Length over central cab	9′ 0¼″
Length over head stocks	35′ 0″
Length over buffers	37′ 11″
Pivotal centres of trucks	20′ 6″
Wheel base of each truck	6′ 6″
Width over cab	7′ 6¼″
Width over side soles	7′ 10⅝″
Width over all	8′ 8″
Height from rails to top of cab	11′ 9″
Height from rails to top of floor	4′ 3¾″
Diameter of wheels	3′ 0″
Diameter of axles at centre	0′ 6⅜″
Diameter of axles at wheel seats	7.28
Diameter of axles at journals	6″
Length of journals	10″

The trucks are of the steel-plate frame type in accordance with English railway practice, strengthened with steel angles and gussets with swinging bolster built up with steel sections and steel castings. The bolster is supported on two nests of coil springs of circular section and is provided with cast-steel wearing-plates, cast-steel centre and side bearing-plates. The side frames are supported on the axle-boxes by laminated springs of heavy design. The axle-boxes are of cast steel machined to work in the horn plates which are also of steel and machined, being riveted to the side frames which are cut out to receive them. The axle-boxes are provided with wings to take the shoe beams and are fitted with heavy brasses babbitted, ample provision is made for lubrication and exclusion of dust. The brake gear is of specially heavy design, as it plays an important part in the work that the locomotive has to handle which is chiefly on heavy grades, blocks are fitted to each side of each wheel, and all gear is heavy enough to stand operation by air pressure. The wheels are of the cast-steel disc type, balanced, and fitted with rolled steel tires 5.5 inches wide by 2.5 inches deep on tread, held in place by retaining-rings and also by eight set screws. The motors are carried on the transoms by means of cast-steel brackets in which

Digitized by Google

the nose on the motor frame rests, being held there by a forged strap. The shoe beams are of oak and bolted to the axle-boxes, the shoes being hung outside the wheel base. All holes are drilled, edges of plates planed and rivets hand-riveted.

The underframe is constructed of steel sections and ballasted with cast-iron blocks to bring up the weight. Each side sole is formed by a girder twelve inches by six inches by fifty-four inches and of I-section; there are two centre longitudinals, each eight inches by three and one-half inches by five-eighths inch of channels section, these four longitudinals being connected at their ends by head-stocks fifteen inches by four inches by one-half inch of channel section; to the front of these is bolted oak head-stocks fifteen and three-quarters inches by eight inches. The whole frame is firmly riveted together with steel angles and gussets, all holes being drilled and edges of plates machined. The underframe bolster is formed by two girders, each six inches by five inches by one-half inch of I-section, held together on the top by a plate three feet wide and three-quarters inch thick, on the lower side being a plate seventeen inches wide by three-quarters inch thick. Between the bolsters, evenly spaced, are five cross-girders, each eight by three and one-half inches by five-eighths inch of channel section, backed with a plate fifteen inches wide by one-half inch thick. On the top of the frame is a floor of fireproof wood one and seven-eighths inches thick, fixed transversely with a top or lining floor of seven-eighths inch thickness laid longitudinally. The draw gear, side couplings and buffers are of the standard English pattern.

The centre cab is constructed of one-eighth-inch steel plate and angles, and is separate to the sloping ends which are also constructed in a similar manner, all three portions being bolted to the underframe. The cab is provided with two side windows on each side, the one at the driving corners being arranged to lower. A sliding door is fitted on each side, of ash, glazed at the top, and panelled at the bottom, bearing on the outside the arms of the company in transfer. The doorways are two feet four inches wide, and six feet in the clear. At the ends of the cab are two windows arranged to slide transversely. Arrangements are made for driving the locomotive from each end of the cab, and it is therefore fitted complete in duplicate with master controller, air-brake, sand and whistle valves. In the centre of the cab is fitted a cast-iron column to carry the hand brake gear; on each side is a panel for the control and pump circuit accessories with a main panel at one end for main and control switches, etc. Air-gauges and ammeters are also fixed in each driving position. Under the sloping ends are fixed the contactors, reversers, and rheostats. The apparatus for each two-motor equipment

ELECTRIC LOCOMOTIVE FOR FREIGHT TRAFFIC, NORTH EASTERN RAILWAY.

Digitized by Google

being fitted in its own end of the cab, the four-motor equipment is thus split up into two equipments as far as possible as regards location. The contactors are supported from an angle-iron framing built on the floor of the cab, the reversers and resistances being bolted to the floor, but raised above it so that the cable runways may run underneath them. The air-brake is of the quick-acting pattern, air being supplied by a British Thomson-Houston electrically driven compressor, which is hung underneath the frame. This compressor will compress against a pressure of ninety pounds per square inch, with a cylinder displacement of twenty cubic feet per minute. The air reservoirs are fixed in the sloping ends of the cabs, as also are the sand hoppers, the sand being carried by flexible tubes to the fixed pipes on the trucks, the air-operating pipes being connected to the same at the base of the hoppers.

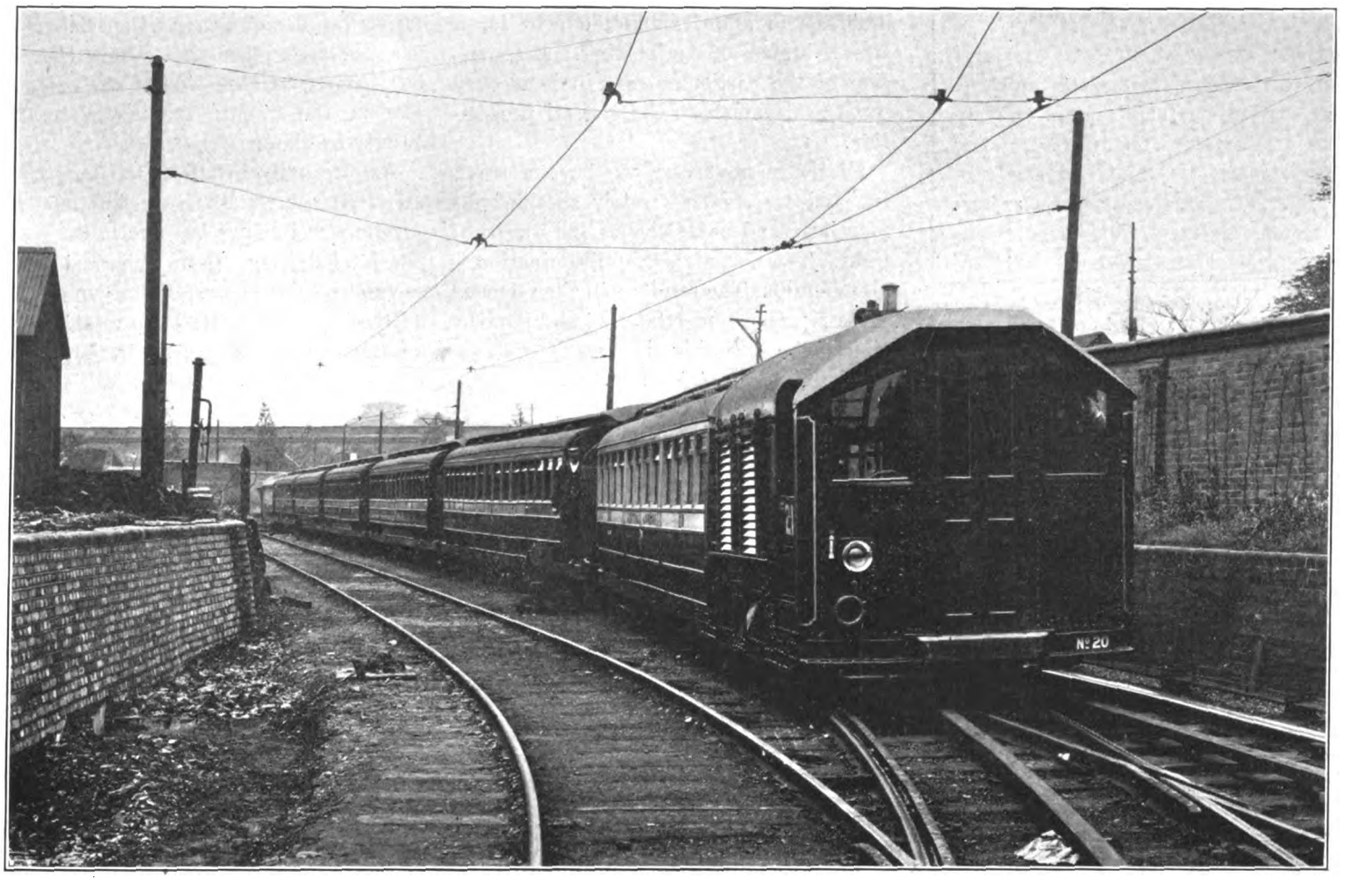
A shaded lamp is fixed in each driving corner with three lights in each of the sloping ends, and a headlight on each end. All lamps are of thirty-two candle-power, and arranged for working six in series on a 600-volt circuit. Two portable lights are also provided.

As the locomotives have to operate over sections fitted both with overhead line and third rail, a sliding bow trolley has been provided of special design, automatically reversing itself according to the direction of travel of the locomotive, and also capable of being reversed and lowered when not in use from the cab by a hand-wheel actuating a worm and wheel device.

All cables are asbestos covered, and are run either in wood troughing lined with uralite or in steel tubing. Besides being fitted with the nine-wire coupler at each end for the control circuit, bus or main-line and pump-line couplers are also provided, so that two locomotives can be coupled together if necessary and operated by one man for dealing with heavier loads.

Each locomotive when operating on a 600-volt circuit is capable of handling a 300-ton train on the level at a speed of fourteen miles per hour, and of starting with a train of 150 tons on a grade of 1 in 27 under all conditions of weather, running up this grade at a speed of nine to ten miles per hour.

It is interesting to note also the physical appearance of the multiple-unit train (illustration herewith), on the Central London Railway, which was opened in July, 1900. This apparatus was also designed and equipped by the British Thomson-Houston Company.



MULTIPLE-UNIT TRAIN, CENTRAL LONDON RAILWAY.

A Simple Condenser with a Variable Capacity for Experiments in Syntonization.

A simple condenser having a variable capacity is described by Herr J. J. C. Müller, who has used the device in experiments in syntonization of electrical oscillating circuits. The conducting plates of the condenser are thin sheets of zinc; the dielectric plates, of glass. The latter are assembled by cementing with shellac strips of glass twelve millimetres wide along two sides and one end of a plate. On these strips a second glass plate is cemented, and on the latter, a second series of glass strips, leaving, however, the plate uncovered at the other end. This process is continued until the desired number of glass cells is formed. The zinc sheets are clamped together in two sets by means of bolts, sleeves and nuts, and are then slipped into the glass pockets from opposite sides. By varying the distance to which one set of plates is inserted, the capacity can be varied continuously. With this device, syntonization between two circuits is easily shown, for there will be a certain position for which the current flowing in the secondary circuit will be a maximum. This point can be determined by means of an air thermometer, the bulb of which contains a fine resistance wire. By varying the inductance of either circuit, it is found necessary to vary the capacity of the condenser to secure the maximum current gain.—*Physikalische Zeitschrift (Leipsic), April 15.*

Digitized by Google

THE LIGHTING OF RAILWAY CARS.

BY E. L. ELLIOTT.

This article was inspired by a brief editorial in a recent issue of the New York *World*. The editorial was brief enough to be quoted in full: "The Subway Cars Should Be Better Lighted, Mr. Belmont." In view of the fact that the subway cars are provided with electric lamps in a

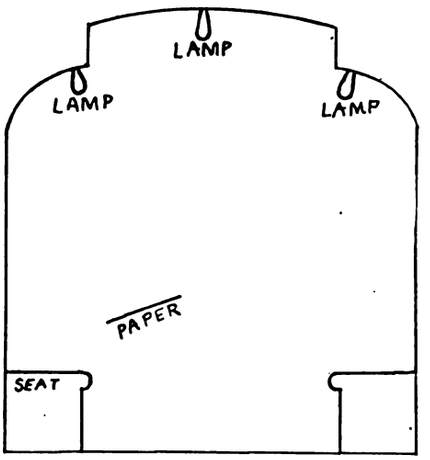


FIG. 1.—CROSS-SECTION OF CAR SHOWING POSITION OF LIGHTS.

more generous manner than is customary, the occasion for this public criticism of their lighting is worth investigating.

If the cars are really poorly illuminated, as the *World* declares, the correction of the fault is a problem requiring the services of an "illuminating engineer." The electrical engineer has done his best, and the result is unsatisfactory: a convincing argument in favor of the specialist in illumination. The writer has, for a number of years, been calling attention to the need of such specialists in the engineering field, and is gratified to observe that the suggestion is at last finding approval, as indicated by Mr. Marks's recent article in the ELECTRICAL REVIEW.

The old notion that the installation of a certain number of lamps of given "candle-power," in any position convenient to the wireman, is all that is necessary to "light" a room or car is on a par with the practice of our grandfathers in building a fireplace on one side of the room, from which to heat the room. "Fire makes heat; if you build a fire in your room, you will therefore heat your room." The argument appears unassailable—until you learn by experience how miserably ineffective and uncomfortable such heating is. "Lamps give light; put up enough of them, and you will have a brilliantly lighted room." The argument is just as plausible, and just as fallacious as the other. The discrepancy in both cases arises from the fact that only the physical effects are considered; while the results sought are purely physiological.

A room is well and properly heated when we feel comfortable in it, no matter what the thermometer may say; and a room is well illuminated when we can see the objects we wish to see with ease and comfort to the eyes, regardless of the "candle-power" and number of lamps in use.

The principles underlying the use of light for the production of illumination are sufficiently scientific and definite, and in the present highly developed state of the ways and means of producing light involve a sufficient number of technical problems to afford an ample field for a special branch of engineering. A discussion of the particular case in hand may serve to demonstrate the general proposition.

In the present case we have a small enclosed space of accurately specified dimensions, and electricity as the source of light. The purpose of the illumination is also definite. The results will then depend upon a proper understanding and application of the following elements:

The location of the light sources.

The number of light sources.

The light-power of the light sources.

The distribution of rays from the light sources.

The distribution required to produce the most satisfactory illumination.

The quality of the illumination—diffusion and color.

The location of the lamps will be such as to produce the desired distribution of light subject to the structural conditions of the cars. These conditions are fortunately most advantageous, permitting the placing of the lamps in positions theoretically ideal. Fig. 1 shows a diagram of a car in cross-section, and Fig. 2 the same in longitudinal section. Lamps placed along the ceiling as indicated are directly above the position in which a newspaper would be held for reading, and also in such position as not to be obscured by standing passengers. The lamps placed in the ceiling of the clerestory, or "well," serve to give additional light in the aisle, and also to illuminate the ceiling sufficiently to prevent any impression of gloominess, which a dark ceiling is sure to give.

The number of lamps in this case is subject to but one structural condition, namely, that it shall be a multiple of five or six in order to run in multiple series on the current supplied, without necessitating the use of lamps of special or unusual voltage. Ten lamps have therefore been placed in each side of the cars, and five in the "well," making a total of twenty-five lamps.

As originally installed, the lamps were all of sixteen candle-power, but later ten-candle-power lamps were substituted. As the total flux, or "mean spherical candle-power" of the sixteen-candle-power lamp of the type used is 13.2, the total quantity of light produced was 25 by 13.2 equals 430 mean spherical candles. With the ten-candle-power lamps it is reduced to 268 candles. The cubic contents of the car is 2,500 cubic feet in round numbers. With the sixteen-candle-power lamps the

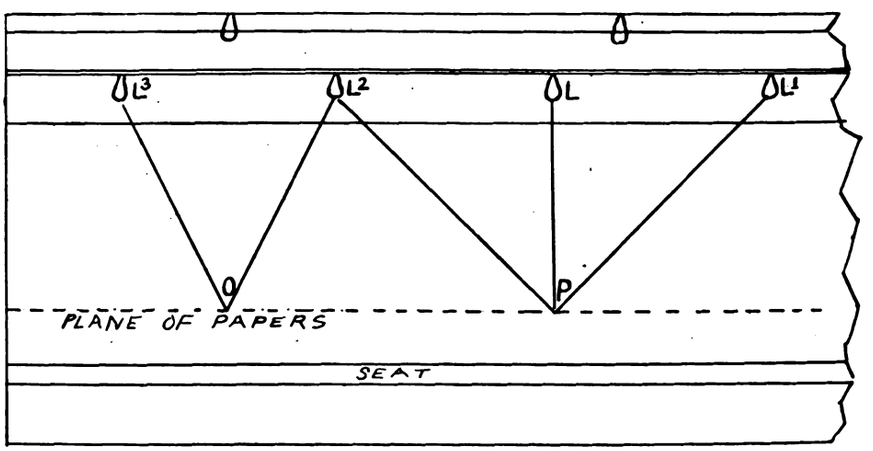


FIG. 2.—PLAN OF CAR SHOWING POSITION OF LIGHTS.

average illumination was one candle to six cubic feet of space, and with the ten-candle-power lamps one candle to 9.4 cubic feet. For the general illumination of interiors one candle to twenty-five cubic feet is considered a very liberal allowance. Even with the ten-candle-power lamps, therefore, the total quantity of light produced is all that is necessary. The source of the trouble, whatever it may be, must therefore be sought in the distribution of the light and its quality.

The illumination demanded by the

Digitized by Google

public in this particular case requires unusual brilliancy in certain positions. The passenger with weak eyesight expects to be able to read his newspaper without fatigue or strain. Considering that newspaper print is often very fine, as well as poorly done, and even in some cases on colored paper, and also that the motion of the car gives additional work to the eye in keeping the focus on the desired point, it will readily be seen that more than ordinary intensity on the paper, as usually held for reading, is requisite for completely satisfactory results. An intensity of one foot-candle is generally conceded to be the minimum for reading average print without abnormal fatigue. It would not be out of the way, therefore, to increase the minimum in the present case to two foot-candles.

A glance at Fig. 1 will show that, with the paper held in the usual position, the lamps on the opposite side of the car have little effect, as the light strikes the paper at a very wide angle. At most, therefore, but three lamps can be considered, the one directly above, together with the two adjacent lamps; or if one is sitting between the lamps, then two only can be considered. If the car is crowded (a condition which sometimes occurs!) it may easily happen that only one lamp shines on the paper of the passengers, the light from the others being cut off by the papers of his neighbors. The distance

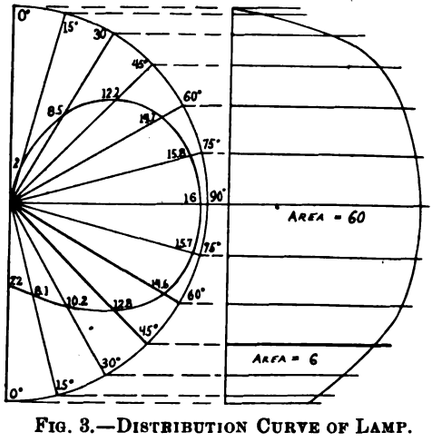


FIG. 3.—DISTRIBUTION CURVE OF LAMP.

from the lamp to the paper may be taken as 4 feet, and the plane of the paper as normal to the rays. The angle of incidence of the rays from the two adjacent lamps may be taken as 45 degrees. These conditions are shown in diagram in Fig. 2, and the curve of distribution of the type of lamp now in use is shown in Fig. 3. Since the vertical intensity is seven-candle-power, the illumination on the paper will be seven-sixteenths foot-candle from the lamp at L. The intensity at 45 degrees is 12.5 candle-power and the distance 5.6 feet. The illumination will therefore be $12.5 \div 5.6^2 \times \cos 45° = 1/3$ foot-candle from one lamp, or 2/3 foot-candle from the two L′ and L″. The total illumination on the paper from the three lamps may therefore be considered as 1 1/4 foot-candles, with the use of sixteen-candle-power lamps, or

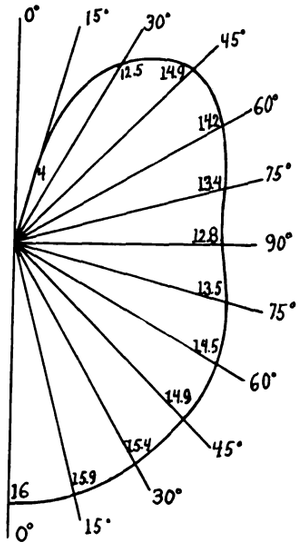


FIG. 4.—CURVE OF DISTRIBUTION OF LAMP GIVING MAXIMUM LIGHT VERTICALLY.

3/4 foot-candle with ten-candle-power lamps. The illumination midway between two lamps figures a little less than this amount. In addition to this there is some reflection from the ceiling, and some light from the lamps in the "well;" but on the other hand there is a very considerable fall in candle-power when the motors are doing heavy work, so that the figures given probably represent about the minimum illumination. It appears, therefore, that the complaint of insufficient illumination is not without cause.

Considering that the total quantity of light produced is more than double the amount ordinarily used for general interior lighting, the question naturally arises, "what becomes of all the light?" A little further figuring will doubtless answer this question. For reading purposes we have seen that only the light within the cone of 45 degrees can be considered, at least in determining the minimum. Drawing the curve for the total flux of light, Fig. 3, and calculating the relative areas representing the quantities given out above and below the angle of 45 degrees from the vertical, we find that 90 per cent of the light is given out above this angle, and therefore unavailable for reading, which we have assumed as the test. By referring to Fig. 1, it will be seen that the strongest rays fall on the advertising cards on the side near the lamp, and on the cards and ventilators of the side opposite. In short, the bulk of the light produced falls on the upper part of the car, where only the minimum amount is required. This distribution gives the general appearance of brilliant illumination; an effect which is found to be deceptive as regards the special illumination which we have taken as a test.

A further complaint might justly be made against the use of bare lamps. The location of the lamps is such that it is impossible for the eyes to avoid the direct encounter of more or less of the direct rays, to their inevitable discomfort. Thus, instead of the lamps on the opposite side of the car being of assistance they actually interfere with comfortable reading by throwing their rays directly into the eyes of the reader. Americans have not yet recognized the indisputable fact that the intrinsic brilliancy of an incandescent lamp filament is entirely too great to be encountered without serious discomfort to the eyes. In this respect European practice is far ahead of the American; a bare lamp in an electric car would be considered a barbarity. The use of bare lamps in the present case is the more indefensible from the fact that a super-

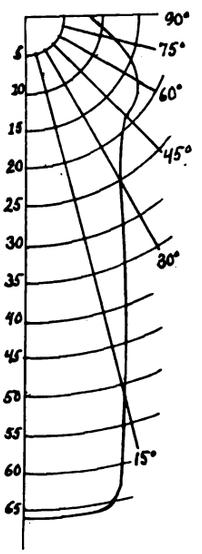


FIG. 5.—DISTRIBUTION CURVE OF SIXTEEN-CANDLE-POWER LAMP WITH HOLOPHANE REFLECTOR.

abundance of light is produced, so that the ten to twenty per cent reduction caused by frosting the lamps would not be seriously missed.

The figures obtained by our calculations, which must be considered rather as reasonably close approximations than absolutely accurate results, disclose the defects and point the way to their removal. A change in the general distribution of the light, so as to produce the strongest illumination in the lower rather than the

Digitized by Google

upper portion of the car, and the use of frosted in place of clear lamps in order to remove the glare of the filaments, would remove the only possible causes of complaint.

A considerable improvement in distribution could be secured by the use of a lamp so designed as to give its maximum light vertically. The distribution curve of such a lamp is given in Fig. 4. With the use of such lamps the illumination on the newspaper in the position assumed would be two foot-candles for sixteen-candle-power lamps, or 1 1/4 foot-candles for ten-candle-power lamps. As this illumination is nearly double that obtained from the lamp now in use, such a change would go a long way toward remedying the defect noted.

By the use of reflectors the distribution could be changed still further. Translucent reflectors are the only kind available for general illumination, as opaque reflectors darken the ceiling too much. Translucent reflectors are made either of opal glass, or clear glass with prismatic ribbings. On account of their higher efficiency, as well as more elegant appearance, prismatic reflectors alone may be considered. These are now made in such great variety of form, and so carefully calculated for the different uses to which they are adapted, that practically any desired distribution may be obtained by selecting the proper reflector. The curve of a sixteen-candle-power lamp of the type now used, in connection with a Holophane reflector (No. 2575), is shown in Fig. 5. Computing the values from this curve, we find that the illumination on the paper would be five foot-candles for sixteen-candle-power lamps, and three foot-candles with ten-candle-power lamps. The illumination would also be practically the same between two lamps as it is directly under one. By this simple expedient of using a reflector, therefore, a minimum illumination that is ample for the most exacting use of the eyes could readily be obtained, without taking into account the lamps in the "well," which would preferably be frosted and used without reflectors to serve their purpose of illuminating the upper part of the car. The prism glass reflectors would transmit sufficient light to illuminate the advertising cards.

That the use of any accessory to vary the distribution of the light was not contemplated before the cars were put into service is manifest from the fact that no provision was made for holding a reflector or globe in place. Possibly it was thought that the breakage of glassware would be a serious matter; but the general use of rather fragile blown glass globes in railway coaches is a sufficient answer to this objection. With the use of frosted lamps and prismatic reflectors the illumination of the cars would fulfil the most rigid specifications that the illuminating engineer could require, and would satisfy that most exacting patron, the general public, whose right to "kick" is cherished as its most inalienable privilege.

A New Oscillograph Wave Tracer.

Mr. Rudolf Goldschmidt has recently described a simple and neat wave tracer. He has taken advantage of the behavior of a small steel needle when placed between two magnetic poles, but in contact with one of them. In this position the needle stands vertically, assuming the poles to be arranged in a vertical position. Any lateral force will deflect the needle slightly, but it will return, when released, to its former position. The oscillograph consists, then, of two opposite poles, one above the other. On the face of the lower pole a steel needle about one-eighth of an inch in length stands on its point. On opposite sides of the needle are placed the coils through which the current to be traced is passed. The upper end of the needle is polished so as to reflect a small beam of light from a suitable source upon a screen. This arrangement would give merely a straight line. To get a curve, two forces at right angles must be used. The latter is obtained by passing a current from the same source through a second pair of coils, these coils containing a high inductance which not only retards the current through the circuit by approximately ninety degrees, but which smooths out the upper harmonics, leaving nearly a simple harmonic force. In the actual device a compound circuit is employed, so as to obtain exactly ninety degrees between the two forces acting upon the needle. The device, as thus arranged, throws upon the screen a curve which represents the wave form. This is a closed curve, and to get it in the usual form it is only necessary to reverse the lower or upper parts. The harmonic force which is used to spread out the line into a curve does not give a deflection directly proportional to the time, as it should. To overcome this objection, the screen is given a semi-circular form, whereby the time error is rectified. The apparatus may be fitted with two or more needles for studying the different currents flowing at the same time. The necessary damping is provided by the eddy currents set up by the motion of the head of the needle in the opposing pole-face. This damping can be regulated by varying the flux density of the magnetic field or the distance between the poles, or by putting a small copper plate on the face of the opposed pole.—*Electrician (London), April* 14.

Lightning Rods.

M. R. Chavannes discusses the general prejudice against lightning rods, and calls attention to the need of investigating more thoroughly the value of these devices so as to remove this feeling. A distinction is drawn between lightning arresters (parafoudres) and lightning rods (paratonnerres), the former being that type of apparatus intended to protect objects insulated from the earth, and the latter protective devices for objects not so insulated. The reliability of lightning arresters has been taken up by a Swiss commission, but its report has not yet been made public. M. Chavannes holds that lightning rods are valuable protective devices when properly installed, but the way in which this should be done is not well recognized. The original idea of a lightning rod was a device which would allow atmospheric charges to escape slowly to the ground, but, in fact, the action of the device is generally otherwise. Discharges are sudden and severe, and have apparently an oscillatory character. M. Chavannes has conducted experiments on a laboratory scale, with a view of studying the effect of sudden oscillatory discharges, using for this purpose high-tension transformers. These experiments have given the following results: the surface of a lightning conductor is as important as its cross-section. The ohmic resistance of the conductor is of little importance. Breaks in the continuity of the conductor are of small consequence. The self-induction of the conductor should be as small as possible. Induction between the lightning conductor and neighboring circuits may give rise to discharges in these circuits, and offer a resistance to the discharge of the main circuit. A house covered with a metal roof is analogous to a condenser, and may set up resonance phenomena. The following rules should be observed wherever possible: all lightning protective apparatus should be placed exterior to the building. The rod, the conductor and the ground plate should be placed in a straight line. The coefficient of self-induction should be sensibly zero. While it is not always possible to arrange the different parts of the lightning rod in a straight line, unnecessary bends should be avoided. M. Chavannes believes that, when the question has been studied thoroughly and the necessary conditions more fully understood, the real value of lightning rods will be recognized, and that, by means of them, the accidents due to atmospheric discharges will be greatly reduced.—*L'Electricien (Paris), April* 15.

Digitized by Google

The International Railway Congress.

Washington, D. C., May 3 to 13, 1905.

THE seventh session of the International Railway Congress was formerly opened at 11 A. M., May 4, 1905, at the New Willard Hotel, Washington, D. C. The Hon. Charles W. Fairbanks, vice-president of the United States, welcomed the members of the congress. The first delegate of the Belgian government, Mr. Ernest Gerard, acted as temporary president, and sat on the right of Mr. Fairbanks. At his left was Mr. Louis Weissenbruch, general secretary of the permanent commission.

In welcoming the delegates, Vice-President Fairbanks said that the railway was a mighty instrument of modern civilization. It was created to meet an imperative demand. It was created locally to meet local conditions, but it has extended until it binds together remote industrial centres. It has brought the capitals of the world nearer together. It has crossed and recrossed continents. It has become an artery over which passes the commerce of the world. It has been inextricably woven into the social, the commercial and the political affairs of millions and millions of the human race. Science and art, labor and capital have wrought a revolution. The work of construction and reconstruction is unending. The universal urgent and imperative demand has increased carrying capacity at a minimum cost of maintenance and operation. Hand in hand with this goes the demand for low rates of transportation.

The assembling of the International Railway Congress, he said, was of far-reaching moment. These sessions bring together into closer fellowship men of distinguished ability, representatives of many nations, interested in promoting a common and wholesome purpose.

Following the remarks of Vice-President Fairbanks, Mr. Ernest Gerard addressed the congress. Mr. Gerard said that it was twenty years since Belgium celebrated the fiftieth anniversary of the opening of the first public railway upon the continent of Europe. The road from Brussels to Malines was opened for business in 1835. To-day Belgium has a system of 4,552 kilometres of standard gauge road, and 2,722 kilometres of local railways. These systems operate through a territory of 29,455 square kilometres. This does not include the more than 500 kilometres of electric tramways now in operation in Belgium. The first six sessions of the congress took place in Europe, and the railways of the United States have, from session to session, played an increasingly important part. The great development of the roads of the United States, the wonderful rolling stock, the famous shops, the innumerable electric railways, with their powerful central power plants, are marked, in every case, by the very latest improvements.

Mr. Stuyvesant Fish then took the chair and delivered a brief address. On behalf of the American Railway Association, Mr. Fish welcomed the International Railway Congress. He recited some of the history of steam railway development, calling attention to the work of the early inventors in this field. Americans, he said, perceived from the very beginning the great importance of railways in the development of their country. As soon as they were put in possession of this marvelous implement, they covered their country with it. Since 1850 the United States has been among the first of the nations of the world in the extent of its railways.

At the close of Mr. Fish's address, the senior delegates nominated first by the governments represented, vice-presidents, *ex officio,* numbering twenty-nine, were requested to take their places. Mr. Fish thought that he was expressing the feelings of the meeting in asking Mr. Weissenbruch, general secretary of the permanent commission, to continue his functions as secretary-general of the seventh session. He proposed as associate-secretary-general Mr. W. F. Allen, secretary of the American section.

The congress was then invited to subdivide into sections, and the provisional presidents of the sections were announced as follows: first section, Mr. Stuyvesant Fish; second section, Mr. Theodore N. Ely; third section, Sir George Armytage; fourth section, Mr. Perouse; fifth section, Mr. Ernest Gerard. The first meeting adjourned at 12.45 P. M.

On May 5 the second section of the congress met at the New Willard Hotel, under the presidency of Mr. Ely. The section took up the discussion of "Locomotives and Rolling Stock." This meeting adjourned at noon.

Section 5, under the presidency of Mr. Ernest Gerard, met in the audience room of the Interstate Commerce Commission. The topic for discussion was "The Influence of Light Railways on Main Lines." The president of this section stated that tramways (street railways) are not included in the programme of the congress, and that there was, in Europe, a special congress for railways of that character. There is a great difference between large lines and tramway lines. Tramways start from large cities and run some distance into the country. Under these conditions, these lines compete, to some extent, with regular railways. The consequence is that large railway systems have no special inducement to favor the development of these tramways and railways of local interest.

Section 1 of the congress, under the presidency of Mr. Fish, met at the Ebbitt House. This section took up the subject of "Wooden Sleepers or Cross-Ties, Selection of Kinds of Woods and Processes of Preservation." Mr. Muntz, who presented the report, was of the opinion that special care should be taken with European woods. The pickling of sleepers in order to increase their life is to be generally recommended. The selection of the antiseptic and the method of carrying out the pickling operations depend upon individual conditions.

Section 3, under the presidency of Sir George Armytage, took up the discussion of "Baggage and Express Parcels." The reporter for all countries on the subject of baggage was Mr. George H. Daniels, general passenger agent of the New York Central & Hudson River Railroad Company. On the subject of express parcels, the reporter for all countries was Mr. J. H. Bradley, general traffic manager of the American Express Company.

On May 6 section 1 took up the discussion of the second conclusion of Mr. Kendrick's report on "Inspection and Preliminary Preparation before Treatment." This was under the heading of "Wooden Sleepers or Cross-Ties."

Mr. Cartault stated that the railways of the Paris, Lyons & Mediterranean Company use creosote treatment. The life of an oak tie is thereby increased to about fifteen or twenty years, and that of a beech tie from twenty-one to twenty-five years. The ties are first subjected to a vacuum in a metal tube, and then the creosote is injected under heavy pressure.

Upon the question of mechanical wear, Mr. Muntz said that the only way to secure a perfect fastening of the rails to the cross-ties is to make use of lag screws.

Digitized by Google

It is necessary to avoid the hammer upon the cross-ties produced by the passing of heavy loads over the track. When the surface of contact begins to wear, a piece of felt or soft wood should be put between the base of the rail and tie. When the holes made by the lag screws become too large, the Railway Company of the East (France) has a method of putting wooden plugs in the place where the screw is removed and boring new holes. This has given entire satisfaction.

Section 3 took up the discussion of "Suburban Traffic." The characteristic feature of this service is the necessity of handling a very large traffic, and making the necessary arrangements during a short period of time every morning and evening. The main points to be considered are: first, the number of passengers carried; second, the motive power; third, the train running speed; fourth, signals; fifth, station management. The conclusions from the report presented by Mr. A. J. Sullivan, general manager of the Missouri Pacific Railway, St. Louis, Mo., were as follows: to be in the highest degree remunerative, the traffic must be handled rapidly by simple and inexpensive means, and with the minimum working organization necessary for the purpose. The type of car is the essential factor. New lines to be constructed should be adapted to the best types of cars. On old lines, in order to utilize to the utmost the space between tracks, the curves should then be compensated to produce the same clearances as upon tangents. The locomotives should be sufficiently powerful to haul trains of maximum size at the speeds required. The train schedule should provide for the movement of all trains at a uniform speed, and stops at all stations upon the same tracks. Separate tracks should be provided upon lines of heavy traffic for trains which are to be run at high speed, and which do not stop at all stations. All necessary measures should be taken to accelerate the movement of passengers and start the trains promptly. In this way the expenditure of energy required to regain time lost is conserved, and the promptness with which the service is conducted communicates itself to the passengers, who quickly learn to move more rapidly. The frequency of train movements should be proportioned to the volume of traffic, to avoid prolonged waiting of passengers and congestion at stations.

Alexander Wilson, assistant general manager of the North Eastern Railway, England, stated that the North Eastern road had been operating for the past year a suburban service in the Newcastle district with electric power, with the object of regaining the traffic from the competing tramways and to increase its amount. Not all the traffic had been regained from the tramways, but the amount handled had been considerably increased. The reduction in expenses has resulted in a net revenue which more than covers the interest in the extra cost of installation necessitated by the introduction of the electric power. The current is furnished at a reasonable rate, by power stations which do not belong to the railroad.

A. Mange, secretary to the management of the Paris-Orleans Railroad, stated that the Paris-Orleans road operates electrically on 12.4 miles on the Paris-Juvisy line a hundred trains daily, instead of seventy-five as before the use of electric power. Four tracks are used—two for express trains, and two for locals. Trains are operated with reversible motors in front and behind. There are two types of trains—heavy trains of 286 tons and 1,000 seats, and light trains of seventy-three tons and 650 seats. The labor of one man was saved, the motorman alone fulfilling the duties of the fireman and engineer on the steam railroad.

Mr. Sullivan stated that installations have been made at the terminal station at Boston, underground, for a continuous circular service. Reversible motor trains like those of the Paris-Orleans road reduce considerably the time required at the terminal between the arrival and departure of trains.

Section 2 continued the discussion of "Locomotives and Rolling Stock." On Thursday, May 11, section 2 took up the discussion of question 8, "Electric Traction," which was debated conjointly with the fifth section.

On Wednesday, May 10, section 1 took up the discussion of "Improved Rail Crossings." On Thursday and Friday this section took up the discussion of "Concrete and Embedded Material."

On Monday, May 8, sections 2 and 3 together took up the question of "Lighting, Heating and Ventilation of Trains." On Tuesday, May 9, this section discussed "Pooling Locomotives." On Wednesday, May 10, the section discussed "Automatic Couplers."

On Thursday, May 4, the delegates were escorted to Mount Vernon. At 9 P. M. there was a reception by the trustees of the Corcoran Art Gallery, assisted by the commissioners of the District of Columbia. On Friday, May 5, Vice-President Fairbanks received the delegates at 2.30 P. M. On Saturday, May 6, the delegates visited the Capitol of the United States and the Congressional Library. On Monday, May 8, there was a reception of the foreign delegates by the German Embassy. On Tuesday, May 9, at 4 P. M., the delegates visited the New Union station, and at 7 P. M. attended the banquet tendered by the American Railway Association. On Wednesday, May 10, the delegates visited the arsenal and gunshop. On Thursday, May 11, visits were made to the Patent Office, the Pension Office and the National Museum. At 7 P. M. on Thursday the second part of the banquet tendered by the American Railway Association was celebrated. The programme for Friday, May 12, called for the entertainment of the delegates at 5 P. M. by Mrs. Roosevelt, and on Saturday, May 13, at 1.30 P. M., the general meeting and formal closing of the session; at 4.15 P. M., an excursion to Fort Meyer and Arlington.

The American Railway Appliance Exhibition.

At the annual meeting of the Railway Supply Men's Association, held in connection with the conventions of the Railway Master Mechanics and Master Car Builders' Associations, at Saratoga, N. Y., June, 1903, a resolution was adopted asking the officials of the American section of the congress if it would be agreeable to have an exhibition of American railway appliances in connection with the seventh session of the congress. A favorable reply was received, and Mr. George A. Post and Mr. J. Alexander Brown, respectively president and secretary of the Supply Men's Association at that time, presented to the executive committee of the American section a sketch of the proposed exhibition, which was approved. Upon a report to this effect to the appointing body at its annual meeting of June, 1904, Mr. Post was commissioned to select a committee representing, as completely as possible, the supply trade, as covered by the Supply Men's Association and the Road and Track Supplying Association, to the end that roadway, as well as mechanical supply trades, might be adequately represented. The members of this committee were announced in the last issue of the ELECTRICAL REVIEW. One of the greatest obstacles which this committee was confronted with at the outset was that there was no place in Wash-

Digitized by Google

ington where an exhibition could be held, except by act of Congress. Permissive legislation was therefore secured, and in January, 1905, an enabling act was passed by both houses of the national legislature. Not a single timber of the many substantial and handsome structures which now grace the Monument lot, where the exhibition is held, was erected until after March 20. The buildings which have since then been put in place represent an expenditure of about a million dollars.

The meeting in celebration of the opening of the American Railway Appliance Exhibition was called to order in the hall in the Monument lot at noon, May 3, by Mr. George A. Post, the chairman of the general committee of arrangements. In part, Mr. Post said:

"The American Railway Appliance Exhibition is an accomplished fact. Its portals are open. Its grand display of the products of more than 300 factories is ready for inspection, and the general committee of arrangements presents this magnificent scene of commercial activity as the result of the glorious cooperation of the American manufacturers in its labors in behalf of the great industry whose cheerful servant it has been. . . . This exhibition is a purely business proposition. Those who have brought their exhibits here from all parts of the country have done so in the fervent hope that they may attract the favorable attention of the railway officials who will be in attendance upon the International Railway Congress."

Mr. Post then presented the Hon. H. B. F. Macfarland, president of the Board of Commissioners of the District of Columbia, who delivered the address of welcome. Mr. Macfarland said that "but for the railroad and the telegraph the national capital would not have remained in the District of Columbia, but would have gone far west with the advancing march of population. The first public American railroad—the Baltimore & Ohio—came early to Washington. The first rail was laid on July 4, 1828. The first telegraph line ran from Washington to Baltimore. The first message was sent from the capital, and the first long-distance telephone line reached to Washington. The labors of Hercules and the wealth of Crœsus are surpassed by the marvelous achievements in transportation and communication in the short period of one lifetime. In the presence of the distinguished guests from abroad, delegates to the International Railway Congress, which we hope to see return at frequent intervals to hold its sessions here, we Americans do well to express our gratitude to the great men, living and dead, who have done so much in these fields for our new country."

Mr. Post, in a brief tribute to his achievements, introduced Mr. George Westinghouse as the speaker of the day. Mr. Westinghouse said, in part:

"It has been my privilege to know many of the great managers of railways in Europe as well as in the United States, and to learn to appreciate the magnificent work they have done in the development of railway transportation, and also to know and appreciate the skill, patience and self-sacrificing efforts put forth to ensure the comfort and safety of most exacting patrons, who, as a rule, have had but little opportunity to become acquainted with the difficulties surrounding those charged with the administration of our great railways. . . . A little error on the part of only one of the thousands of men employed upon a long line of railway which is traversed by a heavily laden train may have the most deplorable consequences, and therefore the infrequency of serious mistakes testifies unmistakably in favor of a most generous recognition of the reliability of the railway men, each of whom is apparently ever actuated in the discharge of his duties by an intense desire to guard the lives of his fellowmen who are even momentarily entrusted to his care.

"A new era of railway operations has dawned, with its many new problems. I refer to the growing use of electricity for the movement of trains. There have already been such demonstrations of the benefits to be derived from the substitution of the electric motor for the steam locomotive that it requires no great prophet to predict the extensive growth of electric traction upon the great railways, and the eventual replacement of the steam locomotive. Fortunately the time element, which is such a controller of events, and the financial problems involved, will ensure gradual development and extension of the use of electricity. With these changes have come vastly different engineering problems and new sources of danger which should, and will, command and receive that attention which is essential to the surmounting of every difficulty as it arises."

At the conclusion of his remarks, Mr. Westinghouse introduced, successively, Secretary Morton, Secretary Taft, the Hon. C. N. Lawrence, deputy chairman of the London & Northwestern Railway, and Mr. Stuyvesant Fish, president of the American Railway Association. Each of these gentlemen made a brief address.

At midnight on May 3 the delegates were entertained by a representation of the flash of a time signal around the world. This entertainment took place in Monument lot, and was under the direction of Rear-Admiral Chester, of the United States Navy. A large outline map of the world, forty-two feet long and twenty-four feet high, placed on a screen and fitted with 200 four-candle-power colored lamps, served to give a graphic demonstration. The map was prepared for this occasion by the hydrographic bureau of the Navy Department. The Western Union Telegraph Company and the Postal Telegraph-Cable Company had placed all their facilities at the disposal of the government. In addressing the delegates, Admiral Chester stated that, in spite of every effort, and especially in spite of the powerful influence of President Clowry, of the Western Union company, and of Vice-President and General Manager Ward, of the Postal company, he did not expect to be able to complete the world's circuit that night, because of the war raging in the far east. The electric lights were placed on the map, located in the positions of 200 of the principal cities of the world. Most of these received simultaneously the telegraphic signals. These 200 lights were merely typical of many thousands of others that might properly be added along the 500,000 miles of wire and cables over which the signals were flashed.

AMONG THE EXHIBITORS.

The Adams & Westlake Company, Chicago, Ill., is exhibiting the Newbold electric car-lighting system. In addition to this there are the Adlake gas car-lighting system, railway lanterns, down-draught signal lamps, car and shop hardware, and oil, gas and electric chandeliers. The company is represented by E. L. Langworthy, A. S. Anderson, F. N. Grigg, R. M. Newbold, and William S. Hamm.

The Anglo-American Varnish Company, Newark, N. J., is represented by William Marshall and George M. Ballard.

Harold P. Brown, New York, is exhibiting electric rail bonds, rail drills, hand-power grinders and instantaneous soldering and brazing processes.

The Bryant Electric Company, Bridgeport, Ct., is located in the Westinghouse building, and is exhibiting standard electrical fittings and hardware.

The Cling-Surface Company, Buffalo, N. Y., is exhibiting its "Cling-Surface"

Digitized by Google

for belts and ropes. Represented by William D. Young and J. B. Faatz.

The Consolidated Car-Heating Company, Albany, N. Y., is exhibiting electric heaters for all classes of electric car service, with regulating switches, and the McElroy automatic axle-lighting system in operation. Represented by Francis C. Green, Cornell S. Hawley, James F. McElroy and William H. Fulton.

The Consolidated Railway, Electric Lighting and Equipment Company, New York city, has on exhibition a standard truck equipped with its system of axle-car lighting, together with switchboards and regulators. Represented by John P. Dickinson, P. Kennedy, Thomas Mount, J. Dorman and W. M. Lawlor.

The Continuous Rail Joint Company of America, Newark, N. J., is exhibiting various forms of rail joints with a special electric bonding, and joints showing the use of all types of bonds. Represented by E. F. Braine, B. M. Barr, V. C. Armstrong, W. Clark and E. A. Condit, Jr.

The Edison Manufacturing Company, New York, is exhibiting Edison primary batteries for railway work. Represented by W. S. Logue and G. A. Guyer.

The Electric Controller and Supply Company, Cleveland, Ohio, is exhibiting the Deutsch electric train-lighting system. Represented by Isadore Deutsch and W. W. Adams.

The Electric Storage Battery Company, Philadelphia, Pa., is exhibiting the chloride accumulator used in connection with the electrification of steam roads, storage battery switchboards, portable and stationary cells, cells for train lighting, recording apparatus, and storage battery auxiliaries. Represented by E. L. Reynolds and W. G. Davis.

The Electro-Dynamic Company, Bayonne, N. J., is exhibiting a number of different sizes of its "Interpole" variable-speed and constant-speed motors. Represented by G. H. Condict and H. McL. Harding.

The General Electric Company, Schenectady, N. Y., has on exhibition a multiple-unit train control, various types of railway motors, the Curtis steam turbine, combination automatic-straight air-brake compressor, and automatic electric signals. In addition to this are moving pictures of electric locomotives; and the application of the mercury arc rectifier is demonstrated. Represented by General Eugene Griffin, E. W. Rice, Jr., J. R. Lovejoy, J. R. McKee, William J. Clark, L. R. Pomeroy, W. B. Potter, A. H. Armstrong, J. G. Barry and F. H. Gale.

The General Railway Signal Company, Buffalo, N. Y., is exhibiting electric, mechanical and low-pressure pneumatic, interlocking electric automatic block signals, and manually controlled block signals.

The Gold Car Heating and Lighting Company, New York city, has on exhibition its car heating and lighting apparatus. Represented by E. E. Gold, John E. Ward, W. E. Banks, B. H. Hawkins, A. E. Robbins, W. H. Stocks and Richard Voges.

The Gould Coupler Company, New York, is exhibiting its electric car-lighting system, together with other specialties. Represented by T. L. McKeen, M. H. Shedd, F. P. Huntley, W. R. Turbayne.

The Hall Signal Company, New York, electric motor signal, electro-gas signal, staff signal apparatus, lightning arresters, electroliquid slot signal, disk signals and indicators, and semaphore indicators. Represented by A. J. Wilson, E. N. Godman and Dixon Boardman.

The International Correspondence Schools, Scranton, Pa., are exhibiting text-books for instruction. Represented by W. N. Mitchell, E. M. Sawyer and L. A. Osborne.

The H. W. Johns-Manville Company, New York, asbestos and magnesia materials. Represented by J. E. Meek and J. R. Younglove.

Kinsman Block Signal System Company, New York, exhibiting the Kinsman block system. Represented by Frank E. Kinsman and W. E. Meschenmoser.

The Lunkenheimer Company, Cincinnati, Ohio, is exhibiting valves of various types and other locomotive fittings. Represented by S. S. Moyer, William Schmidt, Jr., and W. M. Hood.

The Spaulding Print Paper Company, Boston, Mass., is exhibiting the Federal electric blue-printing apparatus. Represented by Charles Spaulding.

The Robins Conveying Belt Company, New York, has on exhibition a working model of a sixteen-inch conveyer, showing dischargers, automatic reversible tripper and different angles of working. Represented by A. B. Brool, Jr., E. S. Stadelman and Thomas Robins.

The Sprague Electric Company, New York, has on exhibition the Sprague electric hoist and the Sprague flexible steel-armored hose for steam and compressed air. Represented by A. C. Bakewell, E. H. Watlington and G. C. Conner.

The Standard Paint Company, New York, has on exhibition its "Ruberoid" covering for locomotive house roofing. Represented by Ralph N. Shainwald, J. N. Richards and Paul M. Wade.

The United States Lighting and Heating Company, New York, has on exhibition a four-wheel truck showing in operation its axle-lighting system. This system was inspected by many of the railroad men. Represented by A. S. Adler, H. K. Brooks and Morris Moscowitz.

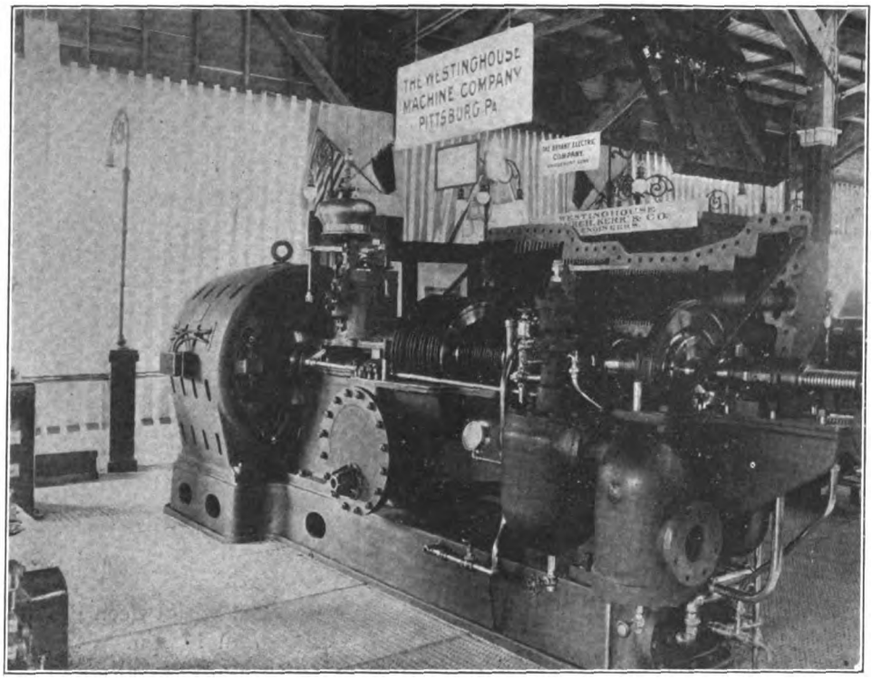
The Westinghouse building at Washington is the largest structure on the grounds, apart from the headquarters building devoted to the grouped displays of the smaller exhibitions. It presents a remarkable combination of Westinghouse products.

The brake and coupler pavilion display includes many operative exhibits. The Westinghouse automatic air and steam coupler is demonstrated by an arrangement of two short car platforms modeled to represent the ends of passengers and freight cars, together with a locomotive pilot, one car platform being so mounted as to permit a variation of four inches in its height and a propulsion at a considerable momentum toward either the pilot on one end or the other car platform on the other, provision being made also for the illustration of successful hose coupling at extreme curves. The model is operated with compressed air and the hose lines are supplied with both air and steam pressure. A miniature model of two complete car trucks and frames fitted with air and steam and signal hose coupling and air cylinders supplement the heavy exhibit, and both are in more or less constant operation. The Westinghouse magnetic brake is shown in operation by an arrangement of a moving track; the Westinghouse friction draught gear is displayed on a testing rack on which it is compressed with an air force of approximately 150,000 pounds, a slow and serial release without recoil demonstrating a feature of prime importance in its operation; and the locomotive driver brakes and the automatic slack adjusters of the American Brake Company; racks hung with valves of various forms shown in sections, and several types of motor-driven and steam air compressors complete the display. The operation of Westinghouse air brakes is completely illustrated in the "instruction car" of the Brake Company on the special track at B and Fourteenth streets, in charge of the company's regular instruction corps.

The most important feature of the electric traction exhibit is a fifty-foot dummy car platform completely equipped with Westinghouse single-phase motors and "straight-air" brakes, and with the West-

Digitized by Google

inghouse unit system of multiple control as designed for alternating-current practice, with induction regulators by means of which a variable operating voltage is



600-Horse-Power, Westinghouse-Parsons Steam Turbine, Open for Inspection, Westinghouse Companies Exhibit, American Railway Appliance Exhibition.

secured to provide a wide range of speed without resistance losses. The motors are of type No. 106, 100 horse-power capacity,

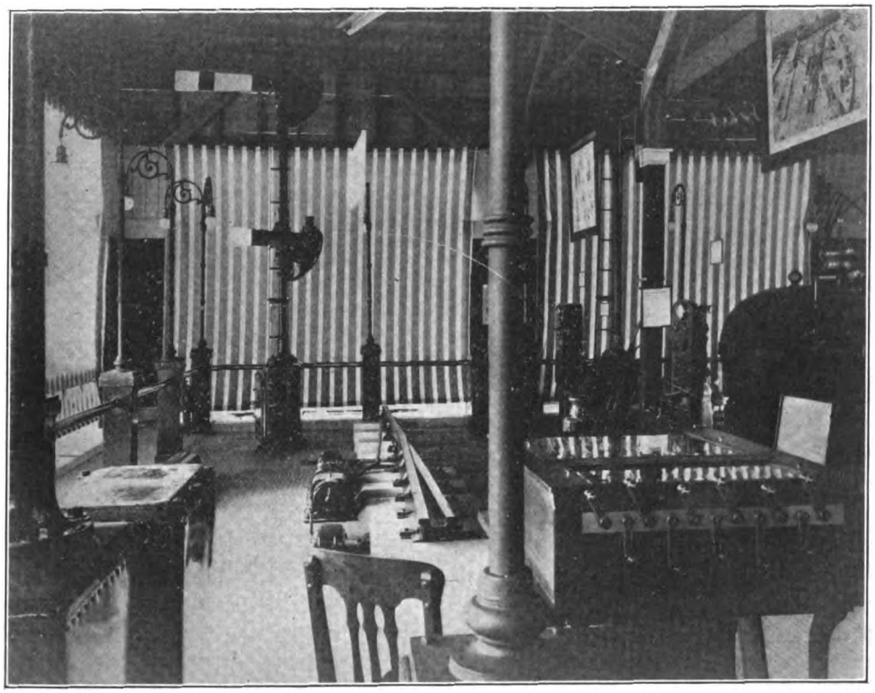
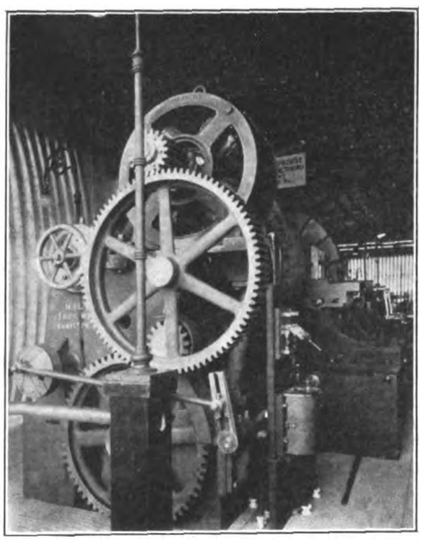


Exhibit of the Union Switch and Signal Company, Westinghouse Companies at the American Railway Appliance Exhibition.

two on each truck, and the master controller and brake operating valve are mounted at each end of the platform as in the motorman's cab, the entire car frame being so raised above elevated tracks as to permit the revolution of the wheels under slight frictional pressure on greased rails to keep the motors under load.

The latest form of Westinghouse multiple control for direct-current practice is demonstrated in the complete car equipment for the operation of a truck driven by two No. 113 motors, each of 200-horse-power capacity, a type embodying slight modifications of motor No. 86 for heavy train service on the Long Island Railroad.

The motor-driven tools on exhibit are all equipped with type S shunt-wound motors, for constant-speed or variable-speed service, and for operation on direct-current circuits at 220 volts. The prominent feature of this display is a large locomotive driving wheel lathe weighing over 100,000 pounds, built at the Ohio works of the Niles-Bement-Pond Company, equipped with a forty-horse-power motor mounted at the top and direct-geared to the revolving and feed mechanism, and with a five-horse-power motor of 1,050 revolutions per minute, for traversing the movable head. The face-plates of the lathe are mortised to receive the crank-pins, thus permitting the "chucking" of the wheels close to the plates, the absolutely rigid hold on the tires under the heaviest cuts greatly facilitating the operation of the machine, which has a capacity of truing six pairs of driving-wheel tires in a ten-hour day. Another Niles machine on exhibit is a double-axle lathe, driven by a twenty-horse-power motor of from 340 to 1,200 revolutions a minute, mounted on an extension to the bed-plate and gear-connected to the mechanism, the machine having a total cutting diameter of twelve and one-half inches. Other tools on exhibit are a Putnam roughing lathe driven by a fifty-horse-power motor of from 500 to 1,000 revolutions a minute; and a Sellers universal tool grinder, driven by a seven and one-half-horse-power motor of 975 revolutions a minute, mounted on a bed-plate extension, and belt-connected to the driving shaft.



Gear Drive of Forty-Horse-Power Motor on Niles Ninety-Inch Locomotive Driver Lathe, Westinghouse Companies Exhibit, American Railway Appliance Exhibition.

Digitized by Google

The National Electric Light Association.

The following programme is announced for the twenty-eighth convention of the National Electric Light Association, to be held at Denver and Colorado Springs from June 5 to 13 inclusive.

Monday, June 5—Arrival of delegates. Reception of local committee. Informal reception with music at headquarters, the Brown Palace Hotel.

Tuesday, June 6—Morning: business session in ordinary of Brown Hotel. Addresses of welcome by Governor Jesse F. McDonald, Mayor Speer, of Denver, and Mayor Hall, of Colorado Springs.

Afternoon: business session. Country Club luncheon for ladies.

Evening: theatre party at Elitch's Gardens.

Wednesday, June 7—Morning: business session.

Afternoon: Broncho-busting contest at D. A. C. Park.

Evening: business session until 10 P. M. At 10.30 P. M. an "athletic" smoker at either the Democratic Club or Coliseum Hall. Party at Orpheum for the ladies (if theatre is open).

Thursday, June 8—Morning: business session.

Afternoon: business session. Street-car rides for the ladies.

Evening: business session. Serenade by the George W. Cook drum corps.

Friday, June 9—Morning: entire party transported to Colorado Springs.

Afternoon: at Colorado Springs—drives to all of the famous scenic points. Visits to the power plants. Trips up Pike's Peak.

Evening: dance and concert at the Broadmoor Casino.

Saturday, June 10—All day; special trains to the Cripple Creek District and return.

Sunday, June 11—All day: trips to the scenic points about Colorado Springs, each delegate taking those he was unable to take on Friday.

Monday and Tuesday will be devoted to excursion parties arranged for those desiring to go over the Moffat Road and the Loop.

The business meetings will be held in the ballroom of the Brown Palace Hotel, beginning the morning of June 6. The business of the convention should be over by the night of June 8. Low rates for the convention have been obtained.

Those arranging to attend the convention and securing railroad tickets reading over the Union Pacific, Burlington or Rock Island systems should have their tickets read to Colorado Springs through Denver, with stop-over at Denver. This arrangement has been agreed to by the roads. On the Santa Fé and Missouri Pacific systems the tickets should read through Colorado Springs to Denver, with stop-over at Colorado Springs returning.

The committee in charge of the convention plans promises a programme of entertainment which will eclipse anything heretofore held. For the entertainment of the womenfolk who attend the convention, the Women's Auxiliary and the members of the Denver Country Club are making extensive preparations.

Arrangements have been made to run a special train of Pullman cars from New York to Denver *via* the Pennsylvania line and Burlington route, leaving New York Saturday, June 3, and arriving at Denver, Monday, June 5. This train will be a duplicate of the Pennsylvania Limited. Electrically lighted parlor, smoker, dining and observation cars will be run *via* Chicago, at which point it will be consolidated with a similar train being made up for the accommodation of western delegates.

The Pennsylvania Railroad has been made the official railroad to be used as far as Chicago, while the C. B. & Q., known as the Burlington route, has been made official and has been given the special train from Chicago to Denver, to operate in conjunction with the Pennsylvania Railroad special, and haul the latter train coupled to its own from Chicago to Denver.

The train will proceed westward through Harrisburg, arriving at Fort Wayne on the morning of June 4. The train will probably reach Chicago the same forenoon. Western passengers to the convention should plan to be in Chicago Sunday morning, June 4. The cost of round-trip tickets and of sleeping-car berths from Chicago to Denver will be as follows: round-trip fare, Chicago to Denver, *via* the Burlington route, $30; lower berth, one way, $6; upper berth, $6; drawing-rooms, $21.

Application for space should be made early, as the lower berths are limited, to Mr. George F. Porter, master of transportation, 136 Liberty street, New York city; or to Mr. Colin Studds, eastern passenger agent Pennsylvania Railroad, 263 Fifth avenue, New York city.

An elaborate programme has been prepared for the business sessions, the following numbers being now in hand:

Wrinkles, H. C. Abell, editor.

Question Box, Homer E. Niesz, editor.

"The Nernst Lamp, Its Present Performance and Commercial Status," by E. R. Roberts.

"Report on Purchased Electric Power in Factories," by E. W. Lloyd, chairman.

"Report on Present Method of Protection from Lightning and Other Static Disturbances," by Alex Dow.

"Some Investigation of Inductive Losses," by E. P. Dillon.

"Insulation Testing Apparatus and Methods," by C. E. Skinner.

"The Choice of an Insulated Cable," by Wallace S. Clark.

"Sign and Decorative Lighting," by LaRue Vredenburgh.

"Automatic Synchronizing of Generators and Rotaries," by Paul MacGahan.

"Series Alternating-Current Motors for Industrial Work," by Clarence Renshaw.

"Long-Distance High-Tension Transmission in California," by John A. Britton.

"Report of the Committee on Progress," by T. Commerford Martin.

Annual Meeting of the American Institute of Electrical Engineers.

The 197th and annual meeting of the American Institute of Electrical Engineers will be held in the chapter room of Carnegie Hall, 154 West Fifty-seventh street, on Tuesday evening, May 16, at 8.15 o'clock. The result of the recent election for officers of the Institute will be announced, and the secretary and treasurer will present their annual reports. The following papers will then be presented and discussed:

1. "Time-Limit Relays," by George F. Chellis, associate, American Institute of Electrical Engineers; Interborough Rapid Transit Company, New York.

2. "The Proper Limit of Duplication to Secure Reliability of Service," by H. W. Buck, member American Institute of Electrical Engineers; Niagara Falls Power Company, Niagara Falls, N. Y.

Dinner of the Indianapolis Telephone Company.

The New Telephone Company, the New Long-Distance Telephone Company and the Indianapolis Telephone Company held a dinner at the German House, Indianapolis, Ind., on Wednesday evening, May 10. The dinner was to celebrate the sixth anniversary of the opening for business of the New Telephone Company and the New Long-Distance Telephone Company.

Digitized by Google

THE MERCURY ARC.[1]

BY E. WEINTRAUB, PH. D.

INTRODUCTION.

This paper contains results of an investigation on the properties and nature of the conductivity of metallic vapors carried out in the research laboratory of the General Electric Company. The investigation was started with the practical purpose in view of using the arc discharge in metallic vapors, and especially mercury vapors, as a source of light. The principal practical problems to be determined at the time the investigation was begun (more than four years ago) were as follows:

1. The starting of the discharge in metallic vapors in an instantaneous and automatic way by the current itself.

2. The determination of conditions under which an alternating voltage can be made to maintain an arc in metallic vapors.

3. Determination of the factors influencing the stability of the arc, with the purpose of constructing a lamp stable under varying external conditions.

4. The production of an arc of the character named which would emit rays belonging to different spectral regions in such proportions as to constitute white light.

None of these problems could be solved on the basis of the knowledge then available, and pure theoretical investigations had to precede any attempt of their solution.

STARTING AN ARC IN METALLIC VAPORS.

The Rôle of the Cathode in the Starting Process—The distinctive feature of the conductivity of gases and metallic vapors, in contradistinction to that of metals and electrolytes, consists in that under ordinary conditions, in absence of exterior ionizing agents, the current itself has to create the material which is to carry it from one electrode to the other. As this material does not exist at the beginning, some special means must be used to start the discharge. Two different ways were used to start the arc discharge. The first one consists in bringing the two electrodes into contact and then separating them. This method is exactly the same as the one used in the carbon arc, the flame arc, etc. The second one is founded on the use of a high-voltage shock.

The new way of starting an arc discharge in mercury vapor that I want to expound here was the outcome of the theoretical conceptions on the mechanism of the arc and the function of the ionization at the cathode surface that I formed in the course of these investigations. According to these conceptions, an arc discharge in metallic vapors is a discharge deriving its carriers, at least in the immediate neighborhood of the cathode, from the material of that cathode. The application of a moderate electromotive force is of itself insufficient to start the process by which these carriers are formed out of the material of the cathode. The new fact discovered was that this formation of carriers (the "ionization" process) is started and the arc discharge made possible if a spark or a small arc is produced at the surface of the cathode.

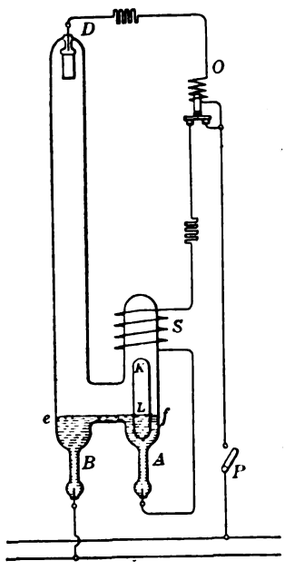


FIG. 1.—ARRANGEMENT FOR SEPARATING ELECTRODES.

For the practical use of this starting method the operations of separating the electrodes and discontinuing the auxiliary arc the moment the main arc is started must be performed automatically by the current itself. One of the arrangements that I have devised is represented in Fig. 1. KL is an iron plunger, S a solenoid and O a magnetic cutout. The solenoid S, in pulling up the plunger KL, produces the auxiliary arc. The current in the main arc flows through the magnetic cutout and automatically opens the circuit of the auxiliary arc.

As a development of the old contact method I have used the following way, which is based on the use of a carbon filament of high resistance which first establishes connections between the anode and cathode, so that on closing the switch the current first flows through the filament. By means of a solenoid and its magnetic action on an iron plunger the filament is lifted and the contact between its lower end and the mercury cathode broken. Exactly as in the case of the old form of contact method the small arc lengthens until the carbon filament is short-circuited by the arc.

Influence of the Conditions Prevailing in the Space between the Electrodes on the Starting Process—The space separating the electrodes has an important influence on the velocity with which the starting takes place, but this influence is mainly of a negative character. The space must present as little hindrance as possible to the flow of ions starting from the cathode surface. Accordingly, the degree of vacuum must be the highest obtainable, and the more careful the exhaustion the more instantaneous is the starting. If foreign gases or inert ordinary mercury vapor is present, the starting is slow. The ionized vapor is seen to rise from the surface of the cathode and slowly move along the tube, impeded in its course not only by the gases present in the tube, but also by the mercury vapor which volatilizes from the heated surface of the mercury cathode. When the vapor reaches the anode the arc will eventually start, but if the pressure of the foreign gases is high enough the arc does not establish itself at all. Although it is relatively easy to produce the high vacuum necessary for the instantaneous starting, it is not easy to drive out completely the gases absorbed on the walls of the tube and in the anode material. The vacuum in the lamps is liable, in some cases, to get worse with use, and some means had to be provided which would render the starting of the arc instantaneous, even with a somewhat impaired vacuum pressure of foreign gases above 0.01 millimetre. As inert mercury vapor also hinders the propagation of the ionized vapor, even perfectly exhausted lamps start harder when hot than when cold. I found that the propagation of ions and the starting of the arc are facilitated if a carbon filament of high resistance is suspended from the anode in such a way that its lower end is distant but a few inches from the mercury surface. When the ionic stream reaches the lower end of the filament a small current is established which helps the starting of the main arc.

Function of the Anode in the Starting Process—In contradistinction to the cathode the anode plays no rôle whatever in the starting process. It receives the carriers of the current without any previous excitation.

CONDITIONS OF STABILITY OF THE ARC.

The Influence of the Conditions at the Cathode Surface—In the study of the

[1] Abstract of a paper read at the seventh general meeting of the American Electrochemical Society, Boston, Mass., April 25, 26, 27, 1905

Digitized by Google

conditions of the mercury arc one meets with a phenomenon which is being observed in all arcs, *i. e.*, the existence at each impressed voltage of a lower limit of current, below which the arc is not stable and extinguishes. The experiments performed on the mercury arc led me to the conclusion that the physical cause of it is in the conditions prevailing at the very surface of the cathode. Under ordinary circumstances there is a bright spot on the surface of the mercury cathode, which spot is continually wandering about on that surface. The wandering of this spot has not found as yet any very satisfactory explanation. The spot is, according to the conceptions expounded here, the place where the production of ions takes place, and the continuous motion of that spot means a disturbance of the ionization process and a danger to the existence of the arc. The wandering of the spot can be avoided in two different ways: either by making the surface of the cathode small, of the same magnitude as that of the spot, or by having a wire of iron or platinum project above the surface of the mercury. In this latter case the cathode spot is centered on the mercury surface right around the metallic wire. In order to limit the surface of the cathode, without changing anything else in the tube, narrow tubes of refractory material, such as silica or porcelain, are fastened inside of the mercury cathode. The arc is started by means of a carbon filament which dips into that small tube. The filament is lifted by the passage of the current, the current broken and the little spark produced inside of the narrow tube. The rest of the mercury surface outside of the small tube is then inert and does not carry any current. This is, by the way, an experiment showing strikingly that the arc has its root in the cathode spot.

Both methods lead to the same result, the lowering of the minimum current at which the arc subsists. With 120 volts applied and about eighty volts consumed by the arc, the low limit of current is normally at about three amperes. When the cathode surface is made very small this limit decreases to 1.5 amperes, and with a platinum wire it becomes as low as one ampere. These values can be made much smaller if reactance is placed in the circuit or if the impressed voltage is higher.

Influence of the Conditions Prevailing in the Space between the Electrodes on the Stability of the Arc—The conductivity of the arc depends on the relative amounts of ionized and inert mercury vapor. If a sufficient condensing space is provided, so that the pressure of the ordinary mercury vapor volatilized from the cathode is kept down to a certain value, the conductivity of the arc is almost exactly proportional to the current. (The current creates its own ions: Ohm's law is applicable.) The voltage across the arc is accordingly almost independent of the current. If, however, sufficient condensing space is not provided the amount of inert mercury vapor rises continually, and

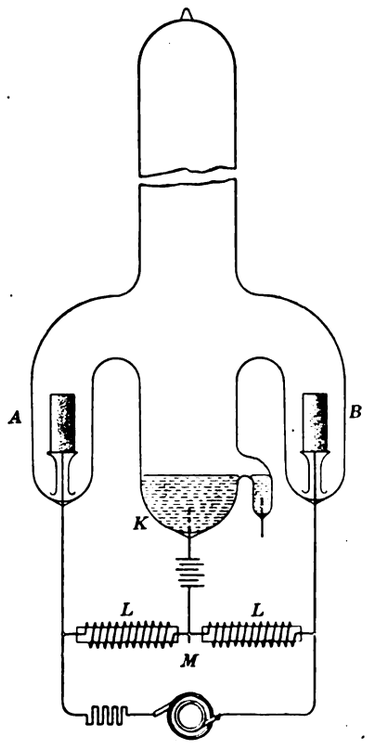


FIG. 2.—ARRANGEMENT FOR CAUSING TWO HALVES OF CURRENT WAVE TO PASS THROUGH ARC.

with it the resistance of and voltage across the arc, until finally, when the voltage across the arc comes too near to the impressed voltage, the arc goes out. Foreign gases present in the tube have influence similar to, and even more pronounced than that of mercury vapor.

The statements above give a complete description of the influence of the conditions prevailing in the arc itself on its stability. They have no noticeable effect on the value of the lower limit of current.

Influence of the Conditions at the Anode—The conditions prevailing at the surface of the anode have no appreciable effect on the stability of the arc. If the anode is made of mercury, great amounts of mercury vaporize because of the heat generated at the anode. This increases the amount of mercury vapor in the arc, and thus indirectly changes the conditions of stability of the latter. This is obviously a secondary effect; otherwise, the anode has just as little effect on the stability of the arc as it has on the starting process.

THE ALTERNATING-CURRENT ARC IN METALLIC VAPORS.

We have seen in the preceding chapters that the ionization process at the cathode must be initiated if an arc discharge in metallic vapors is to be established, and that this ionization process must be kept up by the supply of a certain amount of energy if the arc is to maintain itself. It is in these facts that lies the explanation of the difficulty that previous investigators have found in maintaining an alternating-current arc through metallic vapors. With every change of polarity the ionization process at the cathode dies out and moderate electromotive forces are insufficient to start that process by themselves on the surface of the other electrode when the latter becomes of negative sign. It is therefore obvious that if an alternating electromotive force of moderate value is to maintain an arc in metallic vapors, one metallic electrode must permanently keep its negative sign, notwithstanding the perpetual change of polarity. This, if realized, would mean a unidirectional flow of current in the arc, and consequently rectification of the alternating current.

Of all the devices used by me I mention but two. In both of them the tube contains three electrodes, one of mercury, the others of graphite, iron or mercury. The one electrode of mercury serves as the cathode, the two others, which we will suppose to be made of graphite, serve as anodes of the rectified arcs. In the first arrangement a transformer is used, the ends of the secondary of which are connected to the two graphite anodes. A wire taken out from the middle of the secondary is connected to the cathode. The current derived is pulsating, and if the rectified voltage or current is low, usually a small direct-current arc, springing from the same cathode, is necessary to keep the cathode alive during the zero point of the current. If a constant-current transformer is used this direct-current arc can be dispensed with.

In the second method the alternating voltage is directly applied to the two graphite electrodes and two reactance coils are connected in the way shown in Fig. 2. As in the first arrangement, two arcs are playing in the tube, both having the same cathode. The reactances store up

Digitized by Google

energy, while the current flowing in them increases and discharges through the arc in such a direction as to keep the cathode K alive. By means of arrangements of this kind I succeeded in rectifying voltages up to 15,000, giving direct-current voltage as high as 6,000 to 7,000 volts. This last arrangement may become of importance, even for laboratory use, when unidirectional high voltage is desired.

ARC DISCHARGE IN VAPORS OF ALKALI METALS.

With the purpose of adding red lines to the spectrum of the mercury arc I investigated the arc discharge in vapors of other more or less volatile metals. Alkali metals proved especially suitable. The experiments showed that the regularities found during the study of the discharge in mercury vapors hold good for all other metallic vapors. The cathode phenomena, the bright cathode spot, the behavior toward alternating voltage are exactly the same. Accordingly, all of the experimental facts established for mercury vapor hold good for the discharge in metallic vapors in general.

ON THE MECHANISM OF THE IONIZATION PROCESS AT THE CATHODE.

An insight into the mechanism of these processes would give us a basis to the theory of the arc discharge, and of the conductivity of gases in general. The first question I tried to answer by experiments was, whether the ionization process at the cathode is accompanied by an actual transfer of matter or not. To simplify conditions a graphite anode was used in all the experiments. In this case the mercury distills over in great quantities from the cathode into the condensing space surrounding the anode. This mercury is, however, in the greatest part produced by mere volatilization of the cathode. If the mercury cathode is cooled artificially, so that the heat generated is conducted rapidly away, the amount of the condensed mercury diminishes considerably, and if the wandering of the cathode spot is avoided by the projecting wire method this amount is still further diminished. The amount of mercury that condenses under these conditions in the condensing chamber surrounding the anode is very small and constitutes but a small part of the amount required by Faraday's law. The largest part of it is, however, still due to mere volatilization which can not be completely avoided.

An attempt was made to get quantitative data by using mercury arcs with cathodes made of less volatile material than mercury. If a piece of graphite or any other conducting material that does not combine with mercury, and a mercury cup, both enclosed in an exhausted tube, are connected to respectively the negative and positive pole of a source of an electromotive force, the electrodes brought into electrical contact and separated, an arc is formed with the solid electrode as cathode. The behavior of these solid cathodes is the same as that of the mercury cathode. A bright spot is wandering on the surface of the solid piece and wherever that spot strikes the cathode disintegration of its material takes place. This disintegration is characteristic of the cathode of a metallic arc in an exhausted space. If a piece of charcoal is used as a cathode the motion of the cathode spot leaves fine lines and grooves burned, so to say, into the material. The loss of weight of these solid cathodes is usually very small. The largest part of it is, however, due to the mechanical disintegration of the material which accompanies the electrical one, which circumstance deprives the result of theoretical significance. We can, therefore, conclude from these experiments that a transfer of matter either does not take place at all, or is so small as to be of the order of magnitude that would be required by the value of the electronic mass accepted in the modern theories.

The second question of special interest in connection with the theory of the arc refers to the cause of the ionization process at the cathode. The formation of current-bearing particles does not in all probability take place at all in the arc itself. The potential drop in the arc and that at the cathode surface (about five volts) are so small that productions of ions by collision seem to be excluded. As the anode plays no appreciable rôle during the starting and the running of the arc we are led to the conclusion that in an arc through metallic vapors in an exhausted space the cathode is the only place where the current-bearing material is formed.

The assumption that the cathode is one of the places where ionization takes place has been made by many previous investigators. In view of the fact that solid bodies heated to a high temperature are known to render gases conductive (effect that I observed myself in the case of mercury vapor), the ionization process at the cathode was attributed by some of the investigators to the high temperature prevailing at the cathode. The experience that I have had on arcs in metallic vapors, and special experiments made to elucidate this point, do not support this view. The boiling point of mercury being low, it is necessary, of course, to limit the supposed area of high temperature to the cathode spot itself.

The facts that speak against this assumption are as follows: first, as mentioned above, the cathode spot moves rapidly along the surface of the cathode. If high temperature were a necessary condition of the ionization process the cathode spot would not be expected to move constantly away from the exceedingly hot part to the cold part of the surface. Second, if a spot is fixed by means of a platinum wire no evidence of a high temperature in that spot can be found. The faint light emitted by the spot surrounding the wire reminds one, especially when the current is not very high, rather of a phosphorescent light than of light produced by high temperature. Third, efficient cooling of the cathode does not produce any change, either in the cathode spot or in the arc. Fourth, if solid cathodes, such as graphite, iron, platinum, etc., are used, the cathode spot on the surface, to judge by its color, has not a very high temperature, so that the rapid disintegration is not due to volatilization by heat, but rather to purely electrical causes. If, by an auxiliary current, the solid cathode is heated up in such a way that one part of it, by reason of its higher resistance, is brought to a very high temperature, the cathode spot wanders about the surface of the cathode without showing any preference for the hot spot, which would be expected if high temperature were the cause of ionization.

Fifth: in the case of an "arcing" rectifier, where we have to deal with the formation of the cathode spot, temperature of the solid electrodes plays but an unimportant rôle. The electrodes may be very hot while surrounded by ionized vapor without causing arcing. This is very significant if compared with the relative ease with which at first sight seemingly unimportant factors produce arcing. If, for instance, the electrodes are of mercury, a drop of mercury hitting the surface, or any other mechanical disturbance, is liable to produce a cathode at the point where impact takes place. These and a number of other facts, for which I have not space here, led me to the conclusion that the temperature of the cathode is not the cause of ionization in the case of metallic arcs in an exhausted space. The temperature of the cathode is probably in some way connected with the boiling point of its material and is a result of the ionization process rather than the cause of it. The

Digitized by Google

facts quoted above are not, of course, intended to disprove the influence of high temperature on ionization, which is too well proven in other cases. In arcs in metallic vapors considered here, the temperature of the cathode does not seem to be the ionizing agent.

The time has not yet come to give a complete theory of the arc. In working for years with the mercury arc I had, however, to make for my own use some working hypothesis, and as this hypothesis seems to agree with all the facts that I have observed and was helpful to me in the course of my investigation, I will outline it here briefly, without, however, trying to give in detail its justification, as this would require an article for itself. In some points, this hypothesis agrees with the views of previous investigators, in some others it differs.

Starting from the hypothesis developed by a number of modern scientists, according to which the conduction in metals is due mostly to the negative electrons, and from the postulate that the mechanism of conduction in different states of matter must have the same general characteristics, I assume that the mechanism of the conduction in the arc is similar to that in metals and that an arc is, electrically considered, in the main a flow of negative electrons directed from the cathode toward the anode. While in the metal the number of electrons is a given quantity and the conductivity accordingly constant, the number of electrons crossing the surface of the cathode and entering into the arc must be proportional to the current. Accordingly, the conductivity of the arc is proportional to the current. The process of starting an arc serves to initiate the process by which the electrons are driven out from the metal into the space. The starting is probably reduced by purely electrical causes. If this process, by means of which the negative electrons are projected out of the metallic mass is started, it goes on of itself so long as a sufficient amount of energy is applied. The disintegration of the cathode is a mechanical accompaniment of this electrical process.

The light emitted by the arc is not due directly to the radiation of the electrons. These negative electrons are probably the same in all arcs, and the light emitted changes according to the molecular material through which these electrons move.

The quarterly report of the National Board of Fire Underwriters shows 134 fires due to electricity with a loss of $855,000. Losses of $1,482,000, due to 193 other fires are reported, whose origin was believed to be due to electricity, but where the fire destroyed proof of the origin.

THE TELEPHONE SYSTEM OF TO-DAY.[1]

BY C. J. H. WOODBURY.

The telephone differs from all other electrical devices in that it is the only electrical appliance which does not require skill on the part of its users. It is equally the servant of all, a polyglot, it speaks all languages and acts as a faithful messenger for the whole gamut of sounds.

ADMINISTRATION OF THE TELEPHONE SYSTEM.

The telephone would have remained a piece of physical apparatus, an example of the correlation of forces, an instrument to aid in the study of sound, and a wonder to all had it not been for the production of the switchboard, and particularly of the Blake transmitter, which saved the situation in the development of the telephone system.

It was indeed fortunate for the world's work that the organization of the telephone system from its inception was in the hands of leaders equal to the task of concentrating the labors of many persons upon the sole purpose of furnishing practical operative conditions for the transmission of speech as a public service enterprise.

Its first president, Colonel William H. Forbes, was endowed with wisdom to plan and vigor to execute these duties, in the spirit of imagination to foresee future possibilities, combined with a knowledge of present events which he shaped to existing conditions.

To John E. Hudson, an eminent member of the bar, were largely due the measures which established the system in its strong legal position, and to him also is due in large measure its development as a great national enterprise.

The present executive of the American Telephone and Telegraph Company, Frederick P. Fish, was for many years its counsel in the complex causes of patent litigation, and it has been under his administration that the recent growth of the telephone system has surpassed that of earlier years.

The work of these men has been executed by faithful lieutenants from the greatest unto the least in this army of seventy-five thousand unseen toilers.

THE TELEPHONE CIRCUIT.

Before tracing the operation of the events set in action by the removal of the telephone from the hook, let us follow the lines from the instrument to the switchboard in the latest type of the telephone system.

[1] Abstract of a paper read before the Brooklyn Institute of Arts and Sciences, Polytechnic Institute, Brooklyn, Friday, April 28, 1905.

TELEPHONE LINES.

Following the course of the lines from the subscriber's instrument, the aerial wires are of copper which has been treated by the hard-drawn process, as commercial copper is too ductile and has but little of the elastic property of resilience by returning to its original length when stretched by a load of snow or by a low temperature.

Hard-drawn copper might be classed as one of the modern inventions which the ancients stole if the accounts of early implements may be accepted, but investigations showing that bronze had been supposed to be copper have absolved these people of anticipating the work of Mr. Thomas B. Doolittle, who produced hard-drawn copper by omitting the annealing during the latter part of the process, and obtained copper wire which retains the electrical conductivity of commercial copper, while its tensile strength is doubled, and it is divested of the tendency to continually stretch under its own weight.

The substitution of hard-drawn copper wire for iron wire formerly in use has increased the limit of telephone conversation under other equal conditions about four times, and by its better conductivity has diminished the waste of electricity used in telegraphy or electric lighting and transmission of power, or, what has been more important, has extended the limits of its application.

For local use, these wires are generally one-tenth of an inch in diameter, and for long-distance lines, larger wires about one-sixth of an inch diameter are used.

The contact of these wires with those of other electrical circuits used for lighting or for power to which reference has been made is not the only difficulty, for the mere proximity of other wires conducting these powerful currents will, if they are of changing polarity, produce sympathetic currents by induction in the telephone wires, and acting on the telephone are the occasion of various noises which at times interfere with the transmission of speech through the telephone, furnishing examples of wireless telephony which are impediments to the usual service.

This interference by induction is minimized by transposing the telephone wires to various positions on the cross-arms, so that the result will be neutralized by imposing such conditions of position that

Digitized by Google

these disturbing elements will counteract each other.

The wires of underground cables are laid in twisted pairs so that they are immune to inductive influences.

An aerial line is subject to the attack of all manner of disintegrating conditions; poles decay and break, branches fall from trees and wreck the wires.

It is as unfeasible to make a pole line equal to stress of weather beyond peradventure as it is to make the rigging of a vessel equal to the impact of all storms, for when a sleet-storm builds the wires to icy lines, three inches in diameter, sail is set for the gale to sway the lines until the poles are broken.

During a recent winter, the destruction of aerial telephone, telegraph, and electric light lines in the New England states was estimated to be greater than the loss by shipwreck on the New England coast.

This breaking of lines has been prevented on local wires whenever it has been feasible to substitute aerial cables, each containing a number of wires, in place of the open wiring, but for long-distance and toll wires it has been necessary for electrical reasons to retain open wires.

The gales on the summit of the Rocky mountain passes are so severe that neither poles nor lines will withstand the stress of winter weather, although lines have been built with poles set only fifteen feet apart, yet the sleet builds them up to large dimensions which yield upon the impact of winter gales.

Communication, however, is permanently carried on along these routes by means of submarine armored cables which have been buried in trenches excavated among the rocks.

In addition to the facilities for concentrating forces for immediate repair in case of wreck, the lines are inspected by a patrol to give forewarning of imminent breakage.

These men brave the wilderness and face the elements through sun and through storm, the miasma of southern swamps to the rocky fastnesses of western ranges, in the rigors of heat and of cold, all in order to give every assurance of human power that the response will be made when the telephone is taken from the hook.

Difficulties with aerial wires are by no means confined to those occurring under the severe conditions of northern winters, for each country appears to have troubles of its own.

When telephone lines were first built in Mexico, it was naturally assumed that the absence of severe weather conditions would warrant the use of lighter wires and small porcelain insulators, but these lines proved of great interest to parrots and ring-tail monkeys which made nightly visits to the lines in such great numbers for gymnastic practice as to break the wires; and it became necessary to use as strong construction as in northern climates.

In forest districts, wooden poles are occasionally gnawed down by bears which hear the humming of the wires and vainly seek to break in to some hive of bees.

UNDERGROUND WIRES.

The aerial lines pass from the poles into underground conduits in the congested part of cities, flying from the mishaps of storms and crosses to other difficulties which are largely those of greater expenditure and electrical problems.

The underground system is older than the aerial system of electric conductors in applied electricity, for a portion of Morse's invention of the telegraph consisted in methods of burying the wires, but the first seven miles from Baltimore laid underground in lead pipes placed in a plow furrow proved inoperative.

The underground conduits usually consist of groups of continuous ducts, generally three inches in diameter, and made either of vitrified tile, cement monoliths reenforced with iron, or creosoted timber.

Every few hundred feet these conduits lead to an underground chamber for the purpose of obtaining access to the cable to provide for branches to the service of patrons, and also joining the ends of sections of the cables together.

These underground cables consist of from two to six hundred twisted pairs of wires insulated with paper and the whole covered with a lead sheath.

The electrical difficulties of telephoning through underground conductors were at first prohibitive in their nature, but improvements enabled this to be done later, but in the face of conditions which rendered one mile of underground the equivalent of fifty-two miles of overhead wire; but in the modern cable one mile of underground is the equivalent of twenty-eight miles of overhead copper wire one-sixth of an inch diameter, or twelve and a half miles of overhead copper wire one-tenth of an inch diameter.

These conditions are so severe that on long lines it is necessary to pass around intermediate cities to avoid underground wires, and in the suburbs of large cities are switching stations by which connections may be provided to enable patrons to send their messages by branch lines direct into the cities, or permitted to continue on the main line to places beyond.

Conditions of safety and good service require that a telephone underground system should not also include lines of electric lighting and power circuits, and serious mishaps have occurred in the few instances where the attempt has been made to place these diverse types of electric circuits adjacent to each other in the same underground system.

The rapid corrosion of the lead sheaths or underground cables, even in localities where lead pipes had laid uninjured for many years, was an unexpected occurrence of the most serious nature; and it remained for the late I. H. Farnham, of the New England Telephone and Telegraph Company, to discover in August, 1891, that this impairment was caused by the return currents of the grounded circuits of the trolley railroad systems, whose passage through the earth, from the cars where they left the motors to the ground plates under the generators at the central power stations, produced chemical effects similar in principle to those of electroplating, by which metal was removed from the underground telephone cables, gas and water mains, and deposited beneath the rails.

At the instance of Mr. F. S. Pearson, chief engineer of the West End Street Railway, in November, 1892, the currents used in trolley railroad practice were reversed in polarity from the customary method prevailing at the time, so that the trolley wire would be positive to the earth, and the return currents would tend to build up material on all continuous metallic underground construction until near to the central electric power station, where the electricity leaves such conductors for the ground plates under the generators operating the trolley system, and would therefore produce more active impairment by the removal at this point, were it not for large copper rods connecting these underground pipes and cables to the ground plates.

This course reduced the difficulty in the measure that it was capable of being carried out in practice, for electricity follows divided lines in proportion to their relative conductivity, and a certain amount will follow along the underground conductors until it reaches a direct path of electrical conductivity leading to the ground plates.

This treatment of the problem appears to have been more satisfactory with continuous underground conductors, such as electric cables, than it is with underground

Digitized by Google

pipes having joints of different electrochemical equivalencies.

The divergence of the return currents from the rails has been reduced by bonding the rails together with copper rods, or by casting iron around the ends of the rails, and also the use of heavier rails.

OFFICE DISTRIBUTION OF WIRES.

The terminals of the underground cable at the telephone central station emerge from their lead sheaths and are spread out upon a large iron rack known as a distributing frame, where the insulated wires are equipped with protectors for the same purpose as those at the subscriber's instrument, and the wires are changed from the order in which they are received from the cable to another classification, and thence to a similar rack called the intermediate frame where the wires are grouped to the individual operators, which latter arrangement may be changed from time to time, as the number of telephones to which an operator can give attention varies according to the character of the service.

THE SWITCHBOARD.

The function of the switchboard is merely to place the ends of the wires from one telephone in electrical contact with those of any other telephone in the exchange, with suitable signals for calling the operator and the party addressed, and this system has been amplified until one human voice can reach to districts including considerably more than half of the population of the United States, and the interlacing has been so complete that its service reaches the smaller villages.

In the new switchboards the dropping shutter has been supplanted by a flash of a lamp to signal the operator; the turning of a crank to generate a current for moving a shutter is no longer necessary, and the subscriber removes the telephone from the hook and is ready to begin; galvanic batteries are not installed at the subscriber's equipment, but the whole of the electric energy is supplied by storage batteries at the telephone central station.

When a call for a telephone connected to some other switchboard is received, as the operator can not reach a line directly to the desired telephone, the call is transmitted by an office line to a special operator at another switchboard, where it is noted on a memorandum blank, and the time automatically recorded by means of a clock-registering stamp; then the call is transmitted by trunk lines to the desired telephone central station, or it may be to some station which can reach the desired subscriber, and in some instances it is necessary to transmit the message through a greater number of telephone offices, each one building up the line by additions, and every operator also keeping, by means of the time stamp on memorandum blanks, a record of the hour and minute of each step from the initial call to the final termination of the conversation and the release of the lines.

As soon as an operator has finished the entries on a memorandum blank it is placed in a small orifice, where it is carried by air pressure, through tubes in the manner similar to the well-known cash carriers, to another department where it is compared with similar memoranda made on the same conversation at other points on the line by clerks, and these form the authority for the charge for the toll service.

These memorandum blanks are compared by clerks, and must balance as in other bookkeeping, and form the authority for the charge for the service.

In some instances, where there is a great load of service on long-distance lines, the communication from one central station to another by the operators for the purpose of obtaining the desired party at the telephone is carried on by telegraphing over the telephone lines; for there are methods by which this can be done without interfering with the transmission of conversation at the same time on the identical wires, and these lines branch near to their terminals where each class of electrical currents is transmitted to its proper instrument, whether of the telegraph or the telephone system.

A telephone switchboard is an exception to general forms of construction in that the cost per unit increases at a greater rate than the enlargement, and this is due to the fact that, as the operator who receives a call from a subscriber must be able to reach the terminals leading from the switchboard to any other telephone or to the switchboards at other stations, and therefore, each set of telephone wires must have as many sockets and branches as there are operators' sections at the switchboard.

For example, in a small switchboard with two operators' sections, there would be two sets of such branches and sockets for each telephone line, while in a large switchboard with fifty operators' sections, there would be fifty sets of such connections for each telephone line instead of the two sets mentioned in the first instance, the number of this class of connections multiplying twenty-five times for each telephone, in order to enable each operator to reach all subscribers connected to that switchboard.

This difference in cost may be appreciated by reference to the material entering into the composition of a switchboard for 10,000 telephones and one for 600 telephones, the individual items in each being alike and of the same cost.

In the larger switchboard there are 2,500,000 soldered connections, or 250 to each telephone; and in the smaller switchboard there are 43,000 soldered connections, or about seventy-two to each telephone.

In the larger switchboard there are 10,000 miles of wire, or one mile to each telephone; while in the smaller switchboard, there are 220 miles of wire, or about one-third of a mile to each telephone.

There is an exaggerated opinion of the damageability of a switchboard by water, and while it is perfectly true that it must be thoroughly dry for practical operation, yet switchboards have been thoroughly wet and restored to good service by drying out. It is the general custom to provide waterproof covers for switchboards as well as for generators and motors whenever it is considered that there is any hazard of a water damage from fires in other parts of the building which might cause an interruption in the service.

The charge for maintenance is far greater than that of the operation of the telephone system, being the greatest single expense. One-third of the gross revenue of a telephone company is necessary to preserve the plant in good order without any reference to the cost of extensions or of operation.

THE VARIABLE USE OF TELEPHONES.

The grouping of the use of the telephone may well serve as the basis of a sociological study of the habits and customs of a community, but for studying the conditions of service for which provision must be made, the number of communications each hour of the whole day is taken from time to time, and the result plotted in a diagram whose hills and valleys indicate the relative load of service on the system.

Whatever disturbs travel also affects telephony, as may be noted by the increase in the number of calls, even to full capacity, during storms or in extremely hot weather.

In all cases, the night use between 7 P. M. and 7 A. M. is a small proportion of day use, and while these calls are largely of the important nature of emergency calls for fire department, physician, or police, yet in number they are slightly

Digitized by Google

over one per cent of the calls of the whole twenty-four hours; but the calls during the day begin to increase suddenly at some hour in the forenoon after the morning mail has received attention, and approach the congestion limit in the middle of the day, falling off suddenly as offices are being closed, and resuming activity in the larger cities late in the afternoon when arrangements for dinner or theatre are being made.

THE EXTENT OF ITS INTRODUCTION.

The total amount of telephone line of the Bell system throughout the United States averages three and twenty-nine hundredths miles for each telephone instrument, and, excluding the long-distance lines, fifty-five per cent of the wire is underground.

When a person calls up another telephone, the average line plant at his disposal is six and fifty-eight hundredths miles; truly "it is cheaper to talk than to travel."

The long-distance wires interlace the whole system into a unity from the Atlantic to the western side of the Mississippi valley where the short gap of 140 miles which now exists will be closed in the immediate future to connect with the similar system of lines binding together the various cities of the Pacific slope.

This growth of the lines of the system is the result of a purpose to extend the use of the telephone to every town, no matter how small, throughout the United States; and in all of the cities and towns to put a telephone, at the most reasonable rates, "within easy and immediate reach of every person whose income is sufficient to permit him to ride on street cars."

The extent to which this policy has been put into actual construction is indicated by the fact that, while the last census gives a record of 10,602 incorporated cities, towns, villages, and boroughs in the United States, there is telephone communication to 26,128 different settlements, and the continued growth of extensions postpones, year by year, the saturation point of telephone service which has been recurrently anticipated by conservative persons.

THE OPERATION.

The telephone business in its complications on one hand, and its close relations with the needs of its patrons on the other, is one requiring active zeal.

Under American conditions the equipment of the plant and its attendance must be adequate to give practically instantaneous service at all times, even though the demands at night are but slight in comparison to the requirements of the day.

Reference is frequently made to the low cost of telephone service in European countries, but it should be remembered that it is furnished under lower wages and material conditions far different from those of this country.

The government owns the buildings, and the department does not pay taxes, rent, or maintenance; the army engineer corps builds the subway as a government charge; and the pole lines are built by another department without any charge to the telephone system for material or right of eminent domain.

The demands of American patronage require that the plant and attendance should be adequate to provide prompt responsive service; but in these countries there are so few toll lines that requests for long-distance service are received in the order of their application, and the patron must wait—be it minutes or hours—until a line is at liberty.

The striking feature of the two great applications of electricity which are used by the public, namely, the street car and the telephone system, is that, however complex their mechanism, their use is extremely simple.

It has been a matter of slow growth for the subscribers at large to use the telephone in the best and simplest manner, and that is to speak clearly rather than loud, and to avoid the use of merely formal words in calling for the number wanted.

Nothing reveals more prominently the innate courtesy of a person than the manner of address over the telephone, whether to operator or subscriber.

Operators are prepared by a short course in a special training school which differs from other institutions of learning, except West Point and Annapolis, in that they are under pay during the period of tuition.

The result of such systematic work in connection with improved apparatus in New York, which is cited as an example, because the exact statistics are at hand, has reduced the time of making complete local connections during the last five years three and nine-tenths seconds, which may appear a short time to any one, except when waiting at a telephone, but this small amount of time, when applied to all the telephone connections of the Bell system in the United States, amounts to 10,098 hours a day saved to the subscribers' time, or about three and nine-tenths years in eight-hour days. The saving of time in disconnections, largely owing to the common battery switchboard signaling the operator by lights rather than shutters, enables the lines to be released when a conversation is at an end, three and two-third times as rapidly as formerly, and this is of great advantage to the subscriber in making repeated calls.

These improvements in calling save 1,400 years of subscribers' time every year, and over three times as much time in disconnecting, a part of which time is available for the benefit of the subscriber, but no one has ever ventured to estimate the gross amount of time saved by the use of the telephone.

The vast system provides for over 10,000,000 calls per day, or nearly 2,500 calls a year originating at each telephone, and this means that an equal number of calls are received on the average telephone, so that each telephone averages being in use 5,000 times a year.

The interruption to service has been reduced to a very slight matter, and this is generally owing to an enlargement of the plant, where the changes are made at night. In New York the interruption to each substation from all causes is one hour and twenty-one minutes a year, generally without the subscriber's knowledge, as is shown by the fact that the complaints are only one to 15,138 lines per day, or once in forty-one years per telephone.

LONG-DISTANCE TELEPHONY.

The toll line service began with the line built from Boston to Lowell in 1879, and this revealed both the functional possibilities of the telephone and the great many technical difficulties which have been overcome. In the space of twenty-five years the length of long-distance telephone lines has increased from 27 to 275,000 miles. But these lines are not to be considered as comprising all of the lines outside of any municipality, as they can be attached to lines about 4,000,000 miles in length and radiating at these points, reach to the desired subscriber.

The long-distance commercial service may be considered to date from the New York and Chicago line which was opened on October 18, 1892, by Dr. Alexander Graham Bell in the presence of a concourse of persons eminent in electrical affairs, and on February 7, 1893, Governor William E. Russell and a body of prominent Boston men opened the line from Boston to Chicago.

In short, its applications are becoming more extended as the emergency of yesterday becomes the precedent of to-day.

TELEPHONE RATES.

The fundamental unit of the cost of telephone service is based upon the use of

Digitized by Google

the instrument or the number of the calls rather than the instrument itself as a basis, and the results of improvements in apparatus and methods of administration are continually diminishing the cost of telephone rentals.

The increase during the year 1904 amounted to 701,047 telephones and 712,147 miles of line wire, which, with its attendant construction, cost $33,436,700, being an increment of twenty per cent, which brought the whole number to 4,480,564 telephones, requiring 4,671,038 miles of line wire to reach their patrons.

This work is requiring extensive investment of capital to make these extensions and to build the plant in such a permanent manner as to give assurance of the continuity of this valuable service, and it is of the most favorable significance that this aspect of the system is being so thoroughly accepted by the patrons, who appreciate that its affairs must be conducted on a basis which will assure good and permanent service, and that it is essential that the service must be paid for at a price which will continue its quality and maintain the plant, giving a reasonable profit which will not only conserve present enterprises, but also attract additional capital as it may be needed for future growth of the business.

BOOK REVIEWS.

"The Pocketbook of Refrigeration and Ice-Making." Fourth edition. A. J. Wallis-Tayler. New York. The Norman W. Henley Publishing Company. Cloth. 184 pages. 5 by 7 inches. 31 diagrams. Supplied by the ELECTRICAL REVIEW at $1.50.

This book has been published with a view of meeting the demand for a handy pocketbook which should contain, in an accessible form, such formulæ, data, tables and memoranda as are constantly required by persons engaged or interested in the industries connected with refrigeration and cold storage. The book covers the subjects of refrigeration, cold storage, ice-making and the storage of ice, insulation, the testing and management of refrigerating machinery, general tables and memoranda, and other topics of allied interest.

"The Berlin-Zossen Electric Railway Tests of 1903." Translated from the German by Franz Welz, with an introduction discussing the general subject of train resistance by Dr. Louis Bell. New York. McGraw Publishing Company. Cloth. 100 pages. 8 by 11½ inches. 18 illustrations, and 38 full-page diagrams, curves and plates. Supplied by the ELECTRICAL REVIEW at $3.

With the general results of the noteworthy Berlin-Zossen high-speed railway tests most engineers are familiar. It is, however, convenient to have the complete report of these tests published in book form. In addition to the valuable information contained in this report, the introduction by Dr. Louis Bell, on the general subject of train resistance, is an interesting discussion of the addition to our knowledge of train resistance made by these tests. In an appendix is an abstract from the reports of the Allgemeine Elektricitäts Gesellschaft and the Siemens & Halske Aktiengesellschaft, concerning the proposed high-speed electric railway between Berlin and Hamburg.

"The Telegraphist's Guide to the Departmental and City and Guilds Examinations in Telegraphy." Fifth edition. James Bell and S. Wilson. London. S. Rentell & Company, Limited. Flexible cloth. 227 pages. 5 by 7¼ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at 75 cents.

This book is a compilation of a series of articles written for an English technical paper, for the purpose of instructing those intending to take the examination for telegraphist for the government service. The writer, however, has not confined himself to the bare requirements of that examination, and the guide has been made suitable for preparing candidates for the examinations in telegraphy conducted by the city and guilds of London Institute. The work describes, in a detailed way, the various appliances used in telegraphic work, with diagrams illustrating the method of installation and operation. The apparatus used for testing, and the method of employing it, are also described. The book covers very satisfactorily English systems of telegraphy.

"American Telephone Practice." Fourth edition, enlarged and entirely rewritten. Kempster B. Miller. New York. McGraw Publishing Company. Cloth. 904 pages. 7 by 10 inches. 643 illustrations. Supplied by the ELECTRICAL REVIEW at $4.

The fourth edition of this standard work on telephony is practically a new work, for the book has been largely rewritten and greatly expanded. The work covers the telephone practice of to-day much more comprehensively and accurately than was true of the earlier editions at the time of their publication. In order that the work should not become too bulky, a good deal of matter of purely historical interest has been eliminated. The book is divided into forty-two chapters, each dealing with some particular branch of telephone practice—an arrangement which adds much to the value of the work as a book of reference. Every phase of telephone construction and operation is dealt with, the various systems are described, including the manual, automatic and intercommunicating, and construction work, both inside and outside, is described in detail. The book is, without doubt, one of the most complete works ever published on American telephone practice, which, it need hardly be said, is in advance of that of any other country.

"Practical Electric Light Fitting." Sixth edition. F. C. Allsop. New York. The Macmillan Company. Cloth. 290 pages. 5½ by 7½ inches. 242 illustrations. Supplied by the ELECTRICAL REVIEW at $1.50.

In preparing this book the endeavor has been made to provide a thoroughly practical treatise for fitters and others who require plain, practical instruction and diagrams, rather than mathematical formulæ. The subject is treated by giving an exceedingly elementary account of electric current flow and the different systems of electrical supply which are in use. The greater part of the work is given up to a detailed description of different types of switches and switch boxes of all descriptions, fuses, lamp fittings, methods of running wire in conduit, the installation of meters, and such testing as is required in interior wiring. While the book is written from the English standpoint, a good deal of American apparatus is described. The book concludes with instructions for installing and operating a small isolated plant.

A Projection System for Lecturers.

An ingenious and simple method of illustrating lectures by means of lantern slides is described by Professor Eric Gerard in the bulletin of the Association des Ingenieurs Electriciens (Paris) for the last quarter of 1904. This system, which has been installed in the new auditorium of the Institut Montefiore, is novel in that no darkening of the auditorium is necessary, and the lantern is not in view. The lantern itself is placed in a rear room, such as is usually provided for storing and preparing apparatus. In an opening of the wall between this room and the lecture room is placed a large sheet of ground glass. To avoid the necessity of darkening the preparation room, the screen is enclosed so as to cut off all side lights. The lamp used is a direct-current arc lamp taking fifteen amperes, and it is placed 2.5 metres from the glass screen. The slides which are to be shown are placed between the lamp and the screen, and the illustrations are shown on the screen in the usual way. To avoid the necessity of having an assistant in the rear room, the slides are mounted on a large wheel, built somewhat like a bicycle wheel, the movements of which are controlled by means of a cord from the lecture room. The whole apparatus is under the control of the lecturer, and its effectiveness is thus greatly increased.

Digitized by Google

ELECTRICAL MINING NOTES.

BY SYDNEY F. WALKER.

ELECTRIC COAL-CUTTING MACHINES.

There is a very instructive struggle going on at the present time in connection with electric coal cutters. As usual, the electric system of driving is steadily pushing out the other. It is not in the collieries, where coal-cutting machines have been at work for a long time, that changes are taking place; it is in the new installations which are being constantly put down that a largely increasing number are being arranged for electric driving. It is also not in specially difficult places so much that electric driving is making way. The converted air drill that was introduced a few years since for coal-cutting, in which arcs are swept out by the drill, and in that way undercutting or nicking is done, is making way steadily for "bord and pillar work" and in narrow workings. It is in the straight forward longwall work that the electric longwall machine is making way. There are at present three types on the market, the bar, the disc, and the chain or jib. Up till very recently the disc was the machine, because it could be depended upon to go on cutting, no matter what happened. It would cut through anything and would work continuously under pretty near all conditions met with in a coal mine. The bar, it was acknowledged, took less power, but that was not of much service when it was constantly breaking down. Now all that is changed. The bar is doing good work, and it takes less power, from the fact that it avoids obstacles, such as nodules of pyrites, instead of going through them, as the disc does. There are also now two bar machines in the field, both old friends. There is the Hurd, that has been slowly making its way for a good many years, and has now proved itself by actual work a thoroughly practical machine, and the earlier machine, the Goolden, that had been put on one side as impracticable. A mining engineer, a past president of the Mining Institute, who has been working his colliery by electricity for some time, and who appears to have a very good electrician, has taken it up and claims to have produced a better machine with less gearing than the Hurd. The Hurd, it will be remembered, goes around obstacles, gearing carrying the bar up or down out of the way; it also has a reciprocating motion, and the bar is in the form of a screw, a plate placed behind it completing an Archimedean screw which brings the dirt out. In the new Goolden, it is claimed, the gearing is less, there is no reciprocating motion, the bar goes around obstacles as the Hurd does, and it is claimed there is less to get out of order. In the early Hurd machines the gearing was often a great source of trouble. The manager in question is using the machine in his own colliery, and is doing good work with it. The bar of the new Goolden machine is square, the cutters being fixed in the squared faces.

DEVELOPMENT IN DISC MACHINES.

The competition of the bar machine has led the makers of disc machines to bestir themselves. The Clarke-Steavenson Company has recently introduced worm gearing into its machine. As with all electrical drives, the reduction of the speed is always an important factor. Power is frequently lost in the gearing, especially when it has to run in places like the face of the coal, where dirt abounds, and the gear-wheels and their shafts take up room that can be ill-spared. Up till very recently, however, worm gearing was out of the question—it was so inefficient. In the early days of the Goolden machine, a machine was made with worm gearing, and its gear absorbed so much power that there was none left to cut the coal, the motor at that date being very weak also. During recent years, however, with the advance in engineering methods, the methods of cutting the teeth of worm gearing, and of running the gear have been considerably improved. The thrust bearing for worm gears now usually runs on ball bearings. The Clarke-Steavenson Company claims that it saves thirty-five per cent of the power by means of the new gear, that there is less vibration, and absolutely silent running. This last is of enormous importance, as one of the great drawbacks to all coal-cutting machines is the noise they make, preventing the warning sounds of the roof from being heard.

A curious problem has come up in connection with disc machines that use two motors. In one particular case it was found that the motors broke down rather frequently, and the insurance company made some tests, with the result that it found that the pressure at the terminals of the two motors varied very considerably, and was rarely the same. The two motors are series-wound, and are connected in series. The current passing through the pair must of course be the same. Each motor is geared to a second motion shaft by bevel gear, the two second motion shafts driving a third shaft, which drives the disc. The case is made more peculiar by the fact that in the same colliery there is an identically similar machine, working under exactly similar conditions, which never gives any trouble at all. In my opinion the troubles are due to the personal element, which is so strong in these cases. I am strongly reminded of a similar pair of cases I had in the very early days of electricity in mining. I had charge of two signals, working to two engine houses close to the same pit bottom, and working under identically similar conditions. The attendant in one engine house was an oldish man, very careful and very clean. Though it was not easy under the conditions, he was always clean himself, and so was his engine, and so was my battery, and I rarely had any trouble with it. The attendant in the other engine house was a much younger man who was not careful and not clean, and I always had trouble with his battery. It strikes me that this is the case with these two machines. There is no electrician on the ground, so that the apparatus is absolutely dependent upon the attention of the men in charge, and that of the colliery mechanic. The probable cause of the whole trouble is dirt. It is not an easy matter to keep the coal dust out of the gearing and from the commutator in a coal-cutting machine. Coal dust is being made all the time, and is finding its way everywhere. You will find it right down your back when you undress after watching a machine. Further, it is not easy to keep the motor brushes free from coal dust, and from making copper dust, which again deposits everywhere, including the spaces between the end of the coils, and so on. It is not easy, unless you take a little trouble, but it can be done with a little trouble and a little knowledge intelligently applied, and that is what is wanted here. If the copper dust and the coal dust are cleared out every time the machine stops, which does not take long to accomplish, the dust has no chance to accumulate. If this is done with care there should be very little trouble, very little variation in the pressures, and very few burnouts. My view is that the differences in the terminal pressures were not the cause of the burnouts, though they may have aided the process, but the copper and coal dust, these producing the differences of pressure, and building bridges across between sections of the commutator and the ends of coils, the bridges being burned, and arcs following, when there was some change in the circuit, in the usual way.

Digitized by Google

Electrical Notes from Europe.

By Our Special Correspondent.

THE Lyons tramway lines, which are now using current from a steam-operated central station lying within the city, are soon to take current from a hydraulic station at some distance off. The Société Grenobloise lately received the concession for supplying the tramways with this current. The hydraulic plant, which is located at Montiers, is equipped with Thury machines on the direct-current system. It contains four double dynamos, each pair being mounted together and connected direct with one of the turbines. The receiving station at Lyons is equipped with five double motor groups. It is to be remarked that the transmission between Montiers and Lyons is greater than any yet attempted in Europe, being 180 kilometres (112 miles). The central station is to generate 6,300 horse-power in all, and will use a sixty-five-metre head of water. It was decided to use the Thury constant-current system, as it gives a considerable economy of copper. The plant is on the same lines as the St. Maurice-Lausanne system, which uses a fifty-eight-kilometre (thirty-five-mile) transmission line at 22,000 volts. In these cases the current is constant at all loads, while the voltage is variable. In the new plant the voltage will be 57,000 volts at full load, which is the highest yet employed in Europe. A simple line of two nine-millimetre copper wires will be used. Within the city of Lyons the circuits will be laid underground, with an armored cable of high insulation.

The Austrian government is taking measures toward the application of hydraulic power for railroad lines. In a recent report, the Council of Industry gives a favorable opinion as to the use of hydraulic stations for supplying electric traction on the new railroads of the Alpine region, and it decided to request the government to undertake a thorough and detailed investigation regarding the nature and location of the different falls which may be available for this purpose. It is also proposed to draw up a plan of all the falls in the country, with detailed indications as to each. The railroad companies are favorable to this idea, and by forming a detailed list of the sources of water power, the railroads can select the falls which are most desirable, leaving the others for the industries and agriculture.

A large hydraulic plant is now in construction in Austria on the Sill river near Innsprück. The current is to be used at the latter locality which lies seven miles distant, for lighting and power. From the dam which has been erected across the river the water is brought by a 4.5-mile tunnel which has a one per cent slope. A penstock, 400 metres long, runs from the end of the tunnel down to the station, with a 187-metre fall. It delivers from seven to four cubic metres per second, according to the season, and furnishes from 13,000 to 10,000 horse-power. The station contains six turbine and dynamo sets of 2,500 horse-power each. Current is generated at 10,000 volts and runs on an overhead line to Innsprück. Here a number of transformer stations lower the voltage to 2,000 for the lighting and tramways. Among the other new Austrian plants we may mention the hydraulic station which supplies the large paper works of Ignatius Spiro & Son at Kruman, in Bohemia. The plant is located on the Moldan river and the fall supplies six to eight cubic metres per second, giving some 8,000 horse-power. Ganz three-phase alternators are used here, furnishing 2,500 kilowatts and running at 420 revolutions. The current, which is produced at 15,000 volts, is carried overhead to the first paper factory lying fifteen miles off and then to a second works some three miles further on. The motors in the two factories use some 2,000 horse-power in all. A set of three-phase transformers lowers the voltage to 300 volts for the motors. The remainder of the power is distributed in the district for lighting or motors.

Professor Wedding has succeeded in forming a lamp filament into which zirconium enters as the principal element. He presented some samples of the new lamp at a late meeting of the Cologne Electrotechnical Society. The new filament is obtained by the following process: he first forms the material for the filament by mixing zirconium and magnesium oxides and treating them with a current of hydrogen while at a high heat. The oxides are reduced and the resulting composition has a constant value. After powdering and mixing with cellulose solution, a plastic mass is obtained and the filaments are formed from this. The filaments are treated in a gas of the proper composition which contains no oxygen, and then have a metallic appearance. It is said that the new lamps consume two watts per candle-power. They have been made for thirty-seven volts, three on a 110-volt circuit; or at forty-five volts, for five on a 220-volt circuit. The life is stated to be nearly 1,000 hours. One kilogramme of zirconium furnishes 1,000,000 filaments. The lamp will sell for 1.85 francs ($0.37). Higher candle-power can be obtained by combining several filaments in the same bulb, and it is expected to make 100-candle-power lamps.

Among the new monophase electric tramway lines we may note the new road which runs through the valley of the Stubai, in the Tyrol. The line connects the town of Innsprück with Fulpnels. A voltage of 2,500 is used on the overhead line. This is supplied from the Sill hydraulic plant near Innsprück over a 10,000-volt transmission circuit, with step-down transformers at various points. The trolley wire, which is a thirty-five-millimetre hard-drawn copper wire, is hung from a steel wire which passes along above it. The latter is a five-millimetre wire and is attached to supports at fifty-metre intervals. The copper wire is hung from the steel wire by short supporting pieces placed four metres apart. Porcelain insulators placed on bracket poles are used for the steel wire in the case of single track, and for double track there is a bridge-piece running across the track between two poles. Current is taken into the car by a bow trolley. The wire is some 5.5 metres above the ground. Motor cars, trailers and closed freight cars are used on the line. The motor cars have two bogies of two axles each, and carry four motors of the Winter-Eichberg pattern, furnishing 280 horse-power. The motors are connected two in parallel and have a special controller. A transformer is placed on the car which receives the primary voltage of 2,500 (at forty-two reversals) and has a double secondary which gives 525 and 400 volts for the motors. This line is one of the few in Europe which uses monophase current. It has been equipped by the Allgemeine Electric Company and the Union Company, of Vienna. The track is one-metre gauge and the line is some twelve miles long. The trains run at fifteen or twenty miles an hour.

The German Imperial Laboratory has recently examined some interesting alloys which were submitted by Dr. Heusler,

Digitized by Google

and which are magnetic in character, although they are composed of non-magnetic metals. Two specimens were tested. The first contains 61.5 per cent copper, 23.5 per cent manganese, 15 per cent aluminum, 0.1 per cent lead. The second has the same metals in the following order, 67.7; 20.5; 10.7 and 1.2 per cent. Rods were turned from the alloys, eighteen centimetres long and 0.6 diameter. The first alloy could be easily worked, but the second proved to be somewhat brittle. The rods were submitted to a magnetizing force and induction test, and furnished a curve of which the following are the principal figures. Values of H in centimetre-gramme-second units: 30, 60, 100, 120, 150. Corresponding values of B for the first sample: 3,750, 4,000, 4,100, 4,200, 4,500. For the second sample: 1,530, 1,600, 1,750, 1,765, 1,820. As will be observed, the alloys are somewhat magnetic. Experiments were made to show the effect of temperature variations on the samples. No change is seen when they are cooled in liquid air for ten hours. The second sample has its magnetic properties considerably modified when heated for nine hours at a temperature seventy-nine degrees centigrade and then for twenty-seven hours at 110 degrees. In this case we obtain the following figures for B corresponding to the above values of H: 2,440, 2,600, 2,645, 2,760, 2,820. Continuing the heat for 544 hours (after which no change is seen) we have B = 2,760, 2,880, 3,000, 3,040, 3,060. As will be observed, the new alloys possess some remarkable properties.

The project submitted by M. Kraus, a prominent engineer, for the new Metropolitan Subway of Berlin, has been finally adopted by the authorities. According to the present plans, the subway starts from the Kreusberg and passes under the principal avenues. The total length is 18.6 kilometres (11.5 miles) and it is to cost over $12,000,000. The line will use the third or side-rail system and the cars are to resemble the American construction, using a central passage. A speed of twenty-five miles an hour is contemplated. The cars will be divided into first and second class. Special attention is to be paid to ventilating the tunnel and it will have numerous exits so as to avoid accidents. The underground stations and the cars will be well lighted.

Statistics have been recently published in Germany which show the operation of the electric plants in the country during the year 1904. The total number of central stations is 1,100, against 971 in 1903. Close data have been secured as regards 1,028 of these plants. The number of stations producing more than 2,000 kilowatts is fifty-one, and these lie in thirty-three different cities. They give a total of 290,693 kilowatts. The 1,028 electric plants above mentioned operate 5,700,000 incandescent lamps of fifty watts and 111,000 arcs, together with electric motors figuring for 263,000 horse-power. It is stated that the use of current for motors is increasing rapidly, while the lighting has decreased somewhat. The 1,028 stations furnish 530,947 kilowatts, of which the dynamos represent 434,882 kilowatts and the remainder is given by accumulators. As to the kind of current, 843 plants generate direct current, forty-one single-phase or two-phase current, and sixty-three three-phase. There are fifteen plants producing both direct and alternating current (single or two-phase) and sixty-one which furnish both direct and three-phase current. The motive power in the case of 570 central stations is given by steam engines representing 341,248 kilowatts, 109 hydraulic turbines figuring for 14,547 kilowatts, and ninety-four gas engines furnishing 10,050 kilowatts. The total number of electric meters is given at 247,366.

An electrolytic process is now in use for making tin paste. This composition is used in the decorative arts and also for coating paper. Hydrochloric acid in dilute solution is used for the bath. Both the anode and cathode are formed of tin plates. The tin is dissolved off the anode plate under the action of the current, while it is deposited from the solution upon the cathode. A spongy deposit containing hydrogen is thus formed, and when detached from the plate the gas makes it float on the surface, so that it is easily collected without interfering with the action of the cell. It is found that in order to have the proper kind of deposit, hydrogen must be formed along with the tin, otherwise the tin is deposited in a hard and crystalline state. The new electrolytic process is an improvement over the old chemical method, which gives off heavy fumes.

Some experiments have lately been made by the Menier Company, at Noisel, France, upon the use of waste vegetable products for fuel in connection with a gas generator and a motor using a low-carbon gas. These trials have been successful, on the whole, and show that these products can be used to generate gas and run motors for agricultural purposes. Straw, waste hay, leaves of different plants or trees, reeds and like material can be used, and thus give an economical production of gas. The cost per horse-power-hour is much less than for coal, as the latter is high priced. Petrol motors are also expensive to run in this country, so that the new process has a considerable advantage. The best method proposed is to form a group and establish a station furnishing some fifty or seventy-five horse-power with motors supplied by a vertical gas generator, and the station would thus furnish electric power throughout the neighborhood. The different products are collected, dried and pressed into bales weighing some 1,500 pounds per cubic yard. The straw is chopped before baling. The present experiments were tried on a seventy-horse-power plant, using a vertical column gas generator of the Riché pattern and a duplex low-carbon gas motor.

The city of Bilbao will soon be well supplied with current from three large hydraulic stations lying at considerable distances, the Quintana, Puentellarria and the Leizaran plants. The first of these stations is now working. It is operated by the Iberian Hydraulic Company and lies at forty-five miles from the city. This station is electrically equipped by the Schuckert Company. It contains 750 horse-power tubine and alternator groups. The alternators furnish three-phase current at 375 volts, running at 375 revolutions. The total power of the Quintana plant is 3,000 kilowatts. The second station, that of Puentellarria, is now building. It lies forty-two miles from Bilbao and generates 4.500 horse-power. Current will be sent on an overhead line at 30,000 volts. Farther off, sixty-five miles distant, a third plant is to be erected at Leizaran. It will also furnish 30,000 volts and is expected to supply 3,000 kilowatts. Substations in Bilbao to the extent of 12,000 kilowatts will lower the current to 3,000 volts and also supply the low-tension mains.

It is stated that some of the large gold mines in West Africa in the neighborhood of Chitri, on the Tano river (Gold Coast), are to use electric power obtained from a number of hydraulic plants. The power is to be used especially in the gold workings of Prestea, Tarkwa and Ashantee which lie on the east of the Tano river. This stream is the largest in the region after the Volta. Near Chitri it has a difference of level of twenty-three metres on 1,500 metres distance. The highest fall is twelve metres and at this point a hydraulic plant is to be erected which will furnish 20,000 to 45,000 horse-power, and this will be sufficient for the mines of the Gold Coast. The first lines, according to the present project, are to run to Prestea and Tarkwa which lie at sixty and ninety kilometres from Chitri, respectively. The current will be used for operating the gold mines and also for an electric railroad which is to run between these two localities. It is expected to realize an economy of forty or fifty per cent over coal.

C. L. DURAND.

Paris, April 29.

Digitized by Google

MUNICIPAL LIGHT AND POWER IN TACOMA, WASH.[1]

BY HOWARD JOSLYN.

Prior to municipal ownership, the town of Tacoma purchased its water and electric light from a private corporation, the Tacoma Light and Water Company, which was controlled and mostly owned by persons directly interested in a large amount of real estate in and about the original town site.

On April 11, 1893, the citizens of Tacoma voted for the issuance of twenty-year five per cent bonds to the amount of $2,080,000 for purchase of the light and water plants of the Tacoma Light and Water Company. Of this bond issue, $1,750,000 was for purchase of the light and water plants (with realty) and the remaining $330,000 was for extensions of the water plant.

From general reports of the negotiations prior to the sale and from substantial private authority, it is fair to conclude that $1,500,000 was considered the value of the water plant and its realty, leaving $250,000 as amount paid for the light and power plant.

Prior to the purchase, a committee of the city council made a schedule of the property comprised in both light and water plants; and the machinery, pole lines, etc., composing the electric plant with the valuations are given herewith:

STEAM PLANT.

		Horse-Power.
1	Westinghouse compound engine.....	160
1	" " "	140
1	" simple "	100
4	Russell simple auto. engines, each...	100
2	" " " " ...	65
12	Horizontal tubular boilers, " ...	60
3	" " " " ...	125

Valued $53,520

ARC LIGHT PLANT.

		Lights.
14	Thomson-Houston dynamos, each...	50
3	American dynamos, each	50
859	Arc lamps.....	...

Valued $85,100

INCANDESCENT LIGHTING PLANT.

1 Thomson-Houston alternator capacity 120 kilowatts (2,000 lights) with exciter.
1 Westinghouse 1,500-light alternator with exciter.
1 Westinghouse 750-light alternator with exciter.
100 Kilowatts capacity in transformers, 1,000 to 50 volts, and wire serving business district only.

Valued $17,850

STREET LIGHTING SYSTEM.

1,803 poles, each 40 feet, with cross-arms.
7,000 pins and insulators.
130 miles No. 6 insulated copper wire.
400 hoods and irons for street arc lamps.

Valued $35,270

1 Direct-current 50-hp. power generator.
Buildings and realty.

Valued $5,050

Total, $196,790
Deduct for 10 per cent depreciation, 19,679
Net, $177,111

The plant was housed in a building of wood and corrugated iron which, when built in 1889, contained only the three American and five of the Thomson-Houston arc dynamos with necessary engines and boilers. The alternating-current machinery for incandescent lighting and nine of the arc machines were not installed until 1891, so that the plant can not be taken as having run more than sufficient to put it into good working condition. At time of the sale, the commercial service of the plant, consisting of some 250 arc and 1,500 incandescent lights, was almost entirely confined to the business section; and the hope of extending the lighting service throughout the residence districts had been a strong argument with the people for purchasing the plant.

Some two years previous to this sale, the city had granted another franchise to the Commercial Light and Power Company which had installed and was operating an electric plant with capacity of 100 arc and 5,000 incandescent lights. This plant was apparently in competition with the Tacoma Light and Water Company; but unknown to the public, Mr. C. B. Wright, principal owner of the old company, had, previous to its sale, acquired control of the Commercial Light and Power Company, his supposed competitor. After the city began operating its plant, the Commercial company continued for some years as an active competitor and much surreptitious cutting in lighting rates was carried on. As soon as possible after the purchase the city began buying wire and transformers to extend its service to residence districts, establishing rates therefor of nominally fifty cents per month per sixteen-candle-power lamp, but with rebates and reactions which really made the rate average about twenty-five cents per lamp.

Naturally, with cheap rates, the demand for residence lights became quite vigorous and in 1894 the city purchased another 2,000-light, 1,100-volt alternator to care for this business. The operation of the plant was continued much the same and with reasonable economy and management except in matter of service wires to customers, little attention being paid to the engineering features of the distribution system. The city officials could not see the reason for expending the large amount necessary for copper mains to save losses in transmission and give good service. This resulted in a poor quality of light; at first to residences only and later to the whole city. In the early evening with a large load only the lights near the plant would burn close to full candle-power, and later when the heavy load went off, the voltage not being properly regulated, lights would burn with a brilliancy very gratifying to the eye but expensive in the matter of lamps. In 1896, the city instituted suit against the Tacoma Light and Water Company and Mr. C. B. Wright, to recover a large sum claimed to have been paid by the city in excess of the value of the light and water plants. This litigation resulted in judgment for $750,000 in favor of the city, which claim was settled in 1898 by the city council receiving therefor the sum of $100,000 and the electric light plant of the Commercial Light and Power Company; thereby removing all competition to the city plant except from the Tacoma Gas Company.

In September, 1897, the city entered into a five-year contract with the Tacoma Railway and Power Company, which operated a large steam station by which it should drive the city's dynamos at its steam station, receiving payment for the electric current produced at the following rates according to meter measurements on the city switchboard:

Alternating current for incandescent service at night per kilowatt-hour.....	$0.01625
Alternating current for incandescent service in daytime per kilowatt-hour	.015
Arc light current from city dynamos per kilowatt hour.....	.0175
Direct current 550-volt power current per kilowatt-hour.....	.015

This contract effected a considerable saving to the city in cost of production, which at its own station, as nearly as could be ascertained at the time, had not run less than $0.0225 per kilowatt-hour.

The new arrangement gave the city the advantage of increased motive power and in 1898 it added to its equipment another 2,000-light alternating-current dynamo. Larger and more economical transformers were installed in place of many old ones in the business district, the secondary voltage was changed from 50 to 110 volts, and more copper was added to the distribution mains, thereby reducing the losses in transmission and materially improving the quality of light furnished. After a long period of effort on the part of a few practical men, the city council perceived the great saving to be effected by changing the primary voltage to 2,200 instead of the 1,100 volts previously used; and in 1900 to accomplish this change and meet the further demand the city purchased and installed in the railway station a modern type 1,000-kilowatt, 2,200-volt, revolving field generator, which with additional transformers made the expense

[1] Abstract of a paper read before the Pacific Northwest Society of Engineers, Seattle, Wash., April 1, 1905.

Digitized by Google

of new construction reach the large figure of $51,000 in this year.

About this time the Snoqualmie Falls Power Company entered the city with its power and was naturally desirous of competing for the city contract. In 1901 the city therefore advertised for electric power to be furnished it after expiration of its contract in 1902, and received the following bids:

SNOQUALMIE FALLS POWER COMPANY.

For alternating current, per kilowatt-hour..	$0.0084
For direct current, " " ..	.0094

TACOMA RAILWAYS COMPANY.

For alternating current, per kilowatt-hour..	$0.00895
For direct current, " " ..	.0097

A contract was entered into with the Snoqualmie Falls Power Company for five years and it began furnishing the city power in October, 1902, which service is still in force.

To secure a lower cost of power for its street arc lamps, the city, in 1902, changed this service from the old-style lamps and arc dynamos to series alternating-current lamps operated from "tub" transformers; and the commercial arcs were replaced with alternating-current lamps operated in multiple on general circuits. All the old arc lamps and arc and incandescent and power generators, together with the engines, boilers and scrap from the old station of the city, were sold. The Tacoma Railways Company purchased the 1,000-kilowatt alternating-current generator at practically its cost to the city; and the year 1903 found the city plant with none of its old station apparatus or any of the machines afterward purchased left on hand. Since the sale of the old plant, all the money expended for extensions and betterments had, with exception of a few machines, gone into wire, transformers, meters for the customers, poles and general materials and labor for the distribution system. The only station equipment owned by the city consisted of a ten-panel distribution switchboard and eight series-arc transformers, each with its switch panel, now located in the substation of the Snoqualmie Falls Power Company.

The general statement of expenditures and revenue for the period of ten and one-half years operation of municipal plant is as follows, according to accounts of the city officials.

EXPENDITURES.

Operation, repairs and maintenance.....	$590,385.45
Extensions and betterments.....	239,438.73
	$829,824.18

REVENUE.

Commercial revenue.....	$591,728.53
City light and power.....	386,330.61
Sundries.....	19,093.28
	$997,152.42
Net earnings, according to city accounts...	$167,328.24

Value of light and power plant, $250,000.

Commercial revenue for 10½ years.....	$591,728.53
Cost city light and power for 10½ years.....	386,330.61
Sale of old equipment.....	19,093.28
	$997,152.42
Operation expenses for 10½ years.....	$590,385.45
Maintenance and depreciation for 10½ years	239,438.73
Interest @ 5% on $250,000 for 10½ years.....	131 250.00
	$961,074.18
Net earnings.....	$36,078.24

Before accepting the above statement, it is advisable to consider two important matters in this connection; first, the fairness of the charges made for city lights and power which compose a considerable part of the revenue of the municipal plant; and second, the loss to the city of the revenue from taxation of this plant had it been the property of private persons or corporation during this period.

CHARGES FOR LIGHT AND POWER TO THE CITY.

For investigation of these charges a reasonable comparison may be had with the rates for street arc lights furnished the city of Seattle by private contract. Prior to the sale the Tacoma Light and Water Company had furnished the city some 404 street arc lights at $144 each per annum. Details of the charge for street and incandescent lights furnished during the first two years after the sale are somewhat uncertain; but the cost of street arc lights constitutes at least ninety per cent of the annual amount charged to city lights, and the following statement of the respective rate per street arc lamp per annum in Tacoma and Seattle for the ten and one-half years will afford a fair comparison of the charges per lamp.

Year.	Tacoma.	Seattle.
1893	6 months at $12 per month, $72	6 months at $11.00 per month, $66.00
1894	12 " " 12 " " 144	12 " " 10.25 " " 123.00
1895	9 " " 12 " " 108	12 " " 10.25 " " 123.00
1895	3 " " 11 " " 33	12 " " 9.90 " " 118.80
1896	12 " " 11 " " 132	12 " " 9.00 " " 108.00
1897	4 " " 11 " " 44	12 " " 8.00 " " 96.00
1897	8 " " 8 " " 64	12 " " 7.00 " " 84.00
1898	12 " " 8 " " 96	12 " " 6.00 " " 72.00
1899	12 " " 6 " " 72	12 " " 6.00 " " 72.00
1900	12 " " 6 " " 72	12 " " 6.00 " " 72.00
1901	12 " " 6 " " 72	12 " " 6.00 " " 72.00
1902	10 " " 6 " " 60	
1902	2 " " 5 " " 10	12 " " 6.00 " " 72.00
1903	12 " " 5 " " 60	12 " " 5.50 " " 66.00

Taking into calculation the number of street arc lamps used in Tacoma during the years wherein there is a difference in rates between the two cities, we find that in the earlier years the Tacoma plant charged the city $25,256.80 more than if based on the Seattle rate; while during the later years the rate has at times been less than the Seattle charges to the amount of $8,936.50. Making the deduction we have left $16,320.30 as the net amount of excess charges made in street lighting by the municipal plant.

LOSS OF REVENUE BY TAXATION.

The assessed valuation of the property of the Tacoma Light and Water Company for city taxation in 1892 was $323,950. A conservative estimate of the assessment of the electric plant based upon the purchase price of the two systems would place the assessment against the electric plant, only, at an average of not less than $50,000 during this period.

The total of rates of taxation for city purposes during this period amounted to 109½ mills, thereby placing the amount of taxation revenue lost by the city from this source at $5,475.

SUMMARY.

Deducting the above two amounts from the net earnings hereinbefore given makes the following a conservative statement of the net earnings of the plant during the ten and one-half years.

Net earnings after allowing for interest on bonds.....	$36,078.24
Amount of the overcharge for city lights...	$16,320.30
Amount of taxation revenue lost.....	5,475.00
	$21,795.30
Net earnings to 1904.....	$14,282.94

STATEMENT FOR 1904.

The period of ten and one-half years to the end of 1903 may be aptly termed "the reconstruction period"; and a consideration of the business done by the Tacoma municipal plant in 1904, as shown by the following statement, should give ample knowledge of present conditions.

REVENUE.

Sale of commercial light.....	$115,902.43
Materials sold.....	168.21
Installation of meters.....	1,718.00
Sale of commercial power.....	8,114.70
City light and power.....	26,822.80
	$147,816.14

DISBURSEMENTS.

Expense of operation.....	$57,199.11
Repairs and maintenance.....	9,464.87
Interest and exchange.....	12,520.88
New construction and equipment.....	49,086.59
	$128,271.40
Net earnings.....	$19,544.74

NET EARNINGS.

Examination of the details of the disbursement accounts will show that the

Digitized by Google

items of expense, including office labor and all operation, repair and new constructions, have been carefully distributed, and that the only item of importance left out the above statement is payment toward a sinking fund for retirement of the $250,000 in bonds falling due in 1913.

To provide a sinking fund for retirement of the bonds in eight and one-half years would require the setting aside annually of at least $25,000 which should earn five per cent per annum until required for payment.

Enquiry into details of the expenditures for new construction and equipment shows that some $35,000 of the above amount was put into copper wire, meters, arc lamps, transformers and poles. The city plant is now well equipped with meters and the distribution system reaches practically every section of importance; from which it may be inferred that it should not be necessary to expend for several years in the future as much as the amount charged to new work in 1904.

Assuming that the commercial revenue of the plant will continue at least as large as last year and the new construction work be cut off for the present, we may add this expenditure to the net earnings giving total earnings over expense of $68,631.33. This amount will pay the sinking fund deposit of $25,000; will take care of the charge to the city for light and power, and leave $16,808.53 for new construction and equipment or additional items of expense in operation.

RATES FOR INCANDESCENT LIGHTING.

During the six years following 1897 the rates were reduced four times by the city council in Tacoma; and, as meters

FEBRUARY 1, 1897, TO SEPTEMBER 1, 1898.

Consumption.	Rate per Kilowatt-Hour	
	Tacoma.	Seattle.
9.5 kilowatt-hours or less	$0.20	$0.20
10 " " " over	.19	.20
15 " " " "	.18	.20
20 " " " "	.16	.18
25 " " " "	.14	.18
30 " " " "	.12	.17
35 " " " "	.11	.17
40 " " " "	.11	.16
50 " " " "	.11	.15
60 " " " "	.11	.14
80 " " " "	.11	.13
100 " " " "	.11	.12

SEPTEMBER 1, 1898, TO MAY 1, 1899.

6.5 kilowatt-hours or less flat.	$1.25	$1.25
7.75 " " " over	.16	.20
10 " " " "	.15	.20
15.5 " " " "	.14	.20
21 " " " "	.12	.18
27.5 " " " "	.10	.18
30 " " " "	.10	.17
38 " " " "	.08	.17
40 " " " "	.08	.16
50 " " " "	.07	.15
60 " " " "	.07	.14
80 " " " "	.07	.13
100 " " " "	.07	.12

MAY 1, 1899, TO OCTOBER 1, 1900.

6.25 kilowatt-hours or over	$0.12	$0.20
12.5 " " " "	.10	.20
18.75 " " " "	.08	.20
20 " " " "	.08	.18
28.58 " " " "	.07	.18
30 " " " "	.07	.17
40 " " " "	.07	.16
41.76 " " " "	.06	.16
50 " " " "	.06	.15
60 " " " "	.06	.14
80 " " " "	.06	.13
100 " " " "	.06	.12

were coming into general use, a comparison of the prices in the following table for monthly consumption up to 100 kilowatt-hours will give the saving to the largest number of people benefited by any lower rate in Tacoma.

From October 1 to June 1, 1903, the schedules of rates differed in the basis of charge; the Tacoma prices running the same as last above mentioned and the Seattle rates consisting of a thirty-hour maximum demand of twenty cents per kilowatt-hour and a lower rate for longer usage of lights monthly. The prices in Tacoma, however, would average from twenty to thirty per cent. less for a majority of the consumers.

COMPARATIVE PRESENT LIGHTING RATES.

The following is a statement of the rates for lights by meter in Tacoma, which were put into effect June 1, 1903, and are still in force.

For 8 kw.-hours or less per month	$0.50
For 8 to 50 kw.-hours per month, per kw.-hour	.06
For each additional kw.-hour over 50 and up to 100	.05
For each additional kw.-hour over 100 and up to 2,000	.04
For each additional kw.-hour over 2,000	.03

Rate for power may be fixed by commissioner of public works, subject to approval of city council, minimum charge to be $1.50 per month.

POWER FOR THE TACOMA PLANT.

Although the rates for power supplied to the city distribution plant under the contract with the Tacoma Railways Company, in 1897, effected a considerable saving to the city, they were not notably low. On the other hand, the prices for electric current contracted for five years from October, 1902, with the Snoqualmie Falls Power Company are, as a result of the strong competition between the two power companies, very interesting from point of station cost of production.

For the first year of the Snoqualmie power service, up to October, 1903, the consumption by the city plant amounted to 2,878,480 kilowatt-hours, which gives an average consumption during the year of 440 horse-power. Taking into consideration the heavy loads lasting for an hour or more, we find the maximum load to have been 2,220 horse-power, making the load-factor an even twenty per cent.

For the second year, up to October, 1904, the power consumption by the city aggregated 3,660,940 kilowatt-hours, giving an average load of 560 horse-power. The maximum load during this year, not considering short time peaks, was 2,450 horse-power, making the load-factor 22.85 per cent.

In neither of these years was the direct-current power-load, which is paid for at the higher rate of $0.0089 per kilowatt-hour, more than four per cent of the total consumption; and for general consideration the rate may, therefore, be taken at the lower price of $0.0084 per kilowatt-hour.

Taking into calculation this rate and the load-factors given above, the city plant paid for its current during the first mentioned year at the rate of eleven dollars per horse-power per annum; and during the year ending October, 1904, at the rate of $12.55 per horse-power per annum.

It will thus be evident that the city of Tacoma has for at least two years been obtaining its electric power at an exceedingly low rate; and at a cost which it could not hope to duplicate by operating a generating station with steam or gas engines for motive power, nor could such cost be reached with a water-power plant installed at the low first expense of $100 per delivered horse-power.

The Measurements of High Temperatures.

Within the last few years the demand for appliances for pyroelectric measurement has increased markedly, as those industries using high temperatures in connection with the manufacture or preparation of their products have recognized the importance of being able, at any moment, to determine the extent and value of the temperatures attained. As a natural consequence of this increasing use in indicating pyrometers was the introduction of the recording pyrometer, which has a particular use in furnaces which operate night and day, and which can not be under continual supervision. In an article in the *Electrical Magazine*, London, Mr. L. Ramakers describes a recording pyrometer installation for measuring the temperatures prevailing in the hot-air conduits of blast furnaces, and a device which is controlled by means of two thermoelectric couples for recording the temperature of a tempering furnace.

In the former installation each blast furnace has two so-called Cowper apparatus, one of which is traversed by the hot gases coming from the blast furnace, whereby it is heated; while the other has the cold air drawn in from outside driven through it by means of blast engines. In this way cold air is heated to a temperature

Digitized by Google

of from 700 to 900 degrees centigrade. If the temperature of the latter apparatus—and consequently the air also—has fallen to a predetermined extent, then the cycle of operations is reversed. The first-mentioned freshly heated apparatus is used for heating the air, and the latter is heated afresh. In order to make observation of this process, there is located in the hot-air conduit of each of the blast furnaces—which are arranged in a circle around it—a thermoelement placed in a protecting tube. From the ends of this element wires lead to the common point where the corresponding registering devices are placed. The arrangement is such that every fluctuation in temperature can be seen at a glance, enabling the superintendent to determine any irregularities in the operation of the furnaces. The recording instruments are enclosed in hermetically sealed boxes. They contain a roll of paper sufficient for three or four months' continuous operation.

The recording pyrometer used in the tempering furnaces mentioned above is of particular value because of the exacting requirements now made in connection with the quality of steel for the manufacture of tools. It is essential that individual attention should be given to different kinds of steel, and more especially so during the tempering process. It has been found that the practice of estimating the temperature for tempering by the aid of the eye is by no means sufficient to enable a uniform product to be obtained. The pyrometer, on the other hand, makes it possible to maintain an absolutely constant temperature in a modern gas-fired tempering furnace.

The Ohio Society of Mechanical, Electrical and Steam Engineers.

The tenth meeting of the Ohio Society of Mechanical, Electrical and Steam Engineers will be held Friday and Saturday, May 19 and 20, at Toledo, Ohio. The headquarters of the association will be at the Phythian Castle, Ontario and Jefferson streets. The following programme has been announced:

Friday, May 19, 9 A. M.—Business meeting of council. Business meeting of society. Secretary's report. Treasurer's report. President's report. Report of the committee on the change of by-laws enabling the society to hold meetings outside of the state of Ohio; also to accept as honorary members of the society those connected with the management of plants who are not engineers. A paper will be read by Mr. Robert A. Orin, East Liverpool, Ohio, on "The Abrasive Strength of Materials, with Notes on Actual Tests in Compression."

Friday, May 19, 1 P. M.—The following papers will be presented: "The Colliery Engineer," H. B. Potts, chief engineer, National Coal Company, Byesville, Ohio; "Losses in the Power Plant," Charles N. Harvey, chief engineer, Muskingum Valley Steel Company, Zanesville, Ohio. Later in the afternoon the delegates will visit the gas-engine department of S. M. Jones & Company and the plant of the Pope Motor Car Company.

Friday, May 19, 7.30 P. M.—The following papers will be presented: "Power-Plant Supervision and Accounting," F. W. Ballard, mechanical engineer, Sherwin-Williams Company, Cleveland, Ohio; "Some Recent Improved Forms of Electric Lamps," F. C. Caldwell, professor of electrical engineering, Ohio State University, Columbus, Ohio; "Materials of Boilers—Facts and Theories," J. Rowland Brown, mechanical engineer, Aultman-Taylor Company, Mansfield, Ohio.

Saturday, May 20, 8 A. M.—The following papers will be read: "Pumping Engines and Machinery," Oscar F. Rabbe, mechanical engineer, Heisler Pumping Engine Company, Toledo, Ohio; "Notes on Settings of Horizontal Tubular Boilers," Ezra Fawcett, Alliance, Ohio.

In the afternoon the delegates will visit the plant of the Toledo Furnace Company and the plant of the Ford Plate Glass Company.

The officers of the society are as follows: president, R. H. Probert, Akron, Ohio; vice-presidents, H. H. Kelley, Chicago, Ill.; Henry Jackson, Steubenville, Ohio, and William T. Magruder, Columbus, Ohio; treasurer, O. C. Pillichody, Pittsburg, Pa.; secretary, C. J. Miller, 620 Shorb street, Canton, Ohio.

A Compound Dynamo Brush.

A new type of dynamo brush has been brought out by Messrs. Svenska, of Stockholm, which the inventors believe has some important characteristics. It is known as the bronze-carbon brush, and it is formed by coating the particles of powdered graphite with copper. These coppered particles are then coated with tin, and the tinned particles are pressed together and heated sufficiently to cause the copper and tin coatings to combine to form bronze. Every particle of graphite powder receives a coating of bronze, but as the graphite particles are small, the brush is fairly homogeneous. It takes a polish, is easily soldered, and the twenty per cent of free graphite present acts as a lubricant. These brushes have practically the same conductivity as copper brushes, and, at the same time, they commutate as well as carbon brushes. In fact, they can be used to replace a carbon brush without any other change being required. At a peripheral speed of fifteen metres per second, and a current of ten amperes per square centimetre, the loss of an ordinary carbon brush was found to be 34.5 watts, while with a similar bronze-carbon brush it was only 3.4 watts. The rate of wear of these brushes is slightly greater than that of metal brushes, but the wear on the commutator is correspondingly less.

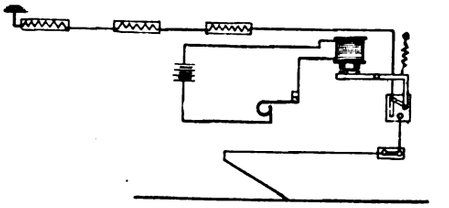
Electrical Patents.

A plug and spring-jack switch is the invention of William W. Dean, of Chicago, Ill., who has assigned his interest in the invention to the Western Electric Company, of Chicago, Ill. (787,900, April 25, 1905). The object of the invention is to provide a plug and spring-jack of improved construction in which certain defects inherent

PLUG AND SPRING-JACK SWITCH.

in devices of the kind heretofore in use will be avoided. The invention has particular reference to the plug and spring-jacks of telephone exchange switchboards. In the embodiment of the invention, front and rear-supporting strips are employed, the rear strip having a pair of contact springs secured thereto and extending forward, one above the other. The upper spring has a hole therein. A contact ring or thimble is located in the front strip, having a tongue extending over the two contact springs back to the rear strip to afford means for attaching the connecting wire. An insulating strip is attached to the underside of the tongue and projects through the hole in the upper contact spring, to form a stop for the lower spring. The stud has a shoulder forming a stop for the upper spring.

Arthur Newton, of Hartford, Ct., has recently invented an electrical system of heating, which is particularly designed for heating electric cars (788,166, April 25, 1905). The object of the invention is to provide a very simple system which can be easily and cheaply installed in cars in use at the present time as well as in new cars, for automatically keeping the temperature of the car near the desired point. In this system, one or more heaters are arranged in a circuit between a source



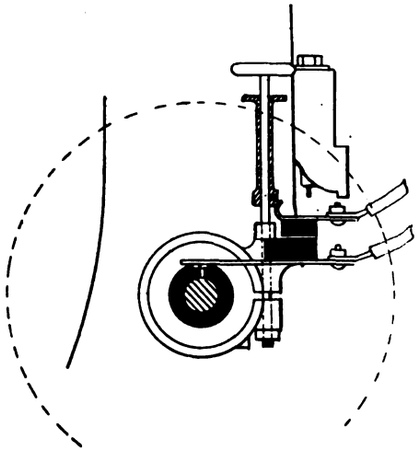
ELECTRICAL SYSTEM OF HEATING.

of electrical energy and the ground, the said circuit including a switch which is adapted to be opened by magnetic means that is energized by another circuit between a source of electrical energy and the ground, which secondary circuit is controlled by a thermostat. A plural number of heaters are disposed about the in-

Digitized by Google

terior of the vehicle and are connected in an electrical circuit from a traveling contact to a ground or return wire. A manually operative cutout is employed in the circuit, also an automatically operative switch. An electrical circuit from the traveling contact to a ground or return wire is provided and a thermostat is connected in this latter circuit and arranged to open it when the temperature is above a predetermined degree and to close it when the temperature is below a predetermined degree. A magnet is connected in the thermostatic circuit and an armature is adapted to be moved by the magnet. A mechanical connection is arranged between the armature in the thermostatic circuit and the automatic switch in the heater circuit.

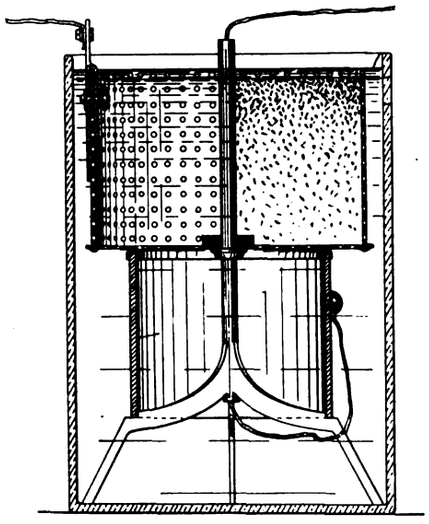
An electric sparking device for explosive engines has been devised and patented by Charles S. Dutton, of Perth Amboy, N. J. (788,253, April 25, 1905). The object of the invention is to provide means for



Sparking Device for Explosive Engines.

igniting the gas at any desired point in the revolution of the engine and for varying the time of ignition at will and to provide means for conveniently interrupting the ignition. In carrying out the invention, an igniting plug is located in the cylinder of an engine. A terminal in the line of an electric circuit is connected with the igniting plug. A shifting or actuating rod is provided on which a metal piece is movable into and out of contact with the terminal.

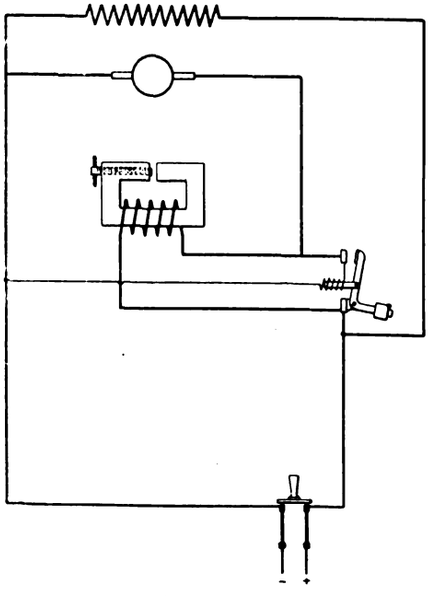
Certain improvements in batteries have been devised and patented by William C. Banks, of New York, N. Y. (787,715, April 18, 1905). The invention relates particularly to primary batteries, and it consists, essentially, in certain features of construction whereby the device is rendered susceptible to ready and easy cleaning and recharging, while at the same time it accomplishes a continuous, even and long discharge of current. A jar is provided, and a standard which supports the remaining parts of the battery. This standard has a tube portion supported above the bottom thereof. A zinc is supported on the standard. A



Battery.

basket is located substantially concentric with the tube located above the zinc. Terminals are provided, one of which leads down through the tube and to its appropriate element.

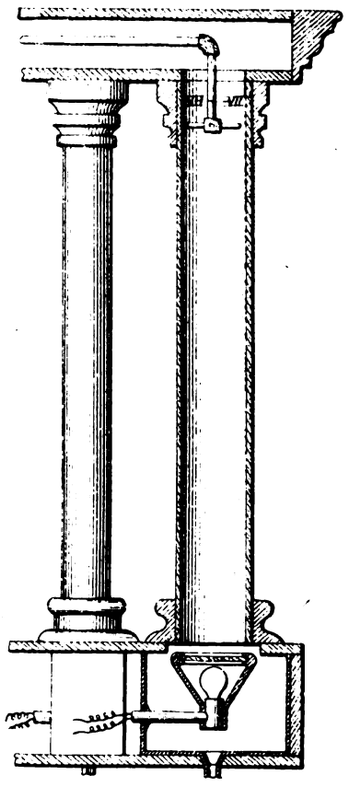
Arthur C. Eastwood, of Cleveland, Ohio, is the inventor of a motor-starting device (787,738, April 18, 1905). The object of the invention is to provide a motor-starting device of relatively simple construction and operation which shall require merely the closing of the switch



Motor-Starting Device.

to safely start the motor with which it is in circuit. It is also the object to provide motor-starting means which will at all times automatically act to protect the motor, particularly in the event of cutting off of current from it and the subsequent re-establishment of the current supply, it being desired that the device shall operate to automatically start the motor upon such restoration of the current flow. A motor is provided having in series with it an inductive starting resistance in addition to its own field-windings. A switch is employed provided with means tending to maintain it in an open condition, said switch being in shunt to the starting resistance. A coil is employed for operating the switch, the ends of the coil being connected respectively to the armature terminals of the motor.

Jesse T. Evans, of St. Louis, Mo., has invented a system of decorating, whereby decorative effects may be produced in the walls of buildings or other structures, the system comprising, essentially, transparent wall-surfaces over which or in



System of Decorating

the rear of which water is caused to flow and means whereby rays of colored light are projected into the transparent wall-surfaces and water for the production of an illuminated decorative effect (787,616, April 18, 1905). In carrying out the invention, a transparent column is employed within which is mounted a rotary sprayer. The sprayer is located near the top of the column and throws water therefrom on to the inner surface of the column in a downward and outward direction. A lamp is arranged at the bottom of the column. Surrounding the lamp is an inverted cone-shaped reflector, which reflector directs the rays from the light upwardly. Over this reflector is arranged a transparent top.

Digitized by Google

Lectures on Electricity in 1751.

At the Boston Art Club an extensive collection of Americana belonging to R. Henry W. Dwight, Esq., president of the Sons of the Revolution, forms an exhibition of particular interest to persons of antiquarian tastes.

Among these is an interesting broadside, which gives a summary of two lectures on electricity by Ebenezer Kinnersley delivered in Faneuil Hall in September, 1751—the first lectures probably ever delivered on the then new subject of electricity. Kinnersley was an Englishman, who was head master in English literature in the College of Philadelphia, from 1753 to 1773, a student of science, who made a number of discoveries in electricity and invented a number of quaint electrical devices. He and Franklin were on intimate terms, and were closely associated in their electrical experiments. Kinnersley has been erroneously cited as an anticipator of Oersted's discovery of the deflection of a magnetic needle by an electric current. The former's experiment, however, was purely electrostatic. In the summary of these two lectures, among other things, it states that electricity "is an extremely subtile fluid."

"That it doth not take up any perceptible time in passing through large portions of space.

"That it is mixed with the substance of all other fluids and solids of our globe.

"That our bodies at all times contain enough of it to set a house on fire."

He exhibits:

"An artificial spider animated by the electric fire so as to act like a live one.

"A shower of sand which rises again as fast as it falls.

"A leaf of the most mighty of metals suspended in the air, as is said of Mahomet's tomb.

"Electrified money which scarce anybody will take when offered to them.

"A curious machine, acting by means of the electric fire, and playing a variety of tunes on eight musical bells."

This broadside of 1751 appears to antedate any other similar notice of electrical experiments.

The ELECTRICAL REVIEW of April 23, 1904, page 621, published copy of an advertisement from the Massachusetts *Gazette,* of March 7, 1765, giving notice of a course of lectures by David Mason, illustrated by "entertaining experiments on electricitv similar to those cited in the broadside under date of 1751."

It may be wondered whether any one will find an earlier citation of "electricity is in its infancy" than that of George Adams in 1792, and yet who can question the propriety of using the adage to-day?

Dinner to the Swedish Delegates to the International Railway Congress.

The American Society of Swedish Engineers tendered a reception and dinner to the delegates from Sweden and Norway to the International Railway Congress. The dinner was given in the clubhouse, 231 Union street, Brooklyn, N. Y., on Friday evening, April 26. The Swedish government railways were represented by Victor Klemming, of the board of directors and chief of the rolling stock department; A. Corin, traffic manager; Hjalmer Vikland, chief of permanent way and works; I. Petterson, engineer of permanent way and works department; Harald Lemcke, district manager. Other gentlemen present were F. W. H. Pegelow, managing director, and Th. George Betts, chief of motive power department of the Stockholm Westeras-Bergslagens Railway; Captain Victor Stahle, general manager of the Stockholm-Rimbo Railroad; Mr. John Johnson, managing director of the Frovi Ludvika Railroad; E. Sunde, managing director and minister of finances of the Norwegian state railways.

The delegates were escorted from the Manhattan Hotel, New York city, to the clubhouse by a reception committee consisting of Mr. G. P. Wern, C. J. Mellin, H. Fernstrom, J. H. Hallberg and F. Clarholm.

During the dinner many references were made by the Swedish delegates to the electrification of the state railways, and it was also stated that results will soon be available of the experimental tests of the high-voltage, single-phase locomotives which have been purchased by the Swedish government.

At the close of the dinner Mr. Fernstrom extended an invitation to the delegates to participate in a tour of inspection, on Saturday morning, of the new developments carried out by the New York Central & Hudson River Railroad.

Annual Meeting of the Technical Publicity Association.

The annual dinner of the Technical Publicity Association was held in New York on April 27. The organization represents over thirty large manufacturers. The members of the association, nearly all of whom were in attendance at the dinner, are Philip P. Kobbe, Rand Drill Company, president; H. M. Cleaver, Niles-Bement-Pond Company, vice-president; C. B. Morse, Ingersoll-Sergeant Drill Company, second vice-president; George H. Gibson, International Steam Pump Company, secretary; H. M. Davis, Sprague Electric Company, treasurer; Rodman Gilder, Crocker-Wheeler Company, and Graham Smith, Westinghouse Companies, executive committee; H. T. Lauretzen, Holophone Glass Company; F. S. Wayne, Robins Conveying Belt Company; Lucius I. Wightman and Fred C. Iglehart, Ingersoll-Sergeant Drill Company; J. C. McQuiston and J. O. Little, Westinghouse Companies; C. P. Hutchins, Joseph Dixon Crucible Company; F. C. Cheston, American Wood Working Machinery Company; Dean Park, Hammacher, Schlemmer & Company; F. R. Matthews, De La Vergne Machine Company; Dixon Boardman, Hall Signal Company; F. H. Gale, General Electric Company; C. S. Redfield and R. R. Glenn, Yale & Towne Manufacturing Company; A. E. Michel, International Steam Pump Company; A. N. Barber, John A. Roebling's Sons Company; W. B. Snow, B. F. Sturtevant Company; E. F. Schaefer, Rand Drill Company; H. H. Kress, Cameron Steam Pump Works; F. B. Vail, American Air Compressor Works; Arthur Warren, Allis-Chalmers Company; A. E. Newton, Cutter Company.

Mr. Emerson P. Harris presented an address on "The Machinery for Marketing Machinery."

An Electrical Speed Indicator.

A simple, and what seems to be a useful electrical speed indicator has been invented by M. Carlier, and is now being constructed by the Siemens & Halske Company, of Berlin. A description of the device is given in *Electro,* Brussels, for March. This device is similar to the well-known Owens speed indicator, except that an alternator is employed in place of the direct-current machine used for the latter. The device consists of a small alternating-current generator with a revolving field. The armature consists of two coils wound over projecting poles, this winding being similar to the field winding of a small direct-current motor. The revolving field consists of a permanent magnet of the horseshoe type, having soft iron pole-shoes attached to its extremities. The machine is driven by means of a cord or other suitable device, and the speed is determined by the voltage set up, an alternating-current voltameter being used for this purpose. The indicator can be placed at any point, but has the disadvantage that it can not be used to indicate accurately wide variations in speed without a readjustment of the arrangement.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Interrupters for Induction Coils.

A brief review is here given of the different types of interrupters used in connection with induction coils, and some experimental results are shown indicating their relative value. The simplest type is the revolving contact-maker having an insulating segment inserted, which breaks the circuit once or twice during a revolution. This device is simple and clean, but deteriorates on account of sparking. It is far more effective when operated at a high speed than at low speed. The double-dipper interrupter consists of two cranks on one shaft, each of which sets into motion a point dipping into mercury. Two points are used, so as to obtain two breaks per revolution. This is a good arrangement, but it is not as satisfactory as the mercury jet interrupter, which consists of a toothed cylinder driven by a small motor, which, at the same time, drives a small mercury pump, the discharge from which is directed against the revolving cylinder. Two types of electrolytic interrupter are shown also, and their construction described briefly.—*Abstracted from Nature (London), April* 6.

A Proposed Method of Investigating Earth Currents.

After giving a fairly complete review of the investigations of earth currents, Mr. J. E. Burbank proposes a method for investigating them more accurately. If two earth plates are sunk in the ground, a current may pass through the wire connecting them, due to a potential difference of the soils at the two points; or the current might be the result of chemical action between the cells and the plates. This effect could be overcome partially by using non-polarizable electrodes. Another cause which might bring about the flow of current would be the circulation of atmospheric electricity. The air usually contains an excess of positive electrification, so that there should be an upward convection current with a low barometer, and a downward current with a high barometer, the circuit being completed by the earth in the upper strata of the atmosphere. Induction currents might be set up, due to variations in the earth's magnetism, or the rotation of the earth in a varying electric field. The first two causes give what is known as the constant part of the current, the second two giving the variable parts; and it is important to be able to separate these parts. Mr. Burbank says that more accurate determinations of the resistance of the soil and its variation of moisture, freezing, etc., are highly desirable; that the electromotive force due to chemical action between the earth plates and the surrounding soil should be determined by means of a normal electrode; that soils from different places should be collected, and the miniature line constructed entirely isolated from the earth. Then, with the aid of a chemical analysis of the soil, it would be possible to select non-polarizable electrodes for each soil. To determine the effect of atmospheric electricity, observations should be made, especially on the conductivity and potential of the air. A continuous record should be made of the earth current, and, for this purpose, a sensitive galvanometer with a suitable damping arrangement, and a fairly short period of swing, should be used. A photographic record should be made of its deflections. By the use of a potentiometer, the steady part of the current might be compensated for, leaving the record of the variable part only. Two such circuits should be constructed, one orientated north-south, and the other east-west, the record being obtained on the same cylinder. A third circuit, entirely isolated from the earth, and consisting of several turns of wire lying in a horizontal plane, and enclosing as large an area as convenient, would furnish a means of studying the variation of the vertical component of the earth's magnetism. It is doubtful, however, if such a circuit would give very satisfactory results, as the changes to be detected are slow. The large number of other influencing factors should be observed at the same time, such as the factor of wind, sunlight, and the radioactivity of different soils.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), March.*

The Church Stretton, England, Gas-Driven Electricity Works.

The small generating station described here is interesting chiefly from the type of prime mover employed. It is one of the few suction-gas-driven plants in England used for public electricity supply purposes. In the engine room there are two eighty-brake-horse-power gas engines running at a normal speed of 200 revolutions per minute, and each driving, through a fourteen-inch belt, a fifty-kilowatt, shunt-wound dynamo. The engines are provided with balanced cranks, and the connecting rod big ends are of the marine type. The flywheel ends of the crank shafts are carried on the outer bearings, the flywheels themselves being eight feet nine inches in diameter, with belt faces eighteen inches wide. Magneto-electric ignition is employed, and self-starters are used for filling the cylinders with gas at a lighting pressure when starting up. The engines are mounted on what is practically a floating concrete foundation. The latter is a solid block of concrete, and rests on a layer of cocoanut fibre six inches thick, which, in its turn, rests on the general concrete foundations of the building. The cocoanut fibre is packed on all sides of the foundation. This arrangement absorbs effectively all engine vibrations. Behind each engine, in connection with the air inlet valve, is an air suction box containing a straining medium for filtering the air drawn into the cylinder. Two suction gas producers of the Dowson type are installed in the producer house behind the engine room. The fuel used is anthracite pea, which is fed into the hopper at the top of the gas generator, in connection with which is a small hand-driven fan installed for blowing up the fire when starting. The steam supply from the vaporizer can be varied at will for altering the composition of the gas, according to the load on the engine. The gas has a calorific value of about 150 British thermal units per cubic foot. In practice, the fuel consumption is said to be less than one pound of anthracite per brake-horse-power-hour. The gas passes through a scrubber, which consists merely of a chamber containing small coke, with a water sprinkler arranged in the top. Once the requisite quality of gas is obtained, and the engine started by means of the hand-starter, the gas production is maintained at exactly the requisite rate through the suction exercised by the engine. An advantage of this system of working is that the gas generator works under a negative pressure, so that no leakage takes place. Besides the two dynamos mentioned above, the station contains a battery consisting of 230 cells, capable of supplying 220 sixteen-candle-power lamps for nine hours. The battery is controlled by a motor-driven booster.—*Abstracted from the Electrical Review (London), April* 21.

Digitized by Google

Burning Out of Electric Street Car Controllers.

Mr. Sydney W. Ashe here discusses the question of the burning out of a street car controller when the safety devices, such as circuit-breaker and fuses, are in proper condition. The burning out of a controller invariably starts with an arc, which jumps to the grounded controller casing, forming a circuit from trolley to ground. Protective devices, under these circumstances, may be in normal proper working condition, or the circuit-breaker may be set high, in which case reliance is placed upon the fuse to protect the circuit. An arc, jumping to a grounded controller casing, may form a direct short-circuit or a partial short-circuit. In the latter case, the arc forms between a resistance finger of the controller and the casing. In this case, the magnitude of the arc, following the grounding of the circuit, depends upon the amount of the series car resistance forming a part of the circuit, and it seems quite possible, in such a case, for an arc of 175 amperes to continue, if the line pressure is 500 volts. The arc will gradually melt the contact fingers and casing until a direct ground is formed, when the current will be in excess of 175 amperes, and a circuit-breaker set for 250 amperes would open. The duration of such a burning-out process, however, would be sufficient to severely damage the controller. The fuse and circuit-breaker could be in a normal condition, and the controller could still burn out if the arc were to form in the above manner. An experiment was performed, in order to determine the behavior of an arc during the interval of time that elapses for a fuse in circuit to blow. A hand-feed arc lamp was connected in series with a 100-ampere ammeter, a fifty-ampere fuse, a regulating rheostat, and a 115-volt service. The rheostat was shunted by a switch, so that it could be short-circuited at will. An arc was sprung between the carbons, and the rheostat adjusted until fifteen amperes was flowing in the circuit. Upon closing the short-circuiting switch, a current of 100 amperes passed through the arc, the fuse blowing shortly afterward. During the interval that elapsed before the fuse blew, there was a discharge between the two carbons which was about twelve inches in length. The conclusion was arrived at, that the controller would be burned out before the fuse could blow, providing the circuit-breaker were set high or were caught. In discussing a remedy for this trouble, it is pointed out that controllers will burn out as long as the main line current is interrupted in the controller case, but that the danger is reduced to a minimum if the controllers are frequently inspected and kept thoroughly clean. Arcs, however, are bound to form whenever metallic dust, oil or gritty matter accumulates, or when the blowout magnet becomes short-circuited. The only way to eliminate entirely the burning-out trouble is to use as a controller a modified form of the contactor system of control employed for heavy traction work, in which the heavy train line circuits are opened and closed by perpendicular-break contactors located underneath the floor of the car. With this form of control, a local current of small value passes through the master controller operated by the motorman, this current governing the operation of the main contactors, and being of such small magnitude as to cause no trouble.—*Abstracted from Engineering News (New York), April 20.*

The Theory of the Electrolytic Rectifier.

A rather exhaustive study of the electrolytic rectifier has been made by Mr. S. R. Cook, who has also contributed previous communications discussing this device. In the present article he describes the particular apparatus which he has used in his latest investigations, and gives data collected during the experiments. He concludes with some interesting remarks on the possible theory of the electrolytic rectifier. Whenever oxygen is the primary or secondary product of the anion, the aluminum anode is covered with a film of hydroxide which has a very high resistance—so high, indeed, that it acts as a dielectric to the charge on the ions. This non-conducting film between the metallic aluminum and the electrolyte produces a condenser effect, with negative charge on the anions of the electrolyte. The conditions that likewise exist when a direct current is applied to an electrolytic rectifier are that, when any potential less than the critical potential is applied, there is introduced an equal and opposite charge in the electrolyte next to the respective electrodes. When the current is broken there exist compound charges in the electrolyte and on the electrodes, which may be assumed to be equal to each other. The curve of decay shows the rate at which these charged ions pass through the film. When the current is reversed, the hydrogen ions pass through the film more readily than the oxygen or other negative ions, forming a gas between the metallic aluminum and the film, thus breaking away the film and exposing the metal to the charged ions. When an alternating current is applied, the film acts as a semi-permeable membrane. The hydrogen atoms, having less mass and greater velocity than the oxygen or other negative ions, pass through it more freely than the slowly moving anions. The critical potential value for an electrolytic rectifier depends upon the electrolyte used and the temperature of the cell. When the critical potential has been passed, the film crystallizes, and, in crystallizing, exposes the metallic aluminum. There are two potentials, depending upon the temperature at which the film undergoes a change such that its resistance to the passage of the ions is decreased, the first being at a potential whose value is about one-third the value of the second. The second is at the point where crystallization takes place.—*Abstracted from the Physical Review (London), May.*

The Electrolytic Preparation and Production of Calcium, Strontium and Barium.

In this article Dr. F. M. Perkin gives a brief historical sketch of the different processes which have been devised for producing metallic calcium, giving somewhat in detail that due to Plato and Ruff, by means of which calcium may be manufactured commercially. He dwells briefly upon the properties of calcium which make it valuable, and then describes recently devised processes for producing strontium and barium. Borscher and Stockem prepare metallic calcium by electrolyzing fused strontium chloride in a vessel, the bottom of which consists of fire-clay, and the sides of a hollow cylinder of carbon. The carbon cylinder forms the anode. The cathode is an iron rod projecting up through the fire-clay. A water bath is provided to cool the fire-clay base of the electrolyzing vessel. Metallic strontium collects in large globules at the bottom of the fused electrolyte, and is obtained by removing the salt after it has solidified, and crushing. Metallic strontium has much the same appearance as calcium. It is about as white as zinc, and as soft as lead. As yet there is no commercial process for producing metallic barium, although Davy has obtained it in the form of an amalgam.—*Abstracted from the Electrical Magazine (London), April.*

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Westinghouse Electrical Apparatus.

The recognized necessity of making frequent tests of incandescent lamps to ensure of their working under the best efficiency and to facilitate their removal from the circuit when their illuminating intensity has dropped below a certain standard has created a demand for a portable lamp-testing apparatus which would combine all the elements requisite for a determination of the watts consumed by the filament and at the same time the voltage of the particular circuit upon which the lamp might be working. The instrument shown in Fig. 1 has been designed especially for this work. In effect, it is a portable wattmeter, provided with a socket or receptacle for the introduction of the lamp to be tested, and with a switch

FIG. 1.—PORTABLE LAMP-TESTING APPARATUS.

for cutting out the series windings, in order to enable the instrument to be used as a voltmeter, operating on the voltage winding alone. Connection is made by means of a pair of leads, the upper ends of which unite in a plug to be screwed into the lamp socket on the lighting circuit, and the lower ends being provided with terminals for attaching to the binding-posts. It requires but a moment to make the connection. When used in lighting installations, the lamp to be tested is removed from the line and inserted in the receptacle on the volt-wattmeter, which is then connected to the socket from which the lamp was taken, and a test is made under the conditions which exist in service.

Two concentric scales are provided, one indicating volts and the other watts, and by use of the switch which cuts the series winding in or out of the magnetic circuit the wattage of the lamp or the voltage of the circuit may be read. This is a feature not possessed by any other lamp tester's instrument, and makes it unnecessary to carry a voltmeter.

Lamp-testing instruments heretofore designed have been wattmeters only, and it has been necessary to use voltmeters in connection with these wattmeters to obtain reliable results, as the watts vary more rapidly than the square of the voltage, and it is insufficient to know merely the watts the lamp consumes.

The instrument may also be used either as a voltmeter or a wattmeter, independently of its lamp-testing function, which gives it an additional value and adopts it for general testing purposes. It is suitable for use on either alternating or direct current without change of calibration. Reverse readings are not necessary on direct currents.

This volt-wattmeter combines the advantages of portability, ease of manipulation, long range of readings and accuracy. It is mounted in a polished mahogany case six and three-fourths by seven and three-fourths by four and three-fourths inches and has a removable cover. The scale is long, with large, open divisions, easy to read. The action is dead-beat. The instrument operates on electromagnetic principles, having two light, movable coils connected to the indicator and four stationary coils connected in series, the arrangement being such as to practically neutralize the self-induction of the system. It is not affected by external fields or changes in frequency, and has powerful spring, giving ample governing force. It has a maximum capacity of 150 volts and 150 watts, which is ample for the service for which it is designed.

A new direct-current integrating wattmeter, Fig. 2, has been developed. Integrating wattmeters for alternating-current service have been made by the Westinghouse Electric and Manufacturing Company since such instruments were first introduced, and the characteristics of the Westinghouse type have become very generally known. Its design is the result of an exhaustive series of tests of each and every factor which affects its performance and of the large experience gained in the manufacture of other meters.

In general appearance the new instrument resembles the Westinghouse alternating-current integrating wattmeters. The case is finished in black enamel, with letters in low relief. The terminals enter at the sides, passing through the case, the line wires being connected on the right-hand side of the meter and the load wires on the left, the upper wire line being the positive. To make connections, it is only necessary to bare the ends of the wires, to insert them in the bushings of the sides of the case and to tighten the binding screws. The bushings form a close junction with the terminal blocks, and make

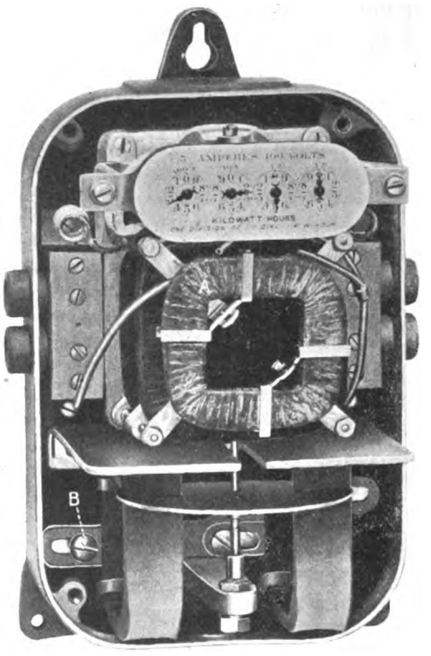


FIG. 2.—DIRECT-CURRENT INTEGRATING WATTMETER.

the case as insect and moisture-proof at this point as at all others.

By removing the cover, as shown in Fig. 2, all parts of the mechanism are exposed. The adjustments, which are wholly mechanical and do not depend upon variable resistance or similar arrangements, can then be easily made. To compensate for friction, the shunt coil shown at A in Fig. 2 is moved in or out, this coil being held in position by two screws which clamp against brackets as shown.

The speed of the disc is controlled by two permanent magnets, so mounted as to secure perfect alignment. Moving the magnets in from the edge of the disc increases the speed, and moving them out toward the edge decreases the speed, at any given load. Releasing the adjusting

Digitized by Google

screws, one of which is shown at B in Fig. 2, permits the magnets to be moved as required.

The lower bearing of the shaft is of the cup-and-ball type, the same as that used in Westinghouse integrating wattmeters for alternating current which, the maker states, has thoroughly demonstrated its value in reducing wear and friction. The shaft terminates in a removable sleeve with a slightly cupped sapphire jewel which rests upon a hardened steel ball one-sixteenth of an inch in diameter. This ball is supported by a second jewel, similarly cupped, which is set in the end of the adjusting screw which forms the lower half of the bearing.

FIG. 3.—CIRCUIT-BREAKER, CLOSED.

The lower jewel is spring-mounted, a construction which effectually protects it against sudden jar. The steel balls and jewels undergo a special polishing process and are rigidly inspected before using.

The very slight friction of a bearing of this form ensures the motor remaining in calibrations at light loads and this feature, combined with the reduced weight of the moving element, affords a much-lengthened period of active service for this meter than for others.

The commutator is an important part of all direct-current wattmeters, and requires the use of non-oxidizing metal and a diameter small enough to minimize friction. Especial attention has been given to this feature and it has been fully developed in every respect, the diameter being only five-sixty-fourths of an inch,

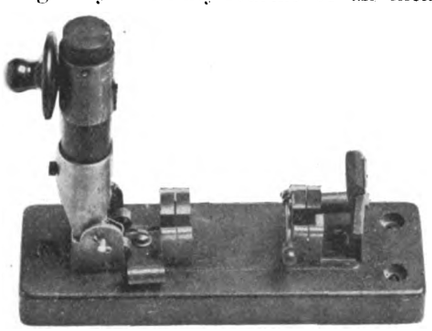


FIG. 4.—CIRCUIT-BREAKER, OPEN.

which ensures a reduction of friction to a minimum.

A perfect commutator is ineffective, however, without suitable brushes, so this feature has been made a subject of special study. Perfect contact with the least amount of friction must be maintained, and the material must be such that oxidization will not take place. The brushes in this meter are composed of a number of strands of wire of non-oxidizing material. This subdivision of the brush gives an excellent contact, as each strand is thereby made a separate brush and the series of strands conforms exactly to the surface of the commutator with less total tension, ensuring ideal working conditions.

A compact and inexpensive circuit-breaker, Fig. 3 and Fig. 4, designated as type F, has been placed on the market, for both alternating and direct-current circuits. The type F circuit-breaker is made in twelve and one-half, twenty-five, fifty and seventy-five-ampere sizes for 250 volts direct and 440 volts alternating. They are made in the overload type only. The tripping point is adjusted by turning the thumb screw shown in the illustration, the range being from eighty per cent to 180 per cent rated capacity. The small insulating knob at the right of the contacts controls a tripping device, by raising which the breaker may be opened by hand. By installing a breaker for each wire of the circuit, two for two-wire and three for three-wire circuits, the switch may be dispensed with and the circuit operated by means of the breakers alone. In this case, the breakers are non-closable on overloads, the breaker on one side of the circuit opening when the breaker on the other side of the circuit is closed. An insulating knob is provided for closing. The only depth required in the containing-box is that required for the opening of the breaker. Current-carrying contacts are of copper, arcing contacts are carbon and are readily renewable. The lever-arm is opened by a spring. The operating solenoid is inside of a fibre tube in the lever arm, which also conduces to a small and compact design. The parts of the breaker are mounted on a neat porcelain block, which is fastened to its support by three screws with countersunk heads.

The well-known Westinghouse Electric and Manufacturing Company Wurts non-arcing arrester has been in service now for over twelve years, and it is notable in this connection that the first changes in its mechanical mounting have only recently been found desirable.

The new type, Fig. 5 and Fig. 6, has the same dimensions as the old type C arrester, style No. 1383, and the arrester unit itself may be used as a repair part wherever this device has been employed. One improvement is the method of securing the non-arcing cylinders to the porcelain supports. These are firmly held in place by machine screws passing through

FIG. 5.—NON-ARCING ARRESTER COMPLETE.

holes in the porcelain supports and screwed in the line and ground contacts. Porcelain supports are moulded to shape with the cylinder centres exactly spaced, thus securing a perfect air-gap adjustment. All the cylinders can be easily turned through any angle to present new surfaces for

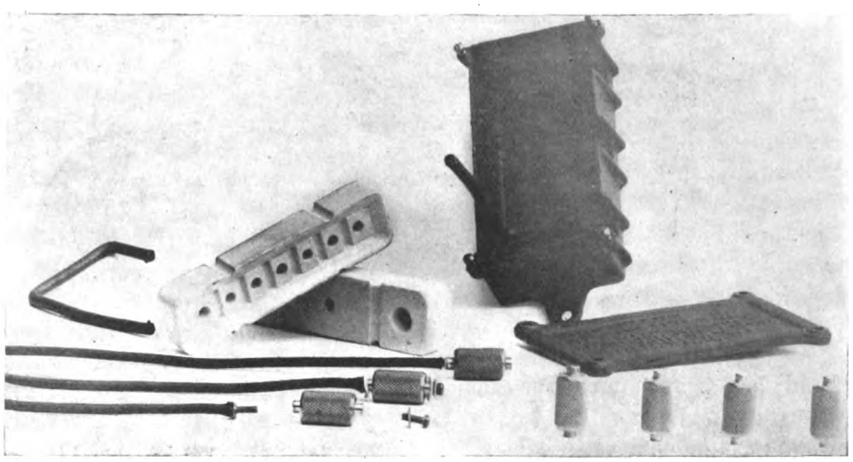


FIG. 6.—PARTS OF NON-ARCING ARRESTERS.

action. Line and ground leads are made in a very secure manner.

The assembled porcelain supports and cylinders are separated from the iron box by rubber-covered wire. This makes an effective packing which ensures the porcelain from breakage if the arrester be shaken or jarred, and the wire holds the packing in place.

The cover is screwed to the box, rubber gaskets keeping out all rain. The arrester is of the line type designed for connection to overhead feeders and circuits, the normal rating being from 500 to 1,250 volts double-pole and up to 2,500 volts single-pole.

All the best electrical operating characteristics of the old type C arrester are retained, the improvements consisting of improved mechanical construction and consequently longer life and ease of inspection and repair.

Digitized by Google

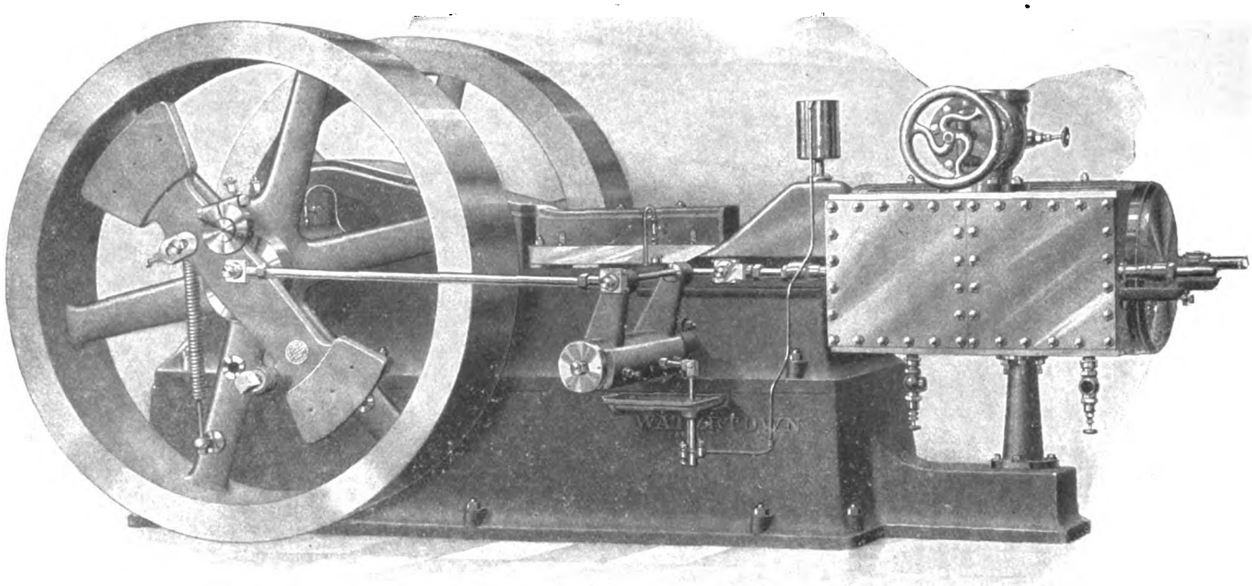
Watertown Four-Valve Engine.

The Watertown Engine Company, Watertown, N. Y., has developed a new four-valve, high-speed engine, which is shown in the accompanying illustration. The steam valves are placed on one side of the cylinder, and are controlled by the governor. The exhaust valves are on the opposite side of the cylinder, and are driven by an adjustable eccentric. The construction of the engine is such that the live steam in the steam chest is in close contact with the cylinder walls before passing through the valve. In this way the cylinder walls are maintained at a uniformly high temperature. The exhaust steam passes from the valves directly to the exhaust pipe, and is not allowed to come in contact with the cylinder walls. The partial jacketing of the cylinder walls with live steam, and the prevention of the cooling contact of the exhaust steam, are features of the engine to which the maker desires to call particular attention.

The valves are flat, double-ported, and balanced under well-stiffened pressure plates. They are light and easily driven. The clearance in the engine is extremely small. The port through the cylinder wall is of a length only necessary to give proper strength to the cylinder. The passage in the valve itself is as short and direct as possible. The valve rods are supported at both ends of the steam chest by guide sleeves, and the connections with the valves are short and direct. The subbase extends the entire length of the engine. It is cut away, however, underneath the cylinder, in order to permit easy access to the drips and exhaust connections. The cylinder is supported by a post running down to the subbase.

The oiling system is the same as that which is used in the smaller engines made by this company. The flow of oil is carried from a reservoir to any convenient point, and from there it is fed by gravity through pipes concealed in the frame to the points required. It then flows through sight-feed regulating valves to the wearing surfaces. It is drained into the crank pit through a filter concealed in the frame. The filter may be removed for examination or cleaning at any time. After passing through the filter the purified oil flows to a pump beneath the rocker, and is forced back to the supply reservoir. The flow of oil to any part of the engine can be regulated.

The engine is extremely heavy in construction, and the wearing parts exceedingly simple in design. It is built in sizes from 150 horse-power and upward in simple engines. Engines of 250 horse-power and over are made compound.



WATERTOWN FOUR-VALVE ENGINE.

Consolidation of the Stanley Electric Manufacturing Company and the General Incandescent Arc Light Company.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., and the General Incandescent Arc Light Company, New York city, have consolidated. The new title of the combined interests will be "Stanley-G. I. Electric Manufacturing Company." The Stanley company, as engineer and manufacturer of the well-known "S. K. C." system, has acquired the reputation of turning out only absolutely reliable electrical apparatus. The "S. K. C." system embraces the latest developments and improvements in generators, transformers, rotary converters, motor-generators, switchboard apparatus, induction motors, etc.

The General Incandescent Arc Light Company is well known as the builder of high-grade arc lamps, incandescent lamps, alternating-current and direct-current motors, and general electrical supplies. The engineers of this company have for years made a special study of electric lighting.

The officers of the Stanley-G. I. Electric Manufacturing Company are William Murray Crane, president; C. C. Chesney, first vice-president; M. D. Barr, second vice-president; M. J. Insull, third vice-president.

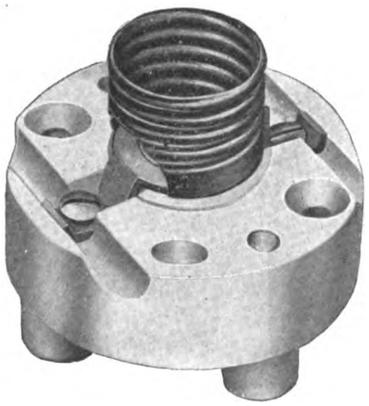
Dixon Crucible Meeting.

At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, Jersey City, N. J., the old board, consisting of Edward F. C. Young, John A. Walker, Edward L. Young, William Murray, George T. Smith, Joseph D. Bedle and George E. Long, was unanimously reelected. The board of directors reelected the former officers, namely, Edward F. C. Young, president; John A. Walker, vice-president and treasurer; George E. Long, secretary. Judge Joseph D. Bedle was also reelected as counsel.

Digitized by Google

Newcode Receptacle.

The Newcode receptacle which is being introduced by Stanley & Patterson, New York city, has been designed to take the place of all open-contact receptacles which, with their exposed terminals, unsatisfactory insulation qualities—because of centre screw, etc.—have been objection-



NEWCODE RECEPTACLE.

able to the majority of the Underwriters' boards in the country.

They desire to call particular attention to the following advantages of the receptacles:

Newcode receptacles have no exposed contacts, and require no soldering of wires to terminals and no taping or painting after connecting. They have four porcelain legs of sufficient height to do away with the old method of building up on porcelain insulators.

The receptacles have spring centre contacts made of phosphor-bronze. The shells are removable by simply taking out two screws. Phosphor-bronze shells are used likewise, so that both contacts are phosphor-bronze in place of the ordinary cop-

NEWCODE RECEPTACLE HOUSING CAP.

per. Five per cent phosphor-tin added to copper is commercially called phosphor-bronze, and means 400 per cent increased life over copper, when exposed to weather.

The centre contact spring puts a slight pressure on the lamp thread, preventing, after the lamp has been screwed home, any possible jarring loose of the lamp. It also ensures absolutely perfect centre contact.

A Newcode receptacle, after once being connected and placed in position, has a porcelain housing cap completely covering all live terminals; the neck of the porcelain cap closely surrounds the neck of the lamp and comes up high enough to effectually guard the butt of the lamp from metallic contact after it has been screwed into the receptacle. Nuts on the back of the receptacle are punched out of one-sixteenth-inch brass, thus giving ample thickness for thread in the nuts; the nuts are square, fitting into the square recesses of the porcelain closely; porcelain walls separate each nut.

The receptacles have binding screws with upset ends, permitting the loosening up of all screws before the receptacle is placed in position. This also permits wires being run along rapidly with no danger of screws falling out. The holes, where the brass connection screws pass, are drawn up so that the metal at this

NEWCODE RECEPTACLE, COMPLETE.

point is nearly double thickness. This permits four full threads, making the thread always safe against stripping.

Newcode receptacles are approved and endorsed by the National Board of Fire Underwriters, the New York department of water supply, gas and electricity and the New York Board of Fire Underwriters.

The Luminous Radiator.

The new and attractive heating device shown in the accompanying illustrations, Figs. 1 and 2, is likely to prove very popular. It is equipped with three large incandescent heating lamps, which glow brightly and throw out a powerful heat. Its cheerful appearance gives it a great advantage over non-luminous radiators and it should be in great demand by the large number of people who are glad to pay for comfort and convenience.

These radiators consume a trifling amount of power for the service they give, and are especially advantageous for giving temporary heat on chilly days, when it would not pay to start a fire in the house for the sake of warming one or two rooms. They replace to advantage the old gas log and similar devices, and should find a ready sale in cases where neither oil, gas

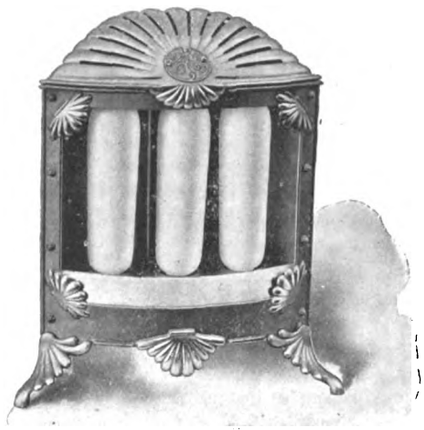


FIG. 1.—PORTABLE LUMINOUS RADIATOR.

nor coal would be considered. Instead of vitiating the air and introducing fire danger they warm the air by simple radiation from a source that is safe, clean and odorless.

The luminous heater is as portable as a footstool, and may be placed in any corner of the room. Its finish—bright copper reflector and oxidized copper frame—harmonizes with any surroundings. If preferred the heater may be installed permanently in the fireplace, as shown in Fig. 2.

The General Electric Company is now ready to fill orders for these luminous heaters. Several of the heaters will be shipped to each of the district offices of

FIG. 2.—PERMANENTLY LOCATED LUMINOUS RADIATOR.

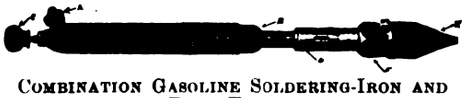
the company, where they will be placed on exhibition.

For use where a strong heat is required and ornamental features may be dispensed with another style having two heats, with a maximum consumption of 1,500 watts, and containing four heater lamps in a plain black iron body, is nearly ready for the market.

Digitized by Google

Combination Gasoline Soldering-Iron and Blow-Torch.

The Emmelmann Brothers Manufacturing Company, Indianapolis, Ind., is successfully introducing on the market a patent combination automatic gasoline soldering-iron and blow-torch illustrated herewith. In operation, the cap at A is removed and the magazine is filled with gasoline to within one-half inch of being full; then the cap is screwed on firmly. The alcohol lamp which accompanies each tool is lighted and the iron is heated at B for at least three minutes in a slanting position with the head down, keeping the valve C closed to generate a hot gas pressure. After heating B the stated time, the valve is gently opened and lighted by passing the tool over the flame at F. The tool should continue to be heated at B for three minutes more; the operator can regulate the blast to suit the work to be done by means of valve C. If the work is being done outside in a heavy wind or the tool is used as a blow-torch



COMBINATION GASOLINE SOLDERING-IRON AND BLOW-TORCH.

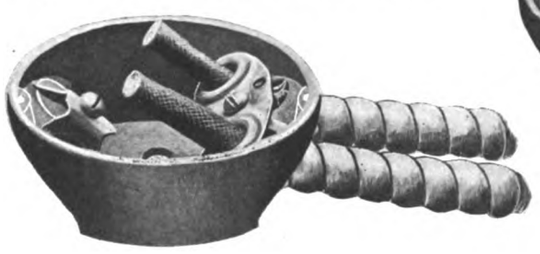
the shutter at B should be closed. The soldering copper is universal. Any shape copper point can be used. By removing the copper point shown at E the tool can be used as a blow-torch. Should the tool not work readily, the steel head shown at F can be unscrewed and the small hole in the centre of plug cleaned with a fine wire; the hole, however, should not be enlarged.

The device will last an unlimited length of time if properly taken care of. It is well constructed; not complicated; and easily operated and kept clean. When properly started, it is claimed that every particle of gasoline is consumed in a hot gas form without any danger of explosion and can be refilled without generating. The cost to keep the tool in constant operation is said to be only about five cents a day. This tool is being used by electricians, linemen, tinners, plumbers and painters. Among its merits are, that it is never too hot or too cold, while the strongest wind will not blow it out. The tool is furnished with two drop forge coppers, one for regular work and one for heavy work; the head is a high-grade steel casting. The cylinder is made of sixteen-inch gauge drawn brass tubing, threaded at both ends. The joints are tinned and sweated. A blunt brass valve stem is used; the valve is made of the same material, reducing grinding, binding and leakage to a minimum.

A New Outlet Box.

The accompanying illustrations show the new form of outlet box brought out by the Sarco Company, New York city. This box has been designated as the Sarco "competition" box, the significance of the name having to do with the utility of this box in competition with either side-wall or ceiling boxes.

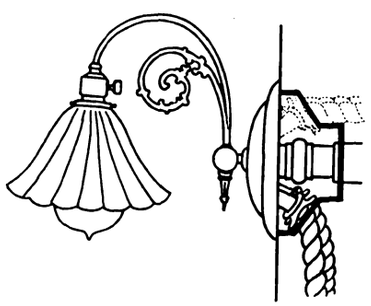
This outlet box is made of cast iron, and possesses the features of the regular



NEW FORM OF OUTLET BOX FOR CEILING OR WALL.

NEW FORM OF OUTLET BOX FOR CEILING OR WALL.

Sarco outlet box for steel-armored cable. The box is so arranged that it does away with several different kinds of outlet boxes on one job. It may be used as a ceiling box or as a bracket outlet, or for a ceiling outlet. It is especially adapted for side brackets having flat canopies. The box is ordinarily furnished with the Sarco duplex flat bushing, and is arranged to have the additional outlets sealed in the manner



OUTLET BOX FOR SIDE BRACKET.

similar to that obtaining with the regular Sarco outlet box.

This box is made in three types, as follows: type "A," for straight electric; type "B," for combination to fit a three-eighths-inch gas pipe; type "C," for combination to fit one-half-inch gas pipe.

The Stirling Company's Book on Boilers.

The Stirling Company, New York city, manufacturer of the Stirling water-tube boiler, has brought out a book entitled "Stirling—A Book on Steam for Engineers." This is a handsome publication bound in cloth, measuring eight by ten inches, and containing 248 pages, profusely illustrated. The first fifty pages of the book are devoted to a description of the Stirling water-tube boiler, together with illustrations of the various portions of the boiler, and photographs of various installations. The remainder of the book contains a large amount of valuable information relating to steam and to boiler operation. In the chapter on heat, a comparison of thermometer scales is given, and there is a discussion of the absolute zero and the specific and latent heats. A table of specific heats of various substances, and the boiling points of various liquids, are given, together with a table of expansions. Other chapters take up the properties of air and water, and the subject of impure feed water and scale in boilers is very thoroughly treated. The properties of steam are discussed, and a very complete steam table is given. There is a description of throttling and separating calorimeters, together with formulæ and tables for their use. Superheated steam and the flow of steam through pipes and orifices are also dealt with. One of the most valuable features of the book is a discussion of fuel. This discussion comprises about fifty pages, and takes up the various coals found in the United States, giving the best methods of burning them, together with tables of analyses and heating values. Oils, bagasse, natural gas and other fuels are also discussed. The subject of chimneys and draught is taken up in a chapter comprising twenty pages, in which a number of chimney formulæ are given and compared. In the chapter on boiler testing, the complete code of the American Society of Mechanical Engineers is given. Other subjects treated of in the book are: principles of steam piping, boiler and steam pipe coverings, boiler cleaning, directions for softening scale, troubles caused by oil in boilers, and specifications for the setting of Stirling boilers.

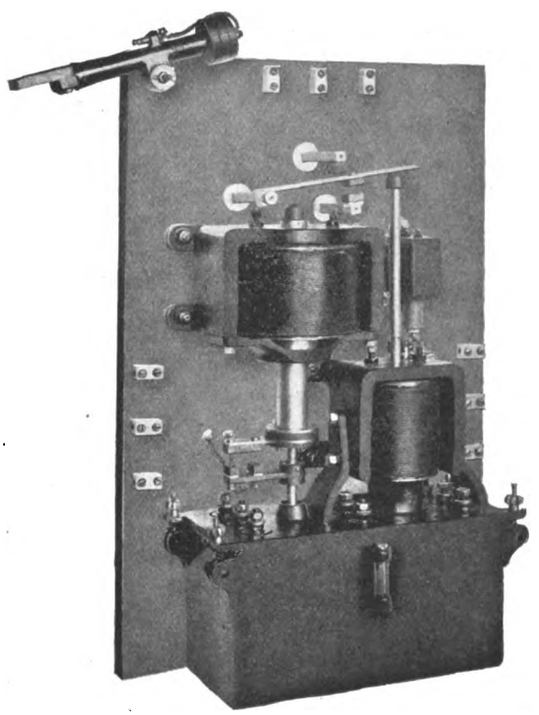
Digitized by Google

An Automatic Starter for Induction Motors.

The accompanying illustration shows one of the several types of automatic starters and speed controllers for induction motors recently brought out by the American Electric and Controller Company, New York city.

The starter includes an autotransformer mounted at the back of the panel or located in any other convenient place, and is for starting and stopping the squirrel-cage type of induction motors.

The illustration shows the apparatus in the full on position and the motor running. When the motor is to be stopped, it may be regulated by a float switch, such as a pressure gauge with electrical contacts, or any suitable device. The small relay at the right of the large upper solenoid is deenergized, this trips a latch and causes the main switch to open, at the same time leaving the circuits ready for starting again. To start the motor the



AUTOMATIC STARTER FOR INDUCTION MOTORS.

large upper solenoid is first energized, thus lifting the plunger and rod, and the latter connected to the transformer switch closes it. At the same time cutting off the current in the solenoid and allowing the plunger to fall very slowly against the retardation of a pneumatic dash-pot, the transformer switch still remains closed. When the plunger has fallen to its lowest point it makes the connection which energizes the lower large solenoids; the main switch is thereby closed across the line, and the transformer switch opened by the one movement, thus completing the cycle.

The starter for the slip-ring type of motor is similar in principle, but the plunger of the large upper solenoid carries a cross-arm which makes sliding contact with a straight set of contacts connected to a grid resistance in the circuit of the motor secondary, and the lower solenoid is dispensed with. An ingenious device can be added to the slip-ring type or resistance starter, making it possible to hold the cross-arm and plunger at any point along the row of contacts, thus making it serve as an automatic speed regulator as well as a starter.

Contracts for Pumping on a Large Scale.

Two very large municipal pumping engine contracts have been placed with the Allis-Chalmers Company, of Milwaukee. One is from the city of New Orleans for $500,000, the other is for the city of Pittsburg, for $350,000.

For New Orleans there will be built the most complete and up-to-date pumping plant ever erected. It will be entirely new in every respect. This plant is to pump the portable water for the city, taking it from the Mississippi river, lifting it first to great settling basins, and finally distributing it throughout the city under pressure by means of these pumps and engines, capable of supplying a total of 260,000,000 gallons a day.

For the preliminary work of lifting the water to the settling basins, there will be three Allis-Chalmers engines, direct-connected to centrifugal pumps of the same make. Each of these pumps will have a capacity of 40,000,000 gallons per day. These three engines will be horizontal cross-compound Reynolds-Corliss engines, and besides these there will be four big pumping engines, each of 30 000,000 gallons per day capacity. These four will be vertical triple-expansion crank and flywheel type.

There will also be supplied one 20,000,000-gallon centrifugal pump, and one horizontal cross-compound Reynolds-Corliss engine, as well as a 500-volt, direct-current Bullock generator, direct-connected to a horizontal cross-compound Reynolds-Corliss engine.

The Pittsburg pumping station will be supplied with two vertical compound crank and flywheel pumping engines capable of pumping 30,000,000 gallons of water daily against a head of 360 feet.

This station will also be supplied with four centrifugal direct-connected pumping units, each pump to have a capacity of 35,000,000 gallons of water per day against a forty-five-foot head. The Allis-Chalmers Company will also supply the Pittsburg pumping station with the auxiliary machinery.

Visit to Works of the Ingersoll-Sergeant Drill Company.

A party of prominent engineers and contractors, identified with the tunneling enterprises, visited the Glendon, Pa., quarries of the Ingersoll-Sergeant Drill Company, Friday, May 5, and saw in operation a new method of tunnel driving with channelers. It was of special interest on account of its availability for tunneling under the foundations of buildings, no heavy blasting being required. The guests left New York on a special train over the Jersey Central Railroad. After the visit to the quarry, they were taken to the new manufacturing plant of the company at Phillipsburg, N. J., where luncheon was served. The afternoon was devoted to an inspection of the new works. The return was then made by special train.

The party included: Chief Engineer Charles M. Jacobs and Assistant Chief Engineer Forgie, of the Pennsylvania tunnel under the Hudson river; Chief Engineer Alfred Noble, of the Pennsylvania tunnel under the East river; President John F. O'Rourke, Vice-President Frederick J. Gubelman and Chief Engineer George B. Frey, of the O'Rourke Engineering and Construction Company; Henry Japp, managing director of S. Pearson & Son, Incorporated; H. B. Reed, engineer for Contractor J. B. McDonald; St. John Clarke, representing William Barclay Parsons; President D. L. Hough, Vice-President William H. Schmidt and Treasurer J. L. Pruyn, of the United Engineering and Construction Company; J. R. McKee, manager of the mining department of the General Electric Company; E. E. Farrell, contractor; Benjamin B. Lawrence, mining engineer; E. E. Kerwin, division superintendent of the New Jersey Central Railroad; Maurice Bouvier, secretary, W. R. Grace & Company.

The Ingersoll-Sergeant Drill Company was represented by President W. L. Saunders, Vice-President J. P. Grace and Sales Manager J. H. Jowett.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

COMPANY FORMED TO OPERATE A TRAMWAY IN MADRID—The Societe Generale des Tramways de Madrid et d'Espagne has been granted a concession allowing it to build and operate an electric tramway system in Madrid, Spain.

NEW CABLE TO THE FAR EAST—The Postal Telegraph-Cable Company, in connection with the Commercial Pacific Cable, has laid new cables to the Caroline Islands and the Dutch East Indies. These cables are now open for public use.

SOUTHERN BELL TELEPHONE COMPANY TO EXTEND SERVICE—The Southern Bell Telephone and Telegraph Company, of Virginia, has secured an amendment to its charter, increasing the capital stock from $200,000 to $2,500,000. The company proposes in the near future to extend its telephone lines to every county in Virginia.

CONSOLIDATION OF ELECTRIC ROADS IN IOWA—The Mason City & Clear Lake Electric Railway, and the Waterloo, Cedar Falls & Northern Railway are to be consolidated. Extensions to the two roads from Mason City to Waverly, and from Sumner to West Union, comprising 200 miles of track, are contemplated. W. C. Brice is president of the Mason City & Clear Lake Railway, and L. S. Cass is president of the Waterloo, Cedar Falls & Northern.

EXTENSION OF WATER-POWER PLANTS IN SCOTLAND—The Loch Lever Water and Electric Power Company, Scotland, will make an extension to the Fowers water power, which was completed last December. Thomas Meik & Sons have prepared plans and specifications for the scheme, and as soon as these have been approved, bids will be invited for the carrying out of the project. The expenditure will amount to about $2,500,000. All the power at present generated is utilized by the British Aluminum Company.

NEW INTERURBAN ROAD IN MASSACHUSETTS—Plans are now being prepared for the construction of a trolley line from Fitchburg to Boston. The line is to be double-tracked from Ayer to Cambridge, a distance of twenty-seven and three-quarters miles, and will run mainly over private right of way. The time from Ayer to Boston will be one and one-quarter hours. The route will pass through Ayer, Littleton, Acton, Concord, Lincoln, Lexington and Belmont. The capitalists behind the scheme are the owners of the Fitchburg & Leominster and the Leominster, Shirley & Ayer systems, which have just been consolidated.

ELECTRICAL NOTES FROM MEXICO—The Mexican Power Development Syndicate, Limited, has been organized in London with a capital of £5,000. Its object is to construct and operate, in Mexico, electric, steam and other railways and tramways, and electric storage, power and lighting systems. M. C. Miller is forming a company with a capital stock of $10,000,000, for the purpose of building and operating a road in Guadalajara. The road will run from Guadalajara to the port of Chamela, on the Pacific coast. Application has been made to the government of the state of Jalisco for a concession to build the road. The hydroelectric plant which is being erected at Tequisquiakam, near Queretaro, for the purpose of furnishing light and power in the state, will be completed about the middle of September. The company, which is constructing the plant, is capitalized at $500,000.

ELECTRIC RAILROAD PROJECTED IN CUBA—The Havana Central Railroad Company has been incorporated under the laws of the state of New Jersey, with a capital of $5,000,000. The company proposes to build and operate a network of electric lines radiating from Havana. The total mileage planned at present is about 120 miles of single track. The company will require about 15,000 tons of standard-section steel rails. The material for the system, including the machinery for the establishment of car shops near Havana, will be largely purchased in the United States. Twelve thirty-three-ton electric locomotives will comprise part of the equipment. Construction work is to be commenced within one year, and the road, when completed, will carry both freight and passengers. C. W. Van Voorhis is secretary and treasurer of the company, with offices at 52 Broadway, New York city. He is also secretary and treasurer of the Havana Electric Railway Company, with which the new line will have a working agreement. The cost of construction and equipment will amount to about $10,000,000.

FURTHER REDUCTION IN NEW YORK CITY TELEPHONE RATES—The New York Telephone Company has made a further reduction in its rates to large users of the telephone. The reduction amounts to from twenty to fifty per cent. For connecting circuits off the premises to private branch exchanges, or for lines connecting one private exchange with another, the charge has been reduced from $60 and $84 to $48 and $60. Circuits which cross the North river, which are used to connect extension stations with a private branch exchange, or for tie lines, and which formerly cost from $204 to $300, will now cost from $180 to $240 a circuit. Local messages from private branch exchanges in excess of 3,600 messages yearly will be charged for at four cents apiece; or, when contracted for in lots of 400, will cost $3 per hundred. The cost of an auxiliary line and station has been reduced from $48 to $36 per year. The charge for a private exchange with two lines to the central station, with 3,600 yearly local messages, has been reduced from $240 to $216. The cost of additional lines to the central office has been reduced from $36 to $24.

NEW PUBLICATIONS.

THE WHY AND HOW OF INTERURBAN RAILWAYS—This is the title of a pamphlet by Mr. Guy Morrison Walker. In it he discusses the benefits of the interurban railway, both to the users and to the owners of real estate, and shows the relation of the growth of wealth of a community to the growth of railroad lines serving it. The condition of the West before the building of railroads is also discussed.

ANNUAL REPORT OF THE COMMISSIONER OF EDUCATION—The annual report of the commissioner of education, Department of the Interior, Washington, D. C., for the year 1903 has been received. This contains a large amount of information on the various topics related to instructional work. Chapter xix is of particular interest to those giving instruction in engineering, as this consists of a report by Professor Calvin M. Woodward, of Washington University, St. Louis, Mo., on "Manual, Industrial and Technical Education in the United States."

NOTES ON STEAM GENERATION WITH IOWA COAL—The engineering experiment station of the Iowa State College, Ames, Iowa, has issued bulletin No. 9, entitled "Notes on Steam Generation with Iowa Coal," by G. W. Bissell. The pamphlet gives the chemical and physical properties of a number of Iowa coals, together with their heating values, and also the results of a number of tests made to determine the cost of generating steam with different kinds of fuel. The difficulties of burning Iowa coals are discussed, and remedies for some of the troubles are given.

AN INVESTIGATION OF ROTATIONS PRODUCED BY A CURRENT FROM A SINGLE-PHASE ALTERNATOR—This is the title of a thesis submitted to the University of Wisconsin by Mr. Arthur Curtis Scott, for the degree of Doctor of Philosophy. It is published as bulletin No. 102 of the university. The book includes a correlation of experimental data, facts and theories concerning the rise and development of single-phase rotations, and the experimental verification of the fundamental principles which have been evolved, together with a study of related subjects. The possibility of broadening the field of study of the subject, or extending its practical possibilities, was kept in view throughout the work.

Digitized by Google

ELECTRIC RAILWAYS.

AUSTIN, TEX.—An electric road is to be built from Dublin, in Erath County, to Hamilton, in Hamilton County.

JAMESTOWN, PA.—The Chautauqua Traction Company will extend its line from Mayville to Westfield and Barcelona on Lake Erie. The work will begin at once.

CORRY, PA.—Governor Pennypacker has granted a charter to C. P. Northrup for building the Corry & Findley Lake trolley line. This road will be twenty miles long and will cost $150,000.

CARROLLTON, KY.—The Shelbyville & Ohio River Electric Railway Company will build an electric railway from Shelbyville to Carrollton, a distance of forty-two miles.

ROCHESTER, N. Y.—E. W. Clark & Company, of New York, acting for the Rochester Railway and Light Company, have bought the Rochester & Suburban Railroad for $675,000.

GOWANDA, N. Y.—Plans are being formed to build an electric road from Gowanda to the shore of lake Erie, near Angola. B. F. Parsons, a Brooklyn capitalist, is the chief promoter.

VALLEJO, CAL.—A franchise to operate an electric railroad in Benicia has been granted to F. A. Brandt. The line may be extended to Vallejo and Suisun. Four months are given in which to start operations.

PITTSBURG, KAN.—The Pittsburg electric railway system has been sold by J. J. Taylor to Guy M. Walker, of New York, and Fred H. Fitch, of Chicago. It is the intention to improve the present system and extend it.

WHEELING, W. VA.—The Wheeling Traction Company will extend its line this summer from Martin's Ferry to Brilliant, Ohio, where connection will be made with the Steubenville, Mingo & Ohio Valley road.

PITTSBURG, PA.—The traction line operated between Derry and Latrobe by the Westmoreland Railway Company will probably be extended from Latrobe to Greensburg, westward, and from Derry to Blairsville, eastward.

KENDALLVILLE, IND.—The Toledo & Western Electric Company, which operates a road between Toledo and Fayette, Ohio, will extend the road west to Butler, Ind., Waterloo, Auburn, Ft. Wayne and Kendallville.

KANSAS CITY, KAN.—The Trust Company of America, New York, has advanced $2,000,000 for the construction of the Bonner Springs and Topeka roads. This money is to be secured by a mortgage on the property of the electric line.

LA CROSSE, WIS.—A survey is being made by the La Crosse & Onalaska City Railway Company for the extension of its electric line from Onalaska to Holmen, Wis. It is proposed to eventually extend the line to Galesville, Wis.

EAST HAMPTON, CT.—Ransom & Hoadley, of Providence, R. I., are making a set of surveys for a trolley line from East Hampton to Moodus. The projected line is about ten miles long, and the road can be constructed, it is estimated, for about $175,000.

MAHANOY CITY, PA.—A Schuylkill County syndicate, headed by Assistant United States Treasurer W. S. Leib, and Dr. J. C. Biddle, has purchased the Schuylkill Traction and Lakeside railway lines, operating between Mahanoy City, Ashland and Shenandoah.

WILMINGTON, DEL.—The Odessa & Middletown Electric Railway Company has decided to extend its line nine miles to Delaware City. When this extension is completed there will be a line of electric railway from Wilmington to Middletown, a distance of twenty-five miles.

PROVIDENCE, R. I.—The Providence & Burrville Street Railway Company is to build twenty miles of double-track railway between Providence, Pawtucket and Woonsocket. A mortgage of $750,000 has been issued to the Rhode Island Hospital Trust Company to secure funds for the work.

CHICAGO, ILL.—The Chicago & Southern Traction Company has secured a tract of land in Riverside, on which to erect a power plant. There will be five structures, consisting of powerhouse, car barn, repair shop, substation and equipment building. The preliminary cost is estimated at $100,000.

LIVE OAK, FLA.—The Suwannee Springs Railway Company has been granted a franchise to build and operate an electric line in Live Oak, and also to build a line to Suwannee Springs, a distance of seven miles. The principal stockholders of the road are C. J. McGehee, F. L. Rees and B. W. Helvenston.

ORILLIA, ONTARIO—The Orillia town council and the James Bay Railway Company have reached an agreement, by which the latter undertakes to run its main line between Toronto and Sudbury, through Orillia, in return for a bonus of $30,000 and a right of way over the town's property, where the line touches it.

WILMINGTON, DEL.—The West Chester Street Railway Company will install a freight service on its trolley line to Kennett Square, Gallagherville and other points. A traffic arrangement may be made with the West Chester, Kennett & Wilmington Company, which operates a line between Wilmington and Kennett Square.

LAPORTE, IND.—Judge A. B. Anderson, of the federal court, has ordered that the Chicago & South Shore Railway Company's interurban line between Laporte and Michigan City, including all property rights and franchises, be sold at receiver's sale at the court house in the city of Laporte on Friday, May 26. The system is estimated worth nearly $500,000.

ROME, N. Y.—The Rome & Oneida Electric Railway Company has been formed to build an electric road from Rome to Oneida. The capital is $150,000. The following managing directors were elected at a recent meeting: DeWitt C. Hadcock, L. Mittenmaier, M. J. Larkin, A. R. Kessinger, William Soper, Charles Bernstein, George Maycock, John Hadcock and J. H. Bailey.

BELLEFONTE, PA.—A charter was granted some time ago to the Bellefonte Traction Company to construct a road from Bellefonte to State College, taking in Milesburg, Coleville, Axeman, Pleasant Gap and Lamont. The company has secured the street rights in all the above boroughs, as well as the right of way through the townships. The road will be about twenty miles long, with an average cost of $20,000 per mile for construction and equipment.

ROCK ISLAND, ILL.—The stockholders of the Rock River Traction Company held their annual meeting recently in Prophetstown. The following officers were elected: president, Levi Waterman, Geneseo; vice-president, F. E. Andrews, Sterling; secretary, Hugh W. Cole, Geneseo; treasurer, William McNeill, Prophetstown. The stockholders voted to instruct the directors to increase the capital stock of the company from $200,000 to $1,500,000, and also to issue bonds to the same amount.

JOLIET, ILL.—A license has been granted to the Chicago, Bloomington & Decatur Railway Company. It is proposed to construct the road from Chicago, through Joliet, Morris, Pontiac, Bloomington and Clinton, to Decatur. The incorporators and first board of directors are: William B. McKinley, D. R. Stephens, Charles Zilly, H. J. Pepper and S. A. Power, all of Champaign. The same parties have formed the Champaign Traction Company, which will take in the towns of Pekin, Bloomington, Clinton, Monticello, Champaign and others. Considerable work has been done on the Aurora, DeKalb & Rockford Railway, and it is expected that the line will be finished between Aurora and DeKalb by July.

TELEPHONE AND TELEGRAPH.

XENIA, OHIO—The Bell Telephone Company will build underground conduits.

PORTLAND, ORE.—A telephone line is to be built between Days Creek and Canyonville.

BUFFALO, N. Y.—The Consolidated Telephone Company has extended its lines to Glenside.

SHERBURNE, N. Y.—The Earlville Telephone Company will install an exchange in Sherburne.

CLARENCE, IOWA—The Clarence Telephone Company will erect an office and exchange building.

SOUTH BYRON, N. Y.—The Byron Telephone Company has installed a new switchboard in its exchange.

PHILIPSVILLE, PA.—A new telephone line is being built from

Digitized by Google

Owen's Corners to Philipsville, where it will join the independent system.

PETERSBURG, VA.—The Petersburg Telephone Company has purchased a site for a new exchange building.

SUMAS, WASH.—The Sumas town council has granted a franchise to the Farmers' Mutual Telephone Company.

FOSTORIA, OHIO—The Postal Telegraph-Cable Company is rebuilding its lines between Belmore and Cleveland.

WEST ALEXANDER, VA.—The Claysville Telephone Company is planning to establish an exchange at West Alexander.

ALBANY, GA.—Owing to increasing business the Southern Bell Telephone Company's exchange at Albany will be enlarged.

YOUNGSTOWN, OHIO—The Bell Telephone Company has purchased the franchise which was secured last fall by Homer Hood.

GOLDFIELD, NEV.—D. H. Peery is forming a telephone and telegraph company to operate from Las Vegas, Nev., to Rhyolite and Goldfield.

ASHLAND, KAN.—A telephone line will be built from Ashland to the county line, where it will be connected with the Meade County system.

ALLENTOWN, PA.—The Interstate Telephone and Telegraph Company, of Pennsylvania, will erect a telephone line to Coopersburg during the summer.

TREMONT, ILL.—A force of men is at work building a new telephone line from Tremont to Peoria, to connect with the Interstate long-distance company.

GLESSNER, PA.—A company has been organized to run a telephone line from Boswell to Jerome, and connect with quite a number of farms between the two places.

TRENTON, N. J.—The common council of New Brunswick has granted an extension of a year to the New Jersey Telephone Company in which to complete its system in that city.

HALIFAX, NOVA SCOTIA—The Canadian government has decided to install wireless telegraph equipment on Sable Island and on Chebuco Head, at the entrance of Halifax harbor.

BATAVIA, N. Y.—There has been filed in the county clerk's office a certificate showing that the capital stock of the Darien Telephone Company has been increased from $800 to $5,000.

DESPATCH, N. Y.—The Bell Telephone Company is now constructing a new line from Penfield village north along the Five-Mile line to Kennedy's Corners, then west to the Sperry Mills.

DECATUR, ILL.—H. H. Randolph has sold to the Bell corporation two of the toll lines that he constructed in 1902. These lines run form Maroa to Lincoln. The consideration is given as $12,000.

WAITSBURG, WASH.—An ordinance granting a twenty-five-year franchise to the Waitsburg Rural Telephone Company to erect poles and string wires in the streets and alleys has been passed.

BALTIMORE, MD.—The Hotel Rennert Company has made arrangements with the Chesapeake & Potomac Telephone Company for the installation of a private branch exchange of over 300 stations.

JOANNA, PA.—The Conestoga Telephone Company will extend its line from Amityville to Wyncote, to connect with the United company, thereby securing communication with Pottstown and vicinity.

BALTIMORE, MD.—The Union Telephone Company, of Trump, of which Charles L. Almony is president and S. S. Van Trump, manager, has increased its capital from $3,000 to $10,000, and will extend its line.

SANDUSKY, OHIO—To take care of increasing the business the Central Union Telephone Company is arranging for additions and improvements to its local plant. A new 100-drop switchboard will be added, and a new cable is also to be installed.

PARSONS, TENN.—A new telephone exchange has been put in at Parsons. The principal stockholders are W. C. Cole, Perryville; Walter Sloan, Linden, and the Beech River Phosphate Company. The lines will cover Perry, Wayne and Decatur counties.

CINCINNATI, OHIO—The Cincinnati & Suburban Bell Telephone Company has made application to the board of public service for a permit to lay subway conduits on the hill tops, in which to place its wires. The work will cost from $85,000 to $100,000.

PHOENIX, ARIZ.—It is announced that the Sunset Telephone, Telegraph and Electric Company has bought the property and franchise of the Gila Valley telephone system, including 300 miles of wire running from Roosevelt, through the Gila valley, to Clifton.

WATERLOO, IOWA—The property, franchise and all appurtenances of the United States Telegraph and Telephone Company, with exchanges in fourteen counties in northwestern Iowa, have been sold to Thomas Caskaden, of Waterloo, for $55,000, at public sale.

DOYLESTOWN, PA.—The Warrington Mutual Telephone Company has made arrangements to extend its line from Warrington to North Wales, *via* Chalfont. This will give the company an outlet through the Keystone company, where connection can be made for long-distance calls.

BLOSERVILLE, PA.—The Bloserville Telephone Company has elected these officers: president, J. S. Darr; vice-president, C. H. Leib; secretary, A. H. Calaman; treasurer, H. E. Buckwalter. Work on the line will soon be commenced. Denton Huntsberger, of Newville, will do the construction work.

SAGOLA, MINN.—The Sagola Telephone Company has decided to extend its line from Sagola, Dickinson County, north to the neighboring town of Channing. Connection also will be made with the Michigan long-distance lines at Iron Mountain, to the south, following the Milwaukee roads right of way.

ROCHESTER, N. Y.—The Independent Union Telephone Company has given to the Knickerbocker Trust Company a mortgage for $500,000. The purpose of the Independent Union company is to acquire, build, maintain and operate telephone lines and exchanges in Erie, Niagara, Chautauqua and Orleans counties.

TROY, N. Y.—D. A. Reynolds, vice-president and manager of the State Line Telephone Company, has organized an independent company at Peekskill. The new company will have its line in operation by July 1, and will reduce the price of telephones to eighteen dollars per year. There will be special fire and police calls.

WHEELING, W. VA.—The National Telephone Company will soon be connected with the West Virginia Western Telephone Company, which operates about Parkersburg and Marietta. The latter company is building its line northward to meet the National, and already has the line completed to some distance above Newport, leaving an intervening gap of less than twenty miles.

HONEOYE FALLS, N. Y.—At a meeting of the village board of trustees of Honeoye Falls, the right was granted to the Inter-Ocean Telegraph and Telephone Company to erect, maintain and operate a telephone system in Honeoye Falls. The company now has connection with the Home, Blake and Mendon Center lines coming into Honeoye Falls, and desires to have Lima, Rush and Mendon and nearby towns connected.

DENVER, COL.—The Colorado Telephone Company has issued its report for 1904. The gross earnings of the company in 1904 amounted to $1,497,350, compared with $1,294,838 in 1903. The expenses in 1904 were $1,118,196, compared with $977,734 for 1903. This gives the net earnings for 1904 as $379,154, compared with $317,104 for 1903. The capital stock of the company December 31, 1904, was $4,354,150, an increase of $200,600, and the number of subscribers was 37,102, an increase of 6,876 over 1903.

DETROIT, MICH.—Between $15,000 and $16,000 will be spent in the next ninety days for the improvement of independent telephone toll line service between Detroit and Lansing; Detroit, Ann Arbor and Jackson; Detroit and Northville, and Detroit and Holly. New double copper circuits will be installed, and in all 480 miles

Digitized by Google

of copper wire strung. The work between Detroit and Lansing will be done by the Peninsular Telephone Company, Detroit; Livingston County Telephone Company, Howell, and the Citizens' Telephone Company, Lansing; between Detroit, Ann Arbor and Jackson, Peninsular Telephone Company, and the Washtenaw County Telephone Company, Ann Arbor; between Detroit and Northville the Peninsular Telephone Company; between Detroit and Holly the Peninsular Telephone Company.

PERSONAL MENTION.

MR. FRANCK Z. MAGUIRE, of London, England, has established a New York office in the Astor Building, 10 Wall street. Mr. Maguire represents a number of electrical interests abroad.

MR. JAMES H. FAGAN on May 1 resigned his position as manager of the Herkimer exchange of the County Telephone Company, of Herkimer, N. Y. Mr. Fagan had been connected with the company for about four years.

MR. JAMES W. SCOTT, of St. Louis, Mo., has been elected treasurer of the San Marcas Valley Interurban Railway Company, which will build an electric line in Texas from San Marcas to Luling, a distance of fifteen miles.

MR. CHESTER I. CAMPBELL, manager of the International Electrical Exhibition, Boston, Mass., which will be held in July, is visiting electrical people in New York, Philadelphia, Baltimore and Pittsburg, interesting them in this project.

MR. WILLIAM G. MATHER, Cleveland, Ohio, who delivered the class day address at the Michigan College of Mines, Houghton, Mich., on May 5, is one of the best known iron-mining men in the country. His address was of exceptional interest.

MR. W. G. SCHRON, late of the Westinghouse Machine Company, has entered the service of the Allis-Chalmers Company, making his headquarters at the Pittsburg office. He will devote his attention to the sale of gas engines, steam engines and steam turbines.

MR. ARTHUR E. JACKMAN, for some time manager of the Willimantic (Ct.) Gas and Electric Light Company, will locate in Boston, Mass., as manager for the Adams-Bagnall Company, of Cleveland, Ohio. His offices will be in the Boston *Journal* Building.

MR. H. M. WHARTON, engineer of works for the Westinghouse Electric and Manufacturing Company for the past five years, has resigned his position. He will become one of the chief designing engineers for the Allis-Chalmers Company, Milwaukee, Wis.

MR. JACQUES M. BRAMLETTE has resigned his position as general superintendent of the East St. Louis & Suburban Railway system. He will take the position of general manager of the Philadelphia & Western Interurban Railway Company, which is building a road from Philadelphia to Lancaster.

MR. WILLIAM C. HUBBARD, for several years with the Westinghouse Electric and Manufacturing Company, severed his connection on May 1, and has entered the sales department of the Cooper Hewitt Electric Company, New York city. Mr. Hubbard has had considerable experience in the lighting field, having been associated with Professor L. B. Marks in the development and introduction of the first commercial enclosed arc lamp in this country. For two years he was vice-president and general manager of the Electric Arc Light Company, and afterward New York manager of the Manhattan General Construction Company, until both companies were absorbed by the Westinghouse interests.

MR. A. P. HEAD, the London representative of the Wellman-Seaver-Morgan Company, has recently completed a tour around the world and has established the following subagencies for the company: Melbourne, Australian Metal Company as Australian agents. The branches of this concern are as follows: New Zealand, the Gilbert Machinery Company, Wellington; Queensland, James Stothert, Brisbane; North Queensland, James Croker, Mackay; New South Wales, W. R. Laidley, Sydney; South Australia, James C. Fraser, Adelaide; West Australia, A. E. Thomas, Koolgardie; Tasmania, Lindsay Tullock, Launceton. In India the following agents representing the presidencies of Bombay, Bengal and Madras, have been appointed: J. Harper, Calcutta; Frank Harrison, Bombay; W. H. Oakes, Madras.

MR. ALBERT S. CRANE has been secured as chief hydraulic engineer for J. G. White & Company, Incorporated, New York city. Mr. Crane was born in 1867, and was graduated from Cornell University in 1891. Since graduation he has been actively engaged in hydraulic work. Mr. Crane designed the details of the Fortress Monroe sewage system for the United States engineer's office, and from 1895 to 1898 was assistant engineer of the Department of City Works, of Brooklyn. From 1898 to 1901 Mr. Crane was engaged on the development of the Michigan & Lake Superior Power Company at Sault Ste. Marie, as chief assistant engineer, and was chief engineer of the Lake Superior Power Company, at the same place, until 1902. Since 1902 Mr. Crane has been engaged as principal assistant engineer of the Sanitary District of Chicago. He has also been engineer for a number of other hydraulic installations. As chief hydraulic engineer for J. G. White & Company, he will be in responsible charge of the hydraulic department.

OBITUARY NOTICES.

MR. WELLS DYGERT, Buffalo, N. Y., died at his home in that city on April 27, after a brief illness. Mr. Dygert was sixty years of age, and was the proprietor of the Buffalo Electric Company.

MR. HENRY P. FLYNN, Carthage, N. Y., died on April 27 after an illness of several months. He was director of the Northwestern Telephone Company, the Carthage National Bank, and the West End Paper Company.

ELECTRICAL SECURITIES.

There was but little change in the character of the stock market last week. In the early sessions prices rallied somewhat, falling later in the week to still lower levels. However, a new element was injected into the situation in the form of increased support from outside investors. Many believe that the issues which were shied at a month ago because of fancy prices are now more or less in the form of bargains, and there is, consequently, some eagerness to buy. This support is not sufficient to influence any immediate change in the situation, unless it becomes a part of the movement instituted by powerful professional interests. These interests, however, appear to be satisfied to let things stand as they are for the present.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 6.

New York:	*Closing.*
Brooklyn Rapid Transit	60⅜
Consolidated Gas	198½
General Electric	173
Interborough Rapid Transit	203
Kings County Electric	200
Manhattan Elevated	164¾
Metropolitan Street Railway	116⅝
New York & New Jersey Telephone	171½
Westinghouse Manufacturing Company	192

Boston:	*Closing.*
American Telephone and Telegraph	141¾
Edison Electric Illuminating	250
Massachusetts Electric	86½
New England Telephone	138½
Western Telephone and Telegraph preferred	99

Philadelphia:	*Closing.*
Electric Company of America	12⅛
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	11¾
Philadelphia Rapid Transit	32¼
United Gas Improvement	114½

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	161
Metropolitan Elevated preferred	60
National Carbon common	59
National Carbon preferred	114¾
Union Traction common	8
Union Traction preferred	37

South Side Elevated for April carried a daily average of 91,901 passengers, an increase of 401.

Digitized by Google

NEW INCORPORATIONS.

URBANA, OHIO—Urbana Light Company. $100,000.

LAMONI, IOWA—Lamoni Telephone Company. $25,000.

ST. PAUL, MINN.—The Watkins Telephone Company. $10,000.

LINCOLN, NEB.—Greeley County Telephone Company. Increased to $50,000.

BIRMINGHAM, ALA.—The Brighton Waterworks and Power Company. $10,000.

CLEVELAND, OHIO—People's Electric Lighting and Power Company. $10,000.

MANNING, IOWA—Hawkeye Electric Company. $50,000. Incorporators: A. K. Resner and others.

MOULTON, IOWA—Farmers' Mutual Telephone System. $1,000. Incorporators: S. H. Jordan and others.

BUFFALO CENTER, IOWA—Buffalo Township Telephone Company. $6,000. Incorporators: O. B. Russ and others.

HUBBELL, NEB.—Frontier Telephone Company. $8,000. Incorporators: Frank Emmery Bell, M. G. Bell and L. F. Heuer.

EAST ST. LOUIS, ILL.—St. Clair Light and Power Company. $7,500. Incorporators: H. C. Barnard, C. L. Gray and R. W. Sikking.

MIAMI, FLA.—Florida Power Company. $300,000. Incorporators: W. N. Camp, Clarence Camp, O. T. Green, R. F. Brewer and G. D. Munsing.

NEWARK, N. J.—The American Beck Electric Lighting Company. $125,000. Incorporators: Eli Teeter, Thomas J. Butler and Theodore D. Gottlieb.

NEWTON, N. J.—Branchville Electric Power, Water and Lighting Company. $30,000. Incorporators: Charles H. Crisman, S. S. Wills and E. T. Wills.

EAST GRAND FORKS, MINN.—Banner Telephone Company. $25,000. Incorporators: Arney Grundysen, O. Osmunden, P. J. McCoy and B. Johnson.

NEWARK, N. J.—The New Jersey Beck Electric Lighting Company. $125,000. Incorporators: Charles A. Woodruff, Thomas J. Butler and Eli Teeter.

DOVER, ME.—Eastern Electric Company. To generate gas and electricity. $10,000. President, W. C. Woodbury, treasurer, F. E. Guernsey, both of Dover.

CONNERSVILLE, IND.—Connersville Railway Company. $100,000. Incorporators: J. E. Jeffries, W. E. Rowe, G. C. Florea, L. O. Burgess and R. Neil Burgess.

BOLIVAR, N. Y.—The Van Dermark Telephone Company. To construct a line from Van Dermark Creek to Scio, there to connect with the Inter-Ocean company's line. $1,200.

ST. LOUIS, MO.—Marissa Farmers and Merchants' Telephone Company, of Belleville. $10,000. Incorporators: C. W. Nevin, S. S. Boyle, W. H. Meek and J. A. Hamilton.

RALEIGH, N. C.—Oxford Water and Electric Company. $50,000. Incorporators: Harry L. Millner, Morganstown; W. T. Sherman and W. E. Richardson, of Washington, D. C.

GUTHRIE, OKLA.—Driftwood Telephone Company. $10,000. Officers: John Nelson, president; William Lightburn, secretary, both of Capron; L. C. Strothers, treasurer, of Kiowa.

NEW YORK, N. Y.—The Municipal Subway Company. To install conduits for electrical conductors. $100,000. Incorporators: J. Bears, W. J. Boroughs and George Stewart, New York city.

MAGNET, NEB.—The Magnet Independent Telephone Company. $10,000. Incorporators: A. J. Williams, P. J. Spaulding, A. N. Swanson, E. E. Snygg, Victor Johnson, Fred Clausen and I. O. Woolsten.

ALBANY, N. Y.—Bellport Lighting Company, of Bellport. $10,000. Directors: Edmund F. Hawkins, Isaac H. Cleaves, George Carman, Alfred S. Osborne, Everett M. Price, William F. Gardner and Henry E. Corwin, of Bellport.

PORTLAND, ME.—The Sumpter & Northwestern Railway Company. To construct and operate a line of steam and electric railway, together with a telephone and telegraph line. $500,000. President, H. E. Mason.

MILWAUKEE, WIS.—Badger Telephone Company, of Oconomowoc. To construct lines in Waukesha, Dodge and Washington counties. $2,000. Incorporators: Thomas Steele, J. J. Reid and Harry Rosenow, of Oconomowoc.

GUTHRIE, OKLA.—The Spring Creek Telephone Company. To operate in Kiowa, Washita and Caddo counties. $2,000. Incorporators: A. J. McMillan, W. T. Parnell, H. A. Lamherson, T. E. Givens, J. W. Gray and A. F. Kobs.

WILMINGTON, DEL.—Consumers' Light, Heat and Power Company, of Chicago; $1,000,000; incorporators: William M. Flook, of Chicago, and James H. Hughes and James L. Wolcott, of Dover. Citizens' Light, Heat and Power Company, of Chicago; $300,000.

WAKITA, OKLA.—Citizens' Telephone Company. $5,000. Incorporators: J. S. Burchfield, president; S. A. Lively, vice-president; G. W. Guthrie, secretary; Ernest Lemon, treasurer; F. P. Singer, J. W. Francis and R. H. Allen, directors, all of Wakita.

LORAIN, OHIO—Lorain & Eastern Traction Company. To construct a short line from the Lake Shore Electric line at Beach Park to South Lorain. $10,000. Incorporators: T. H. Hogsett, H. H. Johnson, George H. Kelly, George Cook and M. G. McAleenan.

RICHMOND, VA.—Kinston, Brighton & Northern Railroad Company, of Northampton County, Va. To construct steam, electric and other railroads. $100,000. Officers: W. E. Dickinson, president, New York; W. G. Smith, vice-president, and G. B. Morton, secretary, Cape Charles, Va.

LOUISVILLE, KY.—The Carrollton & Northville Railroad Company. To construct an electric road nine miles long between the towns named. $50,000. Incorporators: H. E. Randall, of Evansville; A. Z. Boyer, Theodore Snively, Charles E. Davis, John C. J. Watson, H. B. Moore and G. D. Crain, of Louisville.

RICHMOND, VA.—Bedford & Campbell County Telephone and Telegraph Company, of Coffee, Bedford County. To construct and operate a telephone line from Coffee, Va., to Lynchburg, Va., and adjacent points. $5,000. Incorporators: F. W. Nelson, president, Forest, Va.; B. D. Clay, secretary and treasurer, Coffee, Va.

INDIANAPOLIS, IND.—The Fort Wayne, Marion & Bluffton Traction Company. To build an electric road connecting Fort Wayne, Sheldon, Bluffton, Warren, Marion, Van Buren, Curryville, Decatur and Monroeville. $550,000. Directors: Frank H. Cutthall, Samuel L. Morris, Harry E. Vordermark, Fred C. Baase and F. H. Schmidt.

LITTLE ROCK, ARK.—Merchants' Investment Company, of Little Rock. To promote, construct, own and operate electric light and power plants for the production, generation and furnishing of power and light. $250,000. Officers: C. J. Kramer, president; William S. Michell, vice-president; J. B. Wishendorff, secretary; Harry Lasker, treasurer.

TROY, N. Y.—Lewis & Elizabethtown Telephone Company. To operate lines from Elizabethtown through Lewis, Chesterfield, Jay, Elba, Keene, Westport, Willboro and Essex. $4,000. Directors: A. J. Durand, A. E. Coonrad, of Elizabethtown; F. A. Marvin and S. S. Beardsley, of Lewis; E. M. West, of Reber; J. S. Laverty, of New Russia, and W. H. Lobdell, of Wadham's Mills.

ALBANY, N. Y.—Danby Telephone Company. To build telephone lines from Ithaca to Danby, South Danby, Spencer and Candor, and through the towns of Danby, Ithaca, Newfield and Caroline. $7,500. Directors: J. E. Black, Charles E. Bruce, C. F. Denman, F. D. Gunderman, T. W. Slocum, of Danby; H. F. Hutchings, of West Danby, and P. T. S. Ward, of South Danby.

AUGUSTA, ME.—Portland & Lewiston Railway Company. To build an electric line thirty-two miles in length from Morrill's Corner, in Portland, through West Falmouth, West Cumberland, Gray, North Gray, New Gloucester and Upper Gloucester, to Auburn. $130,000. Directors: Edward W. Cross, Auburn; John W. True, New Gloucester; Lewis A. Goudy, L. M. Leighton, Thomas M. Johnson and Jabez True, of Portland, and Frank Redlan, Boston.

Digitized by Google

ELECTRIC LIGHTING.

JOPLIN, MO.—The board of public works is preparing to spend $30,000 on the city's electric light plant.

BENNINGTON, VT.—The Bennington Electric Company has taken over the Bennington Water and Light Company.

FORT MADISON, IOWA—The Fort Madison city council has voted to install thirty-six additional arc lamps for street lighting.

BELLINGHAM, WASH.—The city council will establish an electric light plant in connection with the pumping plant on Sehome Hill.

BELLEFONTAINE, OHIO—Bellefontaine has voted in favor of issuing $50,000 bonds for improving the municipal electric light plant.

WATKINS, N. Y.—The property of the Watkins Gas and Electric Light Company has been sold to M. L. Dreisbach, of Easton, Pa., for $7,500.

EDWARDSVILLE, ILL.—The Pana electric light plant has been sold to A. H. Bickmore & Company, the representatives of a New York syndicate.

CASTLE ROCK, ORE.—A franchise has been granted to the Kalama Light and Power Company allowing it to furnish electric light and power.

HARRINGTON, WASH.—William Brodie and James Shaw, of Ritzville, have applied for an electric light franchise. The plant will cost $20,000.

NYACK, N. Y.—A franchise has been granted the Rockland & Orange County Electric Company, of Monroe, to establish a line in the town of Chester.

WOODSTOCK, VA.—The town of Newmarket has granted a franchise for an electric light system. It is expected that the plant will be in operation by June 1.

MUNCIE, IND.—The Citizens' Electric Light Company has purchased a site for a power plant. The site is on South Walnut street, adjoining the Big Four tracks.

NATCHEZ, MISS.—The towns of New Albany and Ellisville are to build electric light plants and waterworks. W. J. Wilcox is in charge of the work at both places.

SUMAS, WASH.—Franchises have been granted to the Sumas Electric Light, Water and Power Company. Work upon the plant is to commence within sixty days, and it will cost $20,000.

LAUREL, MISS.—The Laurel Improvement Company has been granted a franchise by the city of Laurel for a light and power station. It will begin at once the erection of a $25,000 plant.

READING, PA.—Judge Hassler, at Lancaster, has awarded control of the Lancaster Electric Light, Heat and Power Company to a Philadelphia syndicate, headed by Clarence H. Burr, to reorganize the concern.

LEWISTON, IDA.—Francis Jenkins and associates, of Moscow, Ida., are giving attention to plans for the establishment of a large power plant at Elk Creek Falls, where minimum capacity is about 3,500 horse-power.

LA GRANDE, ORE.—The consolidation of Grand Ronde Electric Company and the La Grande Storage Water Company has been announced. The directors are J. A. Thronsen, Walter M. Pierce, W. G. Hunter, T. H. Crawford.

ARTHUR, ILL.—The Charleston Gas and Electric Company has been sold to the Charleston Illuminating Company for a consideration of $240,000. Congressman W. B. McKinley, of Champaign, heads the new company.

CANTON, N. Y.—The electric light company plans to make improvements in its plant to the extent of $10,000. New buildings will be erected, and two 100-horse-power engines and one 120-kilowatt generator will be installed.

MARION, IND.—The Citizens' Heat and Light Company, at a recent directors' meeting, decided to go out of business. An assessment of one per cent will be levied on all stockholders to meet the obligations of the company.

SHENANDOAH, PA.—The directors of the Citizens' Electric Light Company have elected officers as follows: president, William Krick; vice-president, W. H. Waters; secretary, J. W. Daddow; superintendent and treasurer, T. F. Bradigan.

WINNIPEG, MANITOBA—The Emerson-Roseau Power Company has elected officers as follows: president, L. Stuart; vice-president, D. H. McFadden; general manager, George Pocock; secretary, H. H. Logan; treasurer, A. E. Hoskins.

HARTFORD, CT.—The Hartford Electric Light Company is to increase its capital stock from $1,400,000 to $3,000,000, and it will also increase its outstanding bonds to $2,000,000. The company now has out an issue of bonds amounting to $200,000 and maturing in 1915.

BAKER CITY, ORE.—The Baker Light and Power Company has been incorporated with a capital stock of $400,000, by C. A. Johns, F. N. Averill and J. H. Parker. This corporation takes over the Rock Creek Power Company and the Baker City Gas and Electric Company.

SPRINGFIELD, OHIO—The Springfield Light and Power Company, which is owned by the American Railways Company, of Philadelphia, Pa., has been bought by the People's Light, Heat and Power Company, of Springfield, which has been incorporated with a capital of $2,000,000.

OMAHA, NEB.—The city has entered into a four-year agreement with the Omaha Electric Light and Power Company, whereby the latter is to light the city's streets for $75 per light per year. This is a reduction of $19.50 from the present rate. The city is to use at least 600 lights at all times.

IOWA FALLS, IOWA—The Iowa Falls Electric Light and Power Company's heat and light plants have been transferred to the Pearsen Heat, Light and Water Company, a Des Moines corporation. The present officers will be retained. The transfer follows an option given the Des Moines company's agents a short time ago.

POTTSVILLE, PA.—The Frackville & Gilberton Light, Heat and Power Company has elected as directors W. C. Wagner, John Dunlap, Samuel Bailey, Orval Miller, Garrett Keating, Thos. Lafferty, David Taggart, C. A. Bleiler and G. W. Johnson. The officers are: president, David Taggart; secretary, C. A. Bleiler; treasurer, L. C. Anstock.

CLARKSVILLE, TEX.—The Clarksville Light and Power Company has been sold to the Clarksville Light Company, a new concern, composed of D. W. Cheatham, president; B. A. Dinwiddie, vice-president; John W. O'Neill, secretary, and A. M. Graves. The company has also purchased machinery for an ice plant, which it will run in connection with the light plant.

BALTIMORE, MD.—The Mount Washington Electric Light and Power Company has begun the erection of a new power-house on the site of the present one. The power-house will be twice the size of the old one, and will be built of brick and steel. The roof will be of slate. The building will be equipped with the most improved machinery when completed. John A. Sheridan & Company have been awarded the contract for the erection of the building.

NEW MANUFACTURING COMPANIES.

CINCINNATI, OHIO—Articles of incorporation of the John A. Stewart Electric Company have been filed. The company is capitalized at $40,000, and will take over the interests of John A. Stewart and others.

AUSTIN, TEX.—The Kane Company, of Fort Worth, has been incorporated to manufacture steam, gas and electrical fittings. The company has a capital of $50,000, and the incorporators are J. D. Kane, Lee and M. Stephens.

DOVER, DEL.—The National Electric Alarm Company has been organized with a capital of $500,000. The company will purchase, manufacture and sell electrical devices for the protection of bank and other property and private residences.

AUGUSTA, ME.—The O'Brien Electrophone Company has been organized at Augusta for the purpose of manufacturing and dealing in electric and magnetic appliances of all kinds, with a capital of $500,000. I. L. Fairbanks, of Augusta, is president.

Digitized by Google

INDUSTRIAL ITEMS.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, 1907 Market street, St. Louis, Mo., is distributing a net price list on Commercial high-grade incandescent lamps.

THE C & C ELECTRIC COMPANY, New York city, has removed its general office to its factory at Garwood, N. J. It will, however, maintain a branch office at 149 Broadway, New York city.

G. M. GEST, the expert subway contractor of New York and Cincinnati, has been awarded the contract to construct a complete underground conduit system for the Consolidated Electric Light Company of Maine, at Portland, Me.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., is calling attention to several letters it has received, in which statements are made regarding the remarkable efficiency of Pittsburgh transformers under severe conditions of service.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, manufacturer of the "Sterling Special" lamp, is distributing an interesting booklet entitled "The Mystery of the Missing Kilowatts." This may be secured upon application.

THE H. W. JOHNS-MANVILLE COMPANY, New York city, has established new branch offices in San Francisco, Seattle, Kansas City, Los Angeles, Little Rock and Minneapolis. The company now has eighteen branches, covering the entire United States and Europe.

THE CINCINNATI ELECTRICAL TOOL COMPANY, Cincinnati, Ohio, is distributing a new catalogue descriptive of its portable electric drills and electric grinders. Dimensions and illustrations are given of these drills, which may be run from any incandescent lamp circuit.

THE ROLFE ELECTRIC COMPANY, Rochester, N. Y., is distributing a catalogue descriptive of some of its specialties. In addition to this material the book contains the electrical laws and rules of practice, together with a number of valuable tables for electricians and engineers.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is now located in its new headquarters, 134-140 West Jackson Boulevard. The new building which, it states, is the largest warehouse in the world devoted exclusively to electrical supplies, gives added facilities for the prompt handling of its increasing business.

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, will be pleased to send upon application a new bulletin which it has published, entitled "The Voice of Progress." This bulletin voices forth an appreciation of the rural telephone, detailing the advantages which it has brought to farming communities.

THE CROUSE-HINDS COMPANY, New York city, maker of switchboards, panelboards, knife switches, "Norbitt" specialties and "Hawley" time registers, has removed its offices from the ground floor of the Havemeyer Building, 23 Dey street, to more commodious quarters on the eighth floor, room No. 804, in the same building.

THE CHASE-SHAWMUT COMPANY, Newburyport, Mass., has issued bulletin No. 31, describing the "Shawmut" conduit outlet bushing, which is a capping for the free ends of iron-armored conduit. The bulletin supersedes bulletin No. 26, and contains prices on the larger sizes of bushings, as well as reduced prices of locknuts.

THE LECLANCHE BATTERY COMPANY, 111-117 East One Hundred and Thirty-first street, New York city, is calling attention to the "Gonda" wedge cell. This type of cell is a radical departure from ordinary primary battery construction. The company will be pleased to send a complete description of the cell upon application.

THE WARD LEONARD ELECTRIC COMPANY, Bronxville, N. Y., has issued bulletins Nos. 19038, 19052 and 19053. No. 19038 describes resistance units which are carefully tabulated, showing the resistance and capacities of the various-sized units. No. 19052 describes motor starters, and No. 19053 motor field rheostats and motor speed control.

THE HOLOPHANE GLASS COMPANY, Glackner Building, New York city, is distributing another booklet in its series of illumination literature. This is entitled "The Lighting of Hotels and Clubs." In addition to the text, there are a number of illustrations giving practical demonstrations of the utility of the Holophane globe as a modern aid to illumination.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., will erect a new building 40 by 106 feet, and three stories high. The building will be equipped with machinery for manufacturing electrical appliances. The boiler room will be 36 by 40 feet, and the boiler plant will be of 100 horse-power. The building will give the company 16,000 feet of additional floor space.

THE BAUSCH, LOMB, SAEGMULLER COMPANY, Rochester, N. Y., has been incorporated to manufacture engineering, astronomical, physical and other instruments of precision. The Bausch & Lomb Optical Company is to be the sales agent of the new corporation, whose manufacturing plant is to be in the north end of the recently completed large addition to the Bausch & Lomb factory.

J. H. BUNNELL & COMPANY, INCORPORATED, 20 Park place, New York city, have brought out their catalogue for 1905-1906. This is the twenty-fifth edition, and describes telegraph instruments and appliances, telephone apparatus and fittings, fire-alarm equipment, bells, batteries and general electric supplies. The catalogue is bound in cloth, and has about 400 pages, profusely illustrated.

EUGENE MUNSELL & COMPANY AND THE MICA INSULATOR COMPANY, Chicago, Ill., are sending to the trade a handsome blotter, printed in two colors, announcing their removal from 117 Lake street to large and commodious quarters at 358 Dearborn street. Both companies are experiencing a large demand for mica and micanite materials, and the trade west of Ohio and Pennsylvania is handled by the Chicago house, where a large stock is carried, enabling the company to make prompt shipments.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing price-list No. 10, covering D & W enclosed fuses and safety devices. In this price-list every line of new code fuses is listed, and the arrangement and classification have been given careful consideration, with a view to making the book a compact and convenient reference. The Central Electric Company, as the general western selling agent for D & W fuses and safety devices, will mail one of these catalogues to any user of electrical material on request.

THE DALE MANUFACTURING COMPANY is sending out from its building at Ninth avenue and Thirteenth street, New York city, a very attractive series of cards, eyeleted for convenient suspension, illustrating and pricing Dale's "Leaders" in six divisions. These comprise gas, electric and combination fixtures, and while the prices given are extremely low, the company announces that the workmanship and finish are of the highest order. Illustrations of the full line, with discounts, will be mailed upon application. These fixtures are made in two, three and four lights.

THE AMERICAN ELECTRIC AND CONTROLLER COMPANY, New York, heretofore located at No. 12 Dey street, has taken offices in the Electrical Exchange Building, 136 Liberty street, New York, where it has on exhibition a line of its specialties. It has ready for distribution a list of bulletins as follows: No. 1, describing the "Rheocrat;" No. 2, applications of the "Rheocrat;" No. 3, electrically operated switches; No. 4, automatic starters for induction motors; Nos. 5 and 6, applications of automatic starters; No. 7, solenoids for direct and alternating-current service; No. 8, applications of solenoids. On request it will furnish free of charge a suitable binder in which these bulletins can be preserved.

THE LOWE ELECTRIC COMPANY has been incorporated under the laws of the state of New York. Mr. Ernest A. Lowe has withdrawn from the firm of Lowe & Leveridge, and is now treasurer and president of the new company. This corporation will enter the electrical field well equipped to transact various lines of electrical business. In addition to a new and complete stock of electrical supplies, which will be carried at the store, 35 Dey street, New York city, the corporation takes over the manufacturing plant of Robert L. Hailey, 79 Cortlandt street. Mr. Hailey becomes secretary and a stockholder of the new company. The factory will be thoroughly renovated and fitted up with new machinery for quick repairs to dynamos, motors and all kinds of electrical apparatus. The company will also have an efficient construction department for prompt attention to breakdown demands and emergency service.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 20. NEW YORK, SATURDAY, MAY 20, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Units and Standards . . . 799
The International Railway Congress . . . 799
The Aluminum Electrolytic Condenser . . . 800
The Institute Election . . . 801
The American Institute of Electrical Engineers . . . 802
Schuyler Skaats Wheeler . . . 803
National Electric Light Association . . . 804
A Big Chunk of Copper . . . 804
Electric Lighting at the Lewis and Clark Exposition . . . 804
Exhibition of Cooking by Electricity . . . 804
High-Speed, Long-Distance Electric Traction at the New York Electrical Society 804
The Annual Convention of the American Institute of Electrical Engineers . . . 804
Wheel-Pits and Tunnels for Niagara Power, by Alton D. Adams . . . 805
Electrical Standards and Units . . . 809
New York Electrical Society . . . 811
The Aluminum Electrolytic Condenser, by Clarence Irving Zimmerman . . . 813
Street Lighting in New England . . . 816
The International Railway Congress . . . 818
Progress in the Development of the Electric Drive, by Sidney B. Paine . . . 820
ELECTRICAL PATENTS . . . 821
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 822
INDUSTRIAL SECTION:
New Fort Wayne Induction Integrating Wattmeter . . . 824
New Decade Resistance Box . . . 825
A Handsome Railway Congress Souvenir . . . 825
Arc Lamp Resistance, High-Tension Transformers and Autostarters . . . 826
"Turndown" Type Arc Burst . . . 828
New Form of Lamp Socket . . . 828
CURRENT ELECTRICAL NEWS . . . 829

UNITS AND STANDARDS.

On another page of this issue we give an abstract of the discussion on units and standards which took place at a recent meeting of the Institution of Electrical Engineers, of Great Britain. The discussion was opened with a report by Mr. W. Duddell, of the work of the International Electrical Congress, St. Louis. Part was taken by a number of prominent men, but no definite conclusions were reached. The consensus of opinion seemed to be that the present units and standards should be maintained until more concerted action can be assured between the different countries.

It was admitted during the discussion that the legal value of the Clark cell is too high, and that the true value is much nearer the figure given by Dr. Henry S. Carhart. The advantages of the Weston cell over the Clark cell were admitted, and it seems probable that the new cell will become the accepted standard when time has proved its constancy.

During the discussion much stress was laid upon the fact that while, from the physicist's viewpoint, there is considerable discrepancy between different standards, for commercial purposes this is negligible. This discrepancy will be removed as the standards are improved and as agreement is reached between the different countries. From the physicist's viewpoint it does not diminish the accuracy of his work, and, as more reliable figures are obtained, a correction factor may be applied.

THE INTERNATIONAL RAILWAY CONGRESS.

The importance of the International Railway Congress, held recently in Washington, is hard to estimate. An enormous amount of work was done, and a great deal of a permanent character accomplished. For the first time, electricity was one of the important factors considered. Naturally, the greatest attention was given to railroad matters which are not of special interest to the electrical engineer, but it is significant that electric traction received the serious consideration given to it.

There were three applications of electricity discussed before the congress. The one of most importance was, of course, the electrical operation of railways. Progress in electric traction was reported by Mr. W. D. Young for this country, who described what was being done by the large manufacturing companies, particularly in developing a single-phase motor. Mr. Young referred also to what had been done in Europe in the same line. M. P. Dubois, reporting for France, described what is being done there, and other reporters told how electric traction is progressing in their countries. Remembering that, but a few years ago, the suggestion that the electric motor would be used on large railway systems was laughed at, the change in sentiment during the last five years is remarkable. It should be said for the railway engineer that he is not opposed to new methods, but he does insist upon some reason being given for any change. He is conservative, and very properly so, but when a new method is developed which he is convinced it will be to the benefit of his road to adopt, he is ready to change. He insists further that it be shown beyond doubt that the new apparatus is capable of performing satisfactorily the work assigned to it. He must also be assured either that certain local conditions make the change necessary, or that the financial results will be good. Since the last meeting of the congress we have seen the electric railway grow from the city or suburban line into interurban and high-speed lines; and we are shortly to see the electric system applied on certain sections

Digitized by Google

of the largest and most important railways in this country, the conditions in these cases, however, being such that no other system could be considered.

The other uses of electricity attracting the attention of the congress were the lighting of cars and automatic block signaling. While the electric lighting of trains is being tried on a large scale, as yet it is impossible to come to any final decision as to the best of the five different systems under investigation. The experience of the reporters with the various systems differed somewhat, a system giving satisfaction in one case proving unsatisfactory in another. The general conclusion seemed to be that systems of electric lighting are giving satisfaction on the different roads, and attention was called to their advantage in certain cases for intermittent lighting in passing through tunnels, and for operating ventilating fans.

The third important use of electricity in railway work is in automatic block signaling. This application is not new. In this country automatic systems have reached such a state of perfection that it is held by many to be a safe and economical method of protecting trains on railways. In Europe the same progress has not been made. A number of instances were related, in which an automatic system was installed and operated satisfactorily for a number of years. In some cases, however, it was found that the expected economy due to the reduction in the number of employés was not attained. The general opinion seemed to be that automatic signaling, properly designed and installed, should be recognized as a suitable means of protecting train and switch movements. Its general adoption in place of existing systems is not yet to be recommended.

The reference to automatic block signals brings to mind another phase of railway work where the automatic apparatus is coming into use. This is in the automatic coupling of cars, particularly for electric trains, by which the coupling of the drawbar, the train hose and the train line is effected at the same time. This not only increases the celerity of train movements, but decreases the danger to the train hands.

An important feature of the Washington meeting was the exhibit of American railway appliances. To the foreign members of the congress this was an exceptional opportunity to examine the apparatus and devices which have contributed so largely to our success in railway building and operation.

The arrangements for conducting the congress were excellent, and a better place could not have been selected than Washington, where there are so many points of interest to every one. It would seem to be a desirable meeting-place for the foreign members of the congress, for all of them must be interested in American railway methods. Another phase of the congress work deserves mention—that is, the excellence and promptness with which the work was reported by the official organ, the *Railway Age*. This journal had a large staff at Washington, and issued daily a twenty to twenty-eight-page paper giving the official report of the work and the not less interesting unofficial discussion of matters of interest. The congress was fortunate in having this part of the work handled so ably.

THE ALUMINUM ELECTROLYTIC CONDENSER.

On another page of this issue is given an abstract of a paper presented at the recent meeting of the American Electrochemical Society by Mr. C. I. Zimmerman, on "The Aluminum Electrolytic Condenser." This is the second paper by Mr. Zimmerman on the same subject. An abstract of the first was published in the ELECTRICAL REVIEW for April 30, 1904.

In the second paper, Mr. Zimmerman describes an extension of his investigation, and points out some new and interesting properties of this peculiar device. It may be well to describe briefly the actions which are believed to give rise to the capacity effect of the aluminum electrolytic condenser. When a plate of aluminum is placed in certain solutions it behaves in a peculiar way; it allows an electric current to pass from the electrolyte to it, but it prevents a flow of current in the opposite direction. In other words, the plate acts as an electric check valve. The effect is supposed to be due to the formation of aluminum hydrate, which acts as a semi-permeable insulator—that is to say, it allows hydrogen ions to pass through it, but prevents the passage of hydroxyl ions. It is this effect which has been made use of in the aluminum rectifier. By using two plates—one of aluminum, and the other of some different material, such as carbon—a device is obtained which conducts in one direction only. Applying an alternating electromotive force to this arrangement, but one-half of each current wave will pass through the cell; the other half will be checked. However, by a suitable arrangement of similar cells, or by a combination of electrodes in one cell, the current may be rectified so that both current impulses are sent on in the same direction. The electrolytic condenser depends for its action upon the same effect. Placing two aluminum plates in the same cell gives us an arrangement which, after the first rush of current, stops all flow of current through the cell. We then have two conducting plates separated from a conducting electrolyte by two thin insulating surfaces. We have what is, in effect, two static condensers connected in series, each condenser being formed of the combination—aluminum plate, aluminum hydrate dielectric, electrolytic plate. The combination behaves in many ways as two static condensers connected in series, but it has some peculiar properties of its own.

It may be questioned whether the above statement is exact. As each aluminum plate has the property of resisting the flow of current in one direction only, it would seem that we would have, in effect, but one condenser; but a current can only pass from the electrolyte to an aluminum plate when it can pass into the electrolyte at the other end of the cell. Since each aluminum plate, in turn, prevents the passage of current into the electrolyte, there can, of course, be no passage of current from the electrolyte out. This statement should be modified by saying that, when a condenser is first connected to a source of alternating electromotive force, electricity flows out of the electrolyte until the potential of the latter is that of the lowest negative value of the source. When this point has been reached, the electrolyte can not be drained any further, and

Digitized by Google

since the aluminum plates will not allow electricity to flow into the electrolyte, it must remain at this constant negative potential. It may be considered, then, to have a constant negative charge, and as the potential of the two plates is varied by the variations of the source, this negative charge, caught in the electrolyte, will oscillate back and forth through the electrolyte from side to side, balancing at each plate in turn an equal positive charge. Although this charge oscillates through the electrolyte, there is no current passing through the dielectric coating on the aluminum plates. This coating, then, always acts as an insulator, and gives us the effect of two condensers in series.

Of course, the value of the negative charge held in the electrolyte will be changed if the condenser be connected to a source of electromotive force which has a lower negative value than the first; but, after the first rush, the electrolyte will be brought to a new negative potential, and will then change no further. If the condenser be disconnected from the source of supply, it will be found to hold a negative charge which can be drawn off by introducing an electrode of some material other than aluminum into it. It is in this point that the electrolytic condenser differs from two static condensers connected in series. The analogy could be made almost exact if one of the condensers were short-circuited momentarily, and the connection broken when the intermediate plates were negatively charged. This arrangement will hold a constant negative charge which will oscillate from condenser to condenser as the voltage at the two outer terminals of the arrangement oscillates.

So far we have been considering an arrangement in which the aluminum electrodes are of the same size. If one be made considerably larger than the other, we have two condensers connected in series, one of them having a larger capacity than the other. The negative charge taken by the electrolyte will correspond to the capacity of the larger plate, but as the capacity of the smaller plate is less, it can not hold this entire charge, and part of it will therefore remain bound to the larger plate. Introducing, now, an indifferent electrode into the cell, a peculiar effect occurs; we have, in addition to the rectifying action of the device, a condenser action. The negative charge held around the large electrode can not be taken care of by the small one, as the voltage of the latter electrode rises, and this charge will rush out of the cell through the third electrode. The voltage due to the condenser charge is added to that of the supply, causing the difference of voltage between the indifferent electrode and the small one to be greater than that of the supply. The greater the difference in size between the two aluminum plates, the more marked is this effect. The limiting value is twice that of the supply, but it can not be reached in practice, since it is possible theoretically only when the area of the small electrode is zero. This transformer action, as it were, can be carried still further, for by combining several cells in a certain arrangement, three times the maximum voltage of the supply can be obtained, and, no doubt, the effect could be carried further.

By placing three aluminum plates in the solution, and connecting them to the three phases of a three-phase circuit, a three-phase condenser is obtained, which behaves just as does the single-phase condenser. In this case, however, the bound negative charge held by the electrolyte rotates in the cell.

The aluminum condenser, as compared with static condensers, has a large capacity, due, undoubtedly, to the extreme thinness of the dielectric. Unfortunately, this property, which gives it a large capacity, limits the voltage for which it is suitable. It does not operate satisfactorily much above 100 volts, and as condensers in practice are usually required for higher voltages, this is a serious objection. If, for example, one wishes to make an aluminum condenser for 500 volts, it will be necessary to connect five such condensers in series; and since this arrangement gives a capacity of the set only one-fifth that of one condenser, five such sets would be required in parallel—that is to say, to obtain a capacity for 500 volts, equivalent to that of a single condenser, twenty-five such condensers are required. However, for low potentials the device would seem to be admirable.

The step-up transformer effect described above is also of little value practically, because it is obtained only when one electrode has a very small area; and therefore the current flowing will be small. In other words, we are able to raise the voltage, but can draw but little current from the device.

The efficiency of the condenser may be high. Mr. Zimmerman has constructed one in which the losses are only five per cent of the volt-amperes represented by the charge.

As a practical device, the aluminum condenser, as at present constructed, can have but little use. If an electrolyte could be found which would make it operative up to a thousand volts, say, it would be most valuable because of its cheapness, its indestructibility (it is practically self-healing), and its large capacity. It has been claimed that, by employing certain organic compounds as electrolytes, an aluminum rectifier has been operated up to 500 volts. How satisfactory it was, we can not say. Up to 100 volts many electrolytes are satisfactory.

THE INSTITUTE ELECTION.

At the meeting of the American Institute of Electrical Engineers held in New York city, Tuesday, May 16, the annual election of officers was announced. The Institute is to be congratulated upon its new president. Dr. S. S. Wheeler has been identified with electrical matters for nearly twenty-five years. He has distinguished himself in many phases of the work, and has added not a little to its development. He has been connected with the Institute from almost the beginning, and has served it in many capacities, being a past vice-president and at the present time a member of the board of managers. He has been interested in some of the most important undertakings of the Institute, and was largely influential in securing the new engineering building. He has been a liberal donor to the Institute library. We believe that the Institute may look forward to his administration with the expectation of a successful and active year.

Digitized by Google

The Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held in the chapter room of Carnegie Hall, New York city, May 16. The following announcements were made for officers for the ensuing year:

President — Dr. Schuyler Skaats Wheeler.

Vice-presidents — Charles A. Terry, Townsend Wolcott, Gano S. Dunn.

Managers—C. C. Chesney, Calvert Townley, Bancroft Gherardi, Charles L. Edgar.

Treasurer—George A. Hamilton.

Secretary—Ralph W. Pope.

The reports of officers and committees were presented and accepted. The secretary reported that the membership on May 1 was 3,460.

The report of the representatives of the joint committee on the engineering building was read by the secretary. This explains briefly the plans which have been adopted for the erection of the building and for bringing together the libraries of the three national societies so as to form one comprehensive engineering library. It was stated by the president that the contract for the building would be let shortly, and it is expected that ground will be broken some time next week. A statement from Dr. S. S. Wheeler was read, which gives briefly the arrangements made for the division of the $1,500,000 donated by Mr. Carnegie for the erection of this building, and which also explains the organization effected for carrying out the intentions of the donor.

The report of Chairman Charles F. Scott, of the local organization committee, was read by the secretary. There are now thirty local sections where the work of the Institute is followed earnestly.

The report of Chairman W. D. Weaver, of the library committee, was read by Mr. Gano S. Dunn. The library is now valued at $22,000. A number of gifts were received during the year.

Mr. Calvin W. Rice, chairman of the land and building fund committee, reported that this fund has reached the sum of $66,000, two of the recent contributions being $5,000 from Thomas A. Edison, and $5,000 from Dr. M. I. Pupin, the latter being given under the condition that nine other members of the Institute give a similar amount.

The report of the board of examiners was read by the secretary. This suggests that the board of trustees consider establishing a new class of membership, to which associates who have become eminent in their particular field, but who are not practising engineers, shall be eligible.

The financial statement for April, 1905, shows that the cash on hand was $39,301.15, the value of the Institute properties was $44,220.11, making a total of $92,396.89.

A number of other committee reports were presented.

The floor was given to Mr. C. E. Waddell, electrician in charge of the electrical department of the Biltmore estate, Biltmore, N. C., who is chairman of the local reception committee for the annual convention of the Institute, to be held at Asheville, N. C., June 19-23. Mr. Waddell outlined the programme which had been arranged, and urged a full attendance at the convention.

The general subject for discussion for the evening was safety devices. Under this head the following papers were presented: "Relays," by George F. Chellis (associate), instrument tester, Interborough Rapid Transit Company, New York city; "The Proper Limit of Duplication to Secure Reliability of Service," by H. W. Buck (member), electrical engineer, Niagara Falls Power Company, Niagara Falls, N. Y.

The paper by Mr. Chellis, divided relays into three classes: first, differential relays operating at a lower current value when the direction of the flow of energy is reversed than when flowing in its initial direction; second, straight overload relays operating when the current reaches a predetermined limit, irrespective of the direction of flow of energy; third, reverse-current relays, operating when the current reaches a certain predetermined limit upon reversal of the flow of energy. The characteristics and operation of alternator relays and feeder relays were described, and the methods of applying these relays detailed.

Mr. Buck considers that the question of the proper reserve in an electrical installation is a problem that, like many engineering problems, must be settled largely upon the basis of cost. It is nearly always a question involving a balance between the company's obligation to its customers and the obligation to its stockholders. From the standpoint of the consumer, the more reserve, the surer will be his supply of power. On the other hand, to the power company's stockholders, the less the investment in reserve, the larger the dividends, unless the reserve has been cut down to a point where the company's reputation is endangered by interruptions to service. The question is purely a practical one, and no definite laws can be enunciated, nor can any curves be plotted which will indicate the proper amount of reserve to be installed under various conditions. The decision in each case must be based on an intimate knowledge of the local conditions and requirements of the particular installation in question. His paper consisted of a discussion of the general principles involved.

The discussion on the papers was opened by Mr. H. G. Stott, New York city, who differed from Mr. Buck in some points. Mr. Stott said that our present generating stations have reached the very respectable size of 50,000 kilowatts, but there is no reason to hold that this is the final limit. He believes that we will yet go to 100,000 kilowatts. A large station may be just as reliable as a smaller one, particularly with the plan now generally adopted of making each generating unit independent of the others. Mr. Stott said that the danger to underground cables varies inversely as the voltage of transmission, in other words, it is directly proportional to the square of the current, that is with the heating effect. He thinks that we will shortly raise the voltage of transmission by means of underground conductors to 25,000. He recently had occasion to look into the reliability of electric railway operation, and was much surprised to find that, of the total time of interruption, less than one per cent was due to electrical breakdowns, the other ninety-nine per cent being due to causes common to all railway operation.

Mr. Philip Torchio, New York city, explained the system of relays now being used by the New York Edison Company.

Mr. Charles W. Ricker, New York city, gave some interesting experiences of railway operation, and laid stress upon the necessity for protecting all station apparatus, mechanical as well as electrical, against the effects of electrical troubles.

Mr. C. O. Mailloux, New York city, made some interesting remarks upon station protection and operation, as did also Mr. W. S. Wells.

The discussion was closed by Messrs. Chellis and Buck, the latter holding that, while a duplication of plants is more essential for a hydraulic development, in his opinion, two steam plants are better than one.

Lamp Manufacturers' Meeting.

The manufacturers of incandescent lamps operating under the licenses granted by the General Electric Company on its patents, met in quarterly session at Cambridge Springs, Pa., during the last three days of last week.

Digitized by Google

SCHUYLER SKAATS WHEELER.

PRESIDENT, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Dr. Schuyler Skaats Wheeler, the new president of the American Institute of Electrical Engineers, was born, of Dutch descent, in New York city in 1860. He was educated at Columbia College, being graduated there in 1881. After leaving college, he was employed as assistant electrician in the American branch of the Jablochkoff Electric Light Company. On the dissolution of this company, owing to the failure of the Jablochkoff candle, which was an essential portion of the company's system, Dr. Wheeler took a position with the United States Electric Light Company.

Shortly afterward he became connected with Thomas A. Edison, and it was in this connection that he did his most important early work. At one time he was in charge of the Pearl street station of the New York Edison Company.

Later on, Dr. Wheeler took charge of the installation of a large number of Edison stations in various cities throughout the country. He became superintendent of the Newburgh (N. Y.) Edison Company, after constructing the underground system in that place.

Dr. Wheeler left the Edison company in 1886, and became electrician of the Herzog Teleseme Company. He made many important inventions in this connection. Together with Charles G. Curtis and Francis B. Crocker, he organized the C & C Electric Motor Company, which was the first concern in the United States to manufacture small electric motors. Dr. Wheeler was electrician and factory manager of the new company, and was responsible for most of the features which soon brought the company's motors into prominence.

In 1888 Dr. Wheeler, with his two associates, severed his connection with the C & C company, and Mr. Crocker and Dr. Wheeler formed the firm of Crocker & Wheeler, which later became the Crocker-Wheeler Electric Motor Company. About the time of the formation of the new company, Dr. Wheeler was appointed expert of the Board of Electrical Control, of New York, and performed the duties of that office contemporaneously with the development of the new firm. Shortly after the formation of the Crocker-Wheeler Electric Motor Company, Mr. Crocker was appointed professor of electrical engineering at Columbia University. After his appointment, Dr. Wheeler resigned from the Board of Electrical Control, and gave his entire attention to the new company, of which he was elected president and general manager.

The company was originally located in New York. After about two years, it was reorganized as the Crocker-Wheeler Company of New Jersey, and a large factory was built at Ampere, N. J. The new works were destroyed by fire in 1895, but were immediately rebuilt on a larger scale. The company managed to hold the greater part of its business by installing in tents and temporary sheds large electrically driven tools, and carrying on manufacturing operations during the process of rebuilding. Dr. Wheeler personally supervised the reconstruction of the works, and, on their completion, organized a system of carrying on the business which has proven most successful. This system involves a ledger account of every piece of material, and every finished product which the company uses or manufactures. It also involves the writing of specifications by the draughting department, the issuance of orders and requisitions and by various other departments and a system of receipts and deliveries by the receiving and stock departments. With this system the progress of an order through the shop is rapid and with the minimum amount of friction. It has increased the output, decreased the cost of production and entirely eliminated the necessity of shutdowns for the purpose of inventory.

DR. SCHUYLER SKAATS WHEELER.

Dr. Wheeler is intensely interested in his work, and applies himself to it most closely. He is a man of great force of character, showing a persistent determination to accomplish his ends. This is well illustrated by the methods by which he handled the machinists' strike in 1901, in which the Crocker-Wheeler works were involved.

Five years ago he purchased and presented to the American Institute of Electrical Engineers the Latimer-Clark library, which is said to be the most complete and rare collection of early electrical works in the world. He has contributed on a large number of subjects to the technical journals, and has written, conjointly with Professor Crocker, a book on "The Practical Management of Dynamos and Motors." This book has gone through a number of editions, and has a large circulation.

In 1888 Hobart College conferred on Dr. Wheeler the degree of Doctor of Science. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the University and Lotos clubs, of New York, the Chamber of Commerce, of New York, and a large number of other societies.

Dr. Wheeler was untiring in his efforts to secure a permanent home for the American Institute of Electrical Engineers, and he is one of the electrical engineers composing the joint committee for the expenditure of the building fund and the management of the Engineering Building, which is to be the home of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the Engineers' Club.

As president of the American Institute of Electrical Engineers, Dr. Wheeler will bring to this office all the advantages which obtain with the highly trained mind. He is not only a technician of recognized ability, but he has been adequately schooled by long business experience to handle the Institute affairs with precision and directness. He is a fitting successor to the worthy gentlemen who have contributed so wisely and well to the piloting of this most important engineering organization.

Digitized by Google

National Electric Light Association.

Arrangements have been completed for a special train of Pullman, sleeping, dining, parlor, smoker and observation cars, *via* the Pennsylvania Railroad and the Burlington Railroad, leaving New York at 10.30 A. M., Saturday, June 3, and running as the second section of the Limited, arriving at Chicago at 8.25 A. M., June 4; leaving Chicago 11.15 A. M., and arriving at Denver at 2.30 P. M., June 5.

The convention of the National Electric Light Association holds forth in Denver and Colorado Springs, June 6 to 11.

The Transcontinental Passenger Association has authorized the following rates: from California to Denver and return, one first-class, thirty-day fare. Tickets issued at these rates to be sold *via* usual diverse routes going and returning. The dates of sale are June 2 and 3. The going transit limit to Denver is forty days from date of sale. The stop-over privileges are within the transit limits. For tickets going direct and returning through Portland, $13.50 additional will be charged from San Francisco, Tracy, Lathrop, Stockton, Sacramento, Redding and their intermediates. From points south of San Francisco, Tracy, Lathrop and Stockton, one way local thereto from selling point to be added to $13.50, not to exceed a total addition of twenty-three dollars from Los Angeles or main line points intermediate thereto. From points south of Los Angeles the one-way local thereto to be added to twenty-three dollars, but not to exceed twenty-four dollars from San Bernardino, Colton and Riverside. From Redlands, $24.50 to be added.

In addition to the programme announced last week, the following papers have been arranged for: "Report of the Committee on District Heating," W. H. Blood, Jr.; "Free Signs and Flat Rates," C. W. Lee; "Mercury Arc Rectifier," P. D. Wagoner; "Preliminary Draught for Report of Committee on Rates and Costs," C. L. Edgar, chairman; "A New Type of Single-Phase, Alternating-Current Motor for Elevator Work," S. Percy Cole; "Report on Advertising Methods," Percy Ingalls; "The Paramount Importance of the Selection of Standard in Preference to Special Machinery," David Hall.

Electric Lighting at the Lewis and Clark Exposition.

Electric light is to be used on a large scale at the Lewis and Clark Exposition, Portland, Ore., for decorative effects. A total of over 70,000 incandescent lamps will be used. A feature of the electric illumination will be the electroliers, which will each be made up of a cluster of seventeen fifty-candle-power frosted lamps. The electroliers will be placed on the borders of the sunken gardens of Columbia Court, around which are located all the large buildings. Other electroliers will occupy pedestals on the grand stairway, while the numerous smaller fixtures, each made up of six lights, will be scattered along the walks and through the woods in the western part of the grounds.

The general plan of illumination includes outlining every building by means of eight-candle-power frosted lamps. Four thousand lights will be used on the side of the Agricultural Palace, facing Columbia Court, and 3,000 on the same side of the European Exhibits Building. The dome of the Agricultural Palace will also be lighted by 1,200 frosted lamps. The colonnade entrance will be illuminated by 1,500 lamps. Two towers, located at the ends of the main structure of the Government Building, each 260 feet high, will also be outlined with lamps.

On the bottom of Guilds lake, within the grounds, and on either side of the Bridge of Nations, have been placed rows of fifty-candle-power incandescent lamps. The lamps are enclosed in air and watertight receptacles, and, when lighted, spectators on the bridge will be enabled to see fishes swimming about in the lake. The lake is to be filled with fresh-water fish of many kinds.

Exhibition of Cooking by Electricity.

The New York Edison Company conducted a series of exhibitions of cooking by electricity at its display room, No. 30 West Thirty-second street, New York city, from May 1 to May 13, inclusive. These exhibitions were largely attended by many parties interested in this welcome form of cooking. The cleanliness of the electric system, together with the wide range of the apparatus now fit for service, was highly appreciated by all those who attended these demonstrations.

A Big Chunk of Copper.

A single piece of native copper, weighing 1,000 pounds, will be part of the mining display from Josephine County, Oregon, at the Lewis and Clark Exposition. The chunk of copper was taken from the Golden Standard ledge, the ores of which have been found to assay thirteen dollars a ton in gold and twenty-two dollars in copper.

High-Speed, Long-Distance Electric Traction at the New York Electrical Society.

The 251st meeting of the New York Electrical Society will be held at the American Institute, 19 West Forty-fourth street, New York, Wednesday, May 24, at 8 P. M.

Mr. Charles A. Mudge, formerly chief engineer of the railway department of the Allgemeine Elektricitäts Gesellschaft, Berlin, who took part in the tests on the famous Berlin-Zossen road, will lecture on "High-Speed Long-Distance Electric Traction."

At the juncture when the conversion of steam railroads to electricity is commanding the anxious attention of the mechanical world, this lecture is fraught with unusual importance, and is most timely. The Zossen tests mark the highest point of speed yet attained with locomotives on rails, and point to many of the great problems of the future, as well as their solution. Mr. Mudge's address will be one of the most significant delivered before the society in many years.

The lecture will treat of: the first suggestion of high-speed tests; organization; objects of tests; selection of permanent way; location of road; profile of road; power transmission line; general description of A. E. G. car; summary of tests; first year; second year; third year; illustrated description of apparatus; wiring of car; trolley construction; water rheostat; motor suspension; motor ventilation; truck details; brake arrangements, etc.

Mr. Mudge will conclude the lecture by detailing the bearing of his experience in connection with these tests on the development of high-speed electric railroading abroad.

The Annual Convention of the American Institute of Electrical Engineers.

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., June 19 to 23. A fine list of papers has been prepared for presentation at this convention. The committee on transportation and arrangements is Frederick C. Bates, chairman, 44 Broad street, New York city; Samuel Sheldon and Arthur Williams.

The passenger department of the Southern Railway has issued a handsome booklet giving complete descriptions and illustrations regarding Asheville and its environment. The scenes along this route are many and of rare beauty. It is expected that the convention will be largely attended, and, in addition to the business sessions, the recreation period can not fail of being most delightful.

Digitized by Google

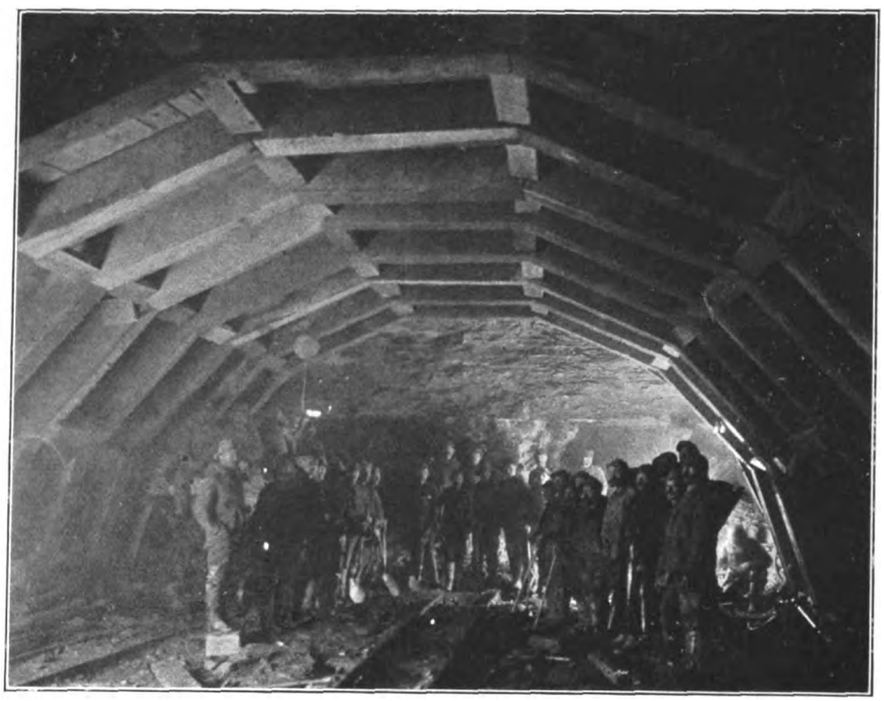
Wheel-Pits and Tunnels for Niagara Power.

By Alton D. Adams.

WATER drops into wheel-pits that are nearly as deep as the gorge beneath four of the great power plants at Niagara Falls. Each of these pits has been excavated through alternate layers of limestone and shale, and the rock removed, if it had been carved out as a monolith, would stand far higher in each case than the generating station that now covers its former resting-place.

Each of these pits represents a large volume of excavation, and no small part of the total plant investment, per horse-power or kilowatt of total capacity, but there are striking differences between the pits in these respects.

On the New York side of the river, both of the power plants operating with these deep wheel-pits are owned by the Niagara Power Company, and on the Canadian side, one of the great pits is owned by the Canadian Niagara Power Company, and the other by the Toronto & Niagara Power Company. Over one of the wheel-pits of the Niagara Power Company there are ten generators of 3,750 kilowatts capacity each, aggregating 37,500 kilowatts, or 50,000 horse-power, and over the other wheel-pits there are eleven generators of the capacity just named that aggregate 41,250 kilowatts or 55,000 horse-power. In the plant of the Canadian Niagara Power Company, on the Ontario side of the falls, there will be ten generators of 7,500 kilowatts or 10,000 horse-power capacity each, that aggregate 75,000 kilowatts or 100,000 horse-power. The wheel-pit and power-house of the Toronto & Niagara Power Company are designed for eleven main generators of 8,000 kilowatts each, or an aggregate capacity of 88,000 kilowatts or 117,000 horse-power. Beneath the older station of the Niagara Falls Power Company, in which the ten generators of 50,000 horse-power total capacity are located, the wheel-pit is 424.7 feet long, 18.5 feet wide and 178.5 feet deep. Assuming the power-house floor to be at the natural ground level, as is nearly correct, this wheel-pit required the excavation of about 52,236 cubic yards of rock. Reduced to volume of excavation per unit of power capacity in the electric generators, this older wheel-pit required the removal of 1.04 cubic yards of shale and limestone for each horse-power of capacity, or of 1.39 cubic yards for each kilowatt. Taking the cost of this excavation at $3.50 per cubic yard, which is said to be the going figure for such work about Niagara Falls, the entire investment for digging the pit was $182,826, and this amounts to $3.65 per horse-power, or to $4.87 per kilowatt of generator capacity. In the second wheel-pit of the Niagara Falls Power Company, which is just across its canal from the earlier pit, the dimensions are nearly the same as those above named, but owing to the use of a more compact design for five of the generators in the power-house above, it was found possible to install eleven instead of ten units, and the amount and cost of the excavation per kilowatt was thus reduced about nine per cent.



THE TUNNEL UNDER THE NIAGARA RIVER, TORONTO & NIAGARA POWER COMPANY.

On the Canadian side of the falls a great saving has been effected in the excavation of wheel-pits, through the adoption of electric generators of fully twice the individual capacity of those in the plants of the Niagara Falls Power Company. Beneath the power-house of the Canadian Niagara Power Company the wheel-pit is about 570 feet long, 17.75 feet wide and 162 feet deep below the level of the power-house floor, so that its excavation involved the removal of 60,636 cubic yards of rock, as the power-house floor is near the natural ground level, and there is only a thin layer of earth over the limestone. As the combined capacity of electric generators in this power-house is 75,000 kilowatts, the volume of rock excavated amounts to 0.80 cubic yard per kilowatt or to 0.60 cubic yard per horse-power of their capacity. Taking the cost of this excavation at $3.50 per cubic yard, as before, the investment for this purpose in the wheel-pit of the Canadian Niagara Power Company is $212,226, and this reduces to $2.12 per horse-power, as to $2.82 per kilowatt of generator capacity.

Nearly all of this very large saving in the volume and cost of excavation per unit of power capacity is due to the adoption of 10,000-horse-power generators in the Canadian plant, instead of generators of 5,000-horse-power such as are used in the plants of the Niagara Falls Power Company.

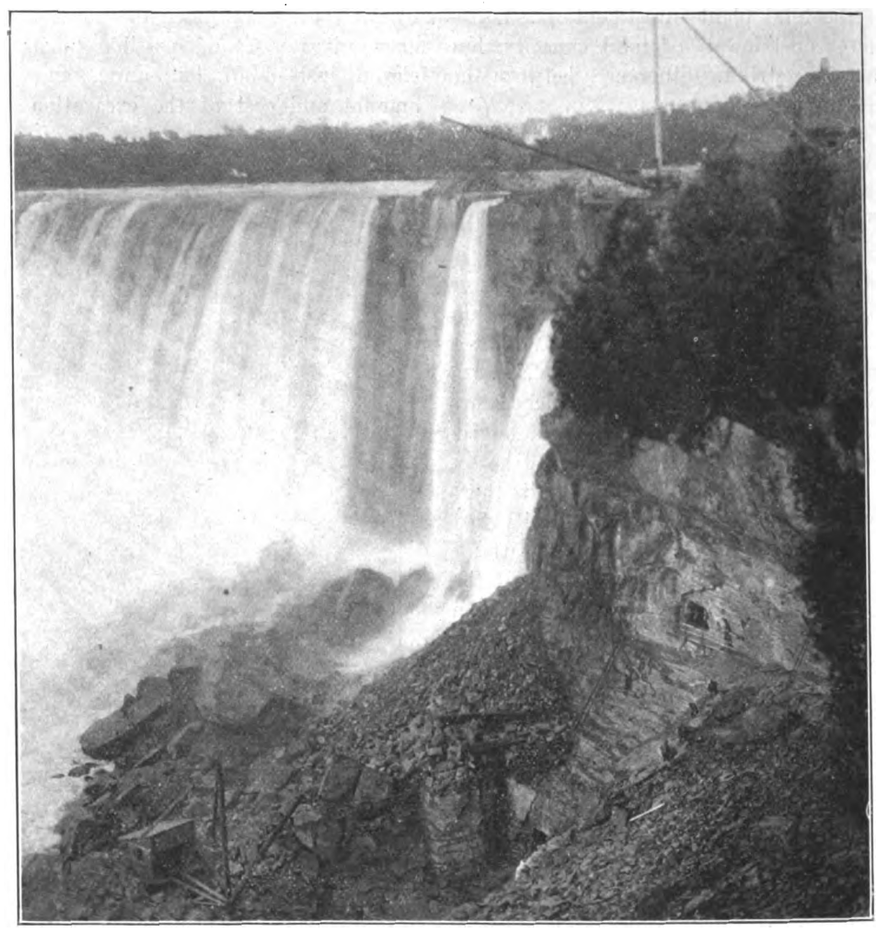
The length of a wheel-pit beneath a given number of vertical direct-connected generators obviously depends on the diameter of each, when located in a single row, and the width of such a pit depends on the diameter of each vertical turbine wheel, which is certain to be less than that of its connected generator. As the diameters of electric generators and of turbine water-wheels increase but slowly with their capacities, a 10,000-horse-power unit requires only a little more

Digitized by Google

floor and pit area than does a unit of 5,000 horse-power. This fact is very evident on comparing the pit area of 7,857 square feet beneath the 50,000-horse-power plant of the Niagara Falls Power Company with the 10,117 square feet of pit area beneath the plant of the Canadian Niagara Power Company with its capacity of 100,000 horse-power. In the case of the former of these two plants the pit area amounts to 0.157 square foot per horse-power of electric generator capacity, and in the latter case the pit area per horse-power is only 0.101 square foot.

Beneath the floor of the power-house of 117,000-horse-power ultimate capacity, now under construction by the Toronto Niagara Power Company, the pit area is 22 by 416 feet, and the depth is 156 feet. The site of this power-house and wheel-pit was formerly in the bed of Niagara river, so that some filling was necessary, but if the entire depth of the pit had been excavated the volume of rock removed would have been 52,878 cubic yards. It follows that the volume of the pit amounts to 0.60 cubic yard per kilowatt, or 0.45 cubic yard per horse-power of main-generator capacity. At the rate of $3.50 per cubic yard, the cost of excavation for such a pit would be $185,073, and this reduces to $1.58 per horse-power, or to $2.10 per kilowatt of generator capacity above the pit. This pit of the Toronto & Niagara Power Company is thus the smallest and least costly, as that earlier one of the Niagara Falls Power Company is the largest and most expensive of the four great wheel-pits about the falls, in terms of generator capacity. In the earlier pit of the Niagara Falls Power Company, the volume of excavation per unit of power capacity is 2.3 times as great as the corresponding volume in the pit of the Toronto Niagara Power Company, and at the same price of excavation per cubic yard the costs of the pits per unit of power have the same proportion. While most of this great difference in volume and cost is due to the use of generators of 8,000 kilowatts individual capacity over the pit of the Toronto company instead of generators of only 3,750 kilowatts each, as over the pit of the Niagara Falls company, a small part of it results from the greater head of water utilized by the wheels of the former company.

The purpose of each of the four great pits just considered is of course to secure a location for the turbine water-wheels where they can operate under heads approximately equal to the height of Niagara Falls, but the heads actually utilized are not equal. As both of the plants of the Niagara Falls Power Company take water at nearly the same point on its canal, they have a common elevation of head water, which stands normally at 561 feet above tide. In the older of these two plants the centre of the vertical turbine wheels is at elevation 425, and the bottom of the pit at elevation 387 approximately. In this pit therefore the mean head of water above the centre line of the wheels is 136 feet, and the bottom of the pit is 174 feet below the water surface in the canal. The normal elevation of the water surface in this pit, probably when the wheels are operating under full load, is given as about 400 feet above tide, or nearly nineteen feet below the wheel centres. As no draught-tubes are used with these wheels, the head under which they operate is merely 136 feet, the distance between their centre line and the water surface in the canal. Beneath the second power station of the Niagara Falls Power Company the floor of the pit is at the elevation 389 nearly, and the centre line of the wheels is 432.75 feet above tide-water. In this case the turbines are provided with draught-tubes, and therefore operate under the full head of about 161 feet between the surface of the canal and that of the tail-water in the pit. The elevations in this second pit show a distance of 128.25 feet between the canal surface at 561 and the centre-line of the turbines, and a distance of 172 feet from the canal surface to the pit-floor. It thus appears that the turbines in the second pit are located 7.25 feet higher than those in the earlier pit, but that the former operate with a head that is greater by twenty-five feet, if the draught-tubes are able to increase the water pressure by 32.75 feet, which seems hardly probable.



PORTAL OF THE CANADIAN NIAGARA POWER COMPANY TUNNEL, BELOW, AND OF THE SMALL TUNNEL OF THE RAILWAY POWER PLANT, ABOVE.

At the plant of the Canadian Niagara Power Company, the normal elevation of water in the forebay is 516 feet above tide, and the maximum elevation of tail-water in the pit is designed to be 376 feet, thus giving a head of 140 feet for the turbines. These turbines are located with their centre line at elevation 401, and are thus 115 feet below the surface of water in the forebay, so that the draught-tubes must supply a suction equal to twenty-five feet of water pressure in

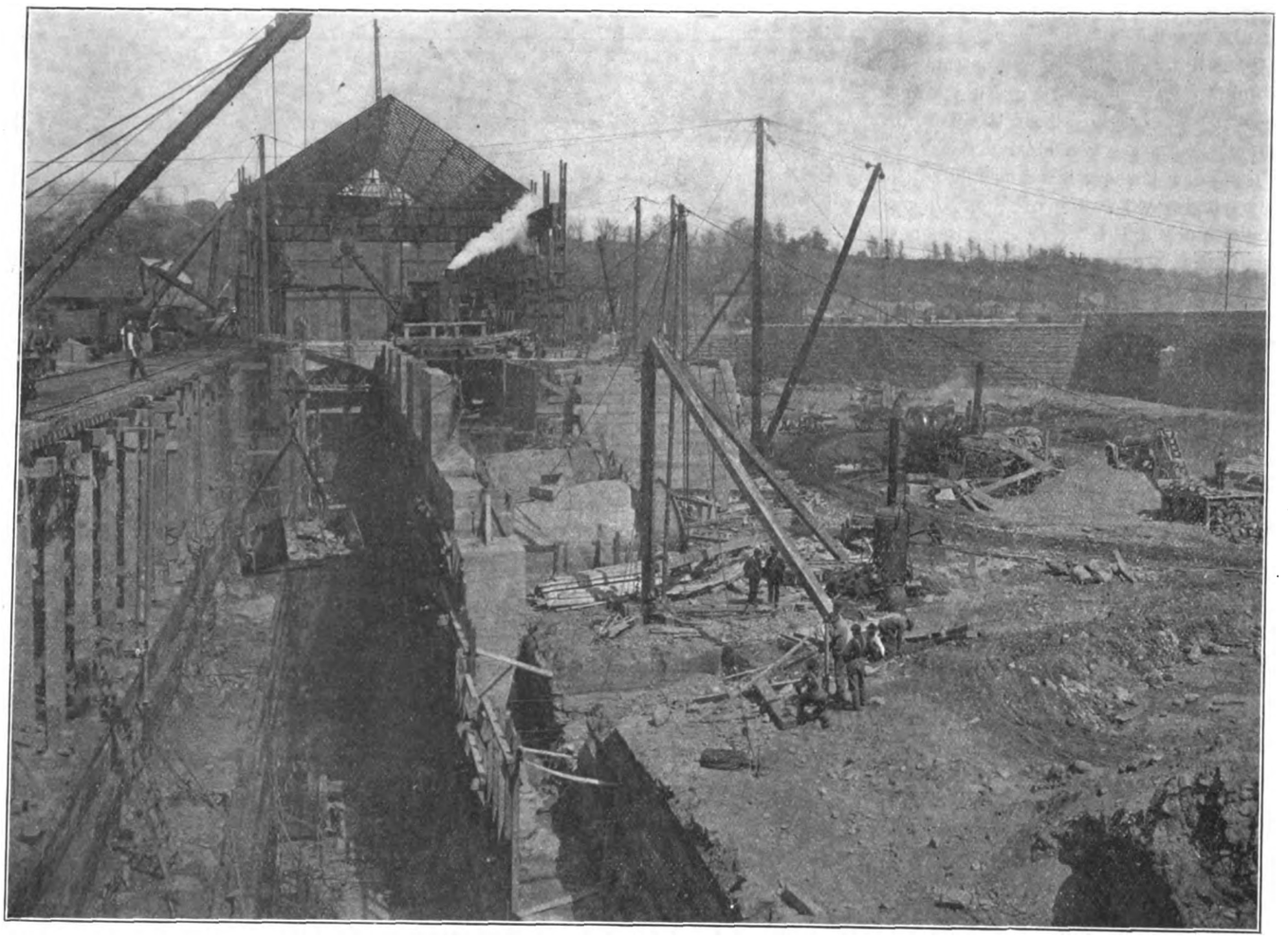
Digitized by Google

order to make up the 140 feet of head. In elevation the wheel-pit slopes from 368 feet at its upper to 351 feet at its lower end, and is thus 148 feet to 165 feet below the surface of head-water, and thirty-three to fifty feet below the centre-line of the wheels. With its maximum elevation of 376 feet above tide, the tail-water in the pit has a depth of about eight feet at its upper and twenty-five feet at its lower end.

In the forebay of the Toronto & Niagara Power Company the normal water-level is about 533 feet above tide, and from this elevation there is a drop of 145 feet to the floor of the pit. The turbine wheels in this case are set on the solid stone floor of the pit, and they discharge through penstocks into tunnels that run parallel with it on either side. When all of the turbines are in operation at full load, it is estimated that the water surface in these side tunnels will stand at elevation 390, so that the head on the wheels will be 143 feet. The centre-line of the turbines in this pit is at elevation 405.5, or 17.5 feet above the main floor, and 127.5 feet beneath the normal level of water in the forebay. Draught-tubes from the wheel cases enter the side tunnels from underneath, and at one point in the length of each side tunnel its bottom is twenty-five feet below the centre-line of the wheel-cases, so that the suction of the draught-tube represents twenty-five feet of head when the tunnel contains no water. In this case the total head on the wheels increases to 152.5 feet, or about 9.5 feet more than the head when all of the wheels are in operation and the water in the side tunnels rises.

In spite of the different levels of head-water at the four plants above named, that is 561, 533 and 516 feet above tide, which differ by forty-five feet, the heads on the turbines at times of full-load are 136, 161, 140 and 143 feet, respectively, at the four plants. The comparatively low head of 136 feet at the earlier of the two great plants on the New York side of Niagara Falls is due, as already noted, to the absence of draught-tubes. At the second plant of the Niagara Falls Power Company, the head of water on the turbines is 161 feet, or twenty-one feet more than the head on the wheels of the Canadian Niagara Power Company, though the elevation of the head-water level at the forebay of the former company is forty-five feet greater than the like level at the forebay of the latter company. This failure to take full advantage of the greater elevation of head-water, just named, was due to the fact that the plants of the Niagara Falls Power Company are much further from the foot of the falls than is the plant of the Canadian Niagara Power Company, and the tunnel of the former company being the longer has a greater descent. A necessity for a large drop in elevation between the upper and lower ends of the long tunnel of the Niagara Falls Power Company kept the floor of its wheel up to elevation 389 at one point, while the shorter tunnel of the Canadian Niagara Power Company permitted an elevation of 351 feet at the lower end of its wheel-pit.

In three out of four of the above-named pits the tail-water rises when the turbines are in operation, and in order to make these turbines constantly accessible they are necessarily located some feet above

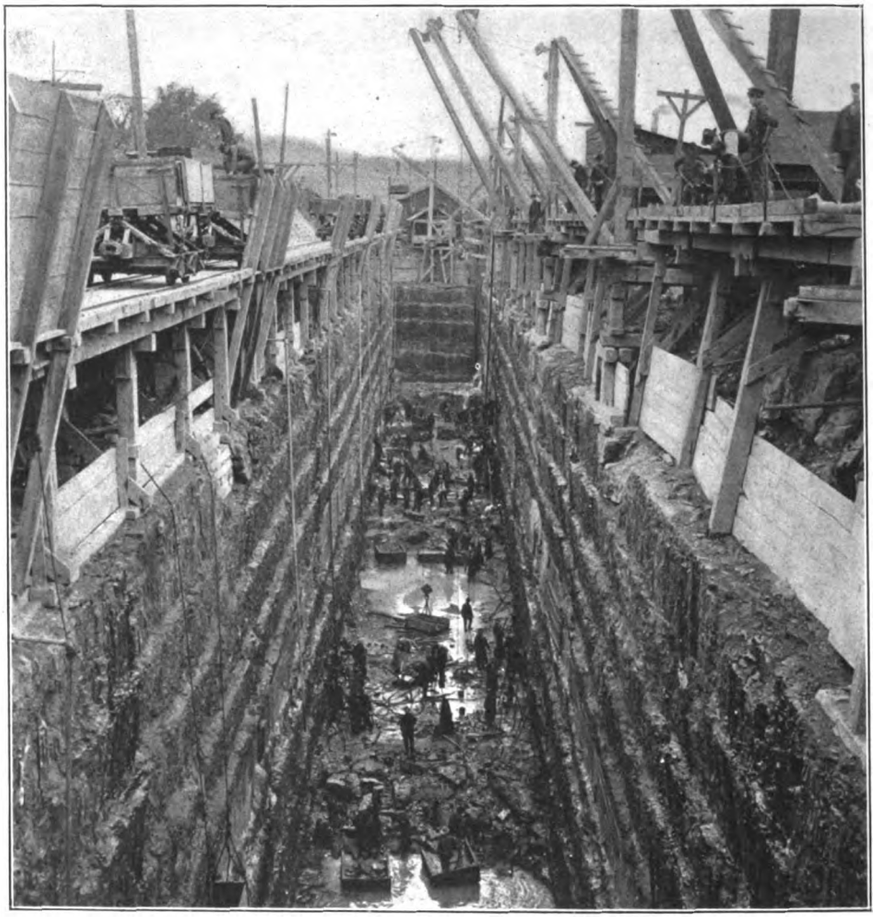


WHEEL-PIT OF THE CANADIAN NIAGARA POWER COMPANY.

Digitized by Google

the pit-floor, and are supported on steel beams. The adoption of parallel tunnels on each side of the pit by the Toronto Niagara Power Company makes it possible to erect the turbine wheels on the pit-floor, which remains dry because the tail-water is discharged into the tunnels. By the construction of two side-tunnels, and the discharge of one-half of the turbines into each, it becomes easy to shut down and inspect some of the wheels while others are in use. Another departure from the construction in the other pits was made by the Toronto Niagara Power Company by the use of masonry arches instead of steel cross-beams to support the bearings of each vertical wheel-shaft at intervals as it rises from its turbine to its generators in the power-house above. In the pit of the Toronto company there are two of these masonry arches for each shaft. Immovable as the underlying rock strata of the Niagara region appear, it is interesting to note that there is a constant movement to and fro of the walls of the great power pits above described, and it is necessary to allow for this expansion and contraction of the rock when erecting beams or arches across the pits. Each pit is lined along its sides with walls of pressed brick or other masonry, and these walls in the pit of the Toronto company are two feet thick. Into these lining walls are set the steel cross-beams and masonry arches that support the bearings of each main shaft. At one side of each pit, and at a greater or less distance from the bottom, a pump chamber is excavated in the rock.

After water passes through the turbines it must be conducted into the gorge at the foot of the falls, and this is done by a tunnel from each pit. Both of the great power pits on the New York side of the falls deliver their water to a single tunnel, but each of the two pits on the Canadian side has its own tunnel. The tunnel that connects the two pits of the Niagara Falls Power Company with the lower river is 6,890 feet long between its portal at the river and the wheel-pit of the first power-house. An extension of 546.53 feet carries the original tunnel to the wheel-pit of the second power plant, and gives it a total length of 7,436.53 feet. Along the first 5,000 feet from its portal at the river this tunnel rises at the rate of 0.7 per cent, or thirty-five feet in all, and along the remaining 1,890 feet to the first wheel-pit it rises at the rate of 0.4 per cent, or 7.56 feet in all, so that the total drop in the tunnel between the first wheel-pit and the portal of the tunnel in the gorge is 42.56 feet. The vertical height of this tunnel from floor to roof is twenty-one feet, its width is 18.5 feet, and it is designed to discharge a maximum of 8,600 cubic feet of water per second into the lower river. On the Canadian side of the river, both of the power plants that discharge through tunnels are much nearer to the Horseshoe falls than are the two New York plants above named to the American falls. By way of the river bank, the plant of the Canadian Niagara Power Company is the nearer of the two on that side to the falls. From the lower end of the pit of this company to its portal in the gorge about 400 feet down stream from the foot of Horseshoe falls, the tunnel is 2,200 feet long. The grade of this tunnel is seven feet per 1,000 sloping toward the river, and as the junction of the tunnel and wheel-pit has an elevation of 351 feet above tide-water, the bottom of the tunnel, since it drops 15.4 feet, has an elevation of about 335.6 feet at the portal. In vertical height this tunnel measures twenty-five feet, its maximum width is nineteen feet, and it is designed to pass a maximum of not less than 8,900 cubic feet of water per second. This tunnel, like that on the American side of the falls, is lined throughout its length, and the lining in this case consists of a four-inch layer of vitrified brick backed with eighteen and one-half inches of concrete on the bottom and up to a height of 14.6 feet on each side. The remaining upper part of the tunnel is lined first with a framework of twelve-inch timbers and three-inch lagging, and this is faced with a layer of tunnel brick sixteen and one-half inches thick. For a length of ninety feet just back of its portal this tunnel is lined with granite masonry 2.5 feet thick, and a granite wall two feet thick and sixty feet high is sunk to a depth of thirty feet below the mouth of the tunnel.



THE 137,500-HORSE-POWER WHEEL-PIT OF THE TORONTO & NIAGARA POWER COMPANY.

Though the plant of the Toronto Niagara Power Company is located further up stream than the plant of the Canadian Niagara Power Company, the tunnel of the former company, measured from the lower end of the pit, is a little shorter than that of the latter. Reason for this is found in the fact that the latter tunnel follows approximately the curved river bank to a point in the gorge below the cataract, while the former forms a straight line from its wheel-pit

Digitized by Google

to a portal behind the Horseshoe falls, and lies entirely under the river bed. This location of the tunnel and its portal is a striking solution of a difficult engineering problem. Measured from the lower or down-stream end of its wheel-pit this tunnel is 2,100 feet long, but at a point 1,935 feet from its portal and 165 feet from the lower end of its pit this tunnel branches into two parts, and one of the two branch tunnels runs parallel with and on each side of the pit. One of the branch tunnels is a little longer than the other, as it receives the discharge of six pairs of turbines while the other branch gets the discharge of only five, and the length of this longer branch above its junction with the main tunnel is about 536 feet. Some distance above their junction point each tunnel is provided with gates, operated from a chamber in the rock above, and when it is desired to inspect one tunnel its gates can be closed so that water from the other will not flow back into it. Each branch tunnel is located with its centre line about thirty-eight feet from that of the wheel-pit. At its portal behind the Horseshoe falls the tunnel has a bottom elevation of 350 feet above tide-water, and about seven feet above the normal level of the basin into which the cataract plunges. Between the junction of the two branch tunnels and the portal behind the falls, a distance of 1,935 feet, the main tunnel drops at the rate of 5.5 feet per 1,000, so that the elevation on the bottom at the point of junction is about 360.6 feet. At points in the branch tunnels in line with the lower end of the wheel-pit the bottom elevation is 364 feet above tide. Over 1,755 feet of its length next above the portal this tunnel measures 26.13 feet high, 17.5 feet wide at the bottom and 23.5 feet in greatest width. In the design this tunnel is to discharge a maximum of 11,200 cubic feet of water per second, and when water is passing through it at this rate the surface level near the lower end of the wheel-pit is expected to be about 382.5 feet. Suspended from the ceiling of this tunnel, and with its footway above the maximum water level therein, there is a steel gallery along which persons may walk from one end to the other. The tunnel is lined with concrete rings, each six feet long, for a distance of 300 feet back from its portal, so that as the face of the cliff behind the cataract wears away the concrete rings will break squarely off and leave a well-defined portal. Save these concrete rings at its lower end, the entire tunnel is lined with two layers of hydraulic pressed brick backed with concrete. In the gorge just below the cataract the water level is subject to large fluctuations, amounting at times to as much as thirty feet. Wheel-pits that are connected by tunnels with the basin below the falls are subject to changes of water-level corresponding in a greater or less degree with those in the lower river, but no water can enter the pit of the Toronto company, though a rise of the tail-water level in the tunnel may reduce the effective head.

All three of the above-named tunnels have cross-sections of nearly the same general form, and the areas of these cross-sections vary nearly as the products of their respective heights and widths. For the tunnel on the New York side of the river the product of height and greatest width, each taken in feet, is 395, for the tunnel of the Canadian Niagara company this product is 475, and for the Toronto company the like product reaches 614. In proportion to their maximum rates of discharge, the tunnels on the Canadian side of the river have thus larger cross-sections than the one on the New York side, and each of the former is only about one-third as long as the latter.

Radiology and Ionization Congress at Liege, Belgium.

Acting Secretary of State Loomis has transmitted to the Secretary of Commerce and Labor a copy of a translation of a note from the minister of Belgium, informing the Department that the first international congress for the study of radiology and ionization will be held at Liege from September 12 to 14 next, under the patronage of the Belgium government, and inviting the United States government to be represented at the congress.

The State Department will issue certificates of appointment to any persons whom the Department of Commerce and Labor may nominate as delegates on the part of the United States and who will be willing to attend the congress at their own expense and without compensation from the government.

Members of the teaching corps of the four universities of Belgium and of the military academy are on the committee charged with the organization of the congress. The following is a summary of the programme framed by the committee:

1. Physico-Chemical Section—(*a*) Properties of the electrons and accompanying radiations; X-rays, cathodic rays, ionization; (*b*) radioactivity and corresponding transformations; (*c*) meteorological and terrestrial phenomena connected with ionization and radioactivity; (*d*) N-rays.

2. Biological Section—Physiological properties and medical applications of the various radiations and of radioactivity.

Letters (*a*) and (*b*) include, as particularly interesting points, the examination of terminology relative to the electrons, ions, etc., as well as of the theories concerning the matter and character of the energy. As to the N-rays, they possess points in common with each of the two sections.

Electrical Standards and Units.

At a recent meeting of the Institution of Electrical Engineers, of Great Britain, a discussion took place on electrical units and standards. This was opened by W. Duddell, who described the work of the International Electrical Congress held at St. Louis, Mo., September last, in this connection.

He was followed by various speakers, among them being Lord Rayleigh, who said that there was an unfortunate tendency to take too much for granted in regard to the accuracy of the ohm. If the ohm had been given to us from heaven there would be a good deal to be said in favor of taking the volt as the other standard; but, as things are, the uncertainty there might be about the ohm, and the added uncertainty there might be about the volt, would become unextricably mixed. From the practical point of view much might be said in favor of the Clark cell as a tertiary or working standard, but an eye must be kept on the future, with a view to reducing the uncertainties which exist in this apparatus. Recent improvements in the method of setting up the Clark cell were equally useful for the Weston cell, and the latter presented some distinct advantages over the former. However, until the Weston cell had been watched for many years, and by many observers, it would be unsafe to adopt it.

Professor W. E. Ayrton, in speaking of the doubt which exists with regard to the third decimal figure of the electromotive force of the Clark cell, said that this uncertainty was due mainly to the form of apparatus which has been used in determining it. He thought that a magnetic balance should be used for making this determination. He pointed out that, while it has been shown possible to construct resistance coils agreeing within one part in 100,000, this had nothing to do with determining the exact value of the ohm. He suggested that a redetermination of the ampere be made, and described briefly apparatus which is now being constructed for this purpose.

Dr. R. T. Glazebrook said that the work at St. Louis was to consider the realization of a practical connected series of standards, and did not deal so much with the absolute units. He agreed with Lord Rayleigh as to the undesirability of accepting the volt as a fundamental standard, and that this would involve two possible errors in the determination of unit current. He said that, if the concrete standards now existing in England were universally accepted, and could be

Digitized by Google

taken as the standards throughout the world, then, for practical purposes, so far as electrical engineers were concerned, the question under discussion would cease to have any very marked interest; but this was not the case. The effort has been made to set up an ampere in Germany, also based on the electrochemical equivalent, but determined under different conditions, and giving, consequently, a different result. The same was true with regard to the standard of electromotive force. The main object of the discussions at the conference which, he hoped, would shortly take place between representatives of the different governments, would be to discuss and secure measurements whereby a uniform set of concrete standards could be established and accepted throughout the world.

Dr. Sylvanus P. Thompson suggested that, in place of the volt or the ampere, the watt or unit of power should be adopted as a standard.

Mr. A. P. Trolter, electrical advisor to the British Board of Trade, said that the order in council of 1894 keeps a clear distinction between a unit and a standard. It says that the "new denominations of standards are required for use in trade based on the following units of electrical measurement." Then follow three paragraphs of definitions. The primary definition of the ohm is 10^9 centimetre-gramme-seconds. The secondary definition—"and is represented by the resistance" of a certain column of mercury. The primary definition of the ampere is one-tenth centimetre-gramme-second. The secondary definition—"and which is represented by the unvarying electric current which," deposits a certain amount of silver per second. The primary definition of the volt is 10^8 centimetre-gramme-seconds. The second definition—"being the electrical pressure that, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere. The third definition—"and which is represented by" the value of the Clark cell. In these three paragraphs the word "standard" is not to be found.

The order in council says that new denominations of standards have been made and verified, and goes on to "approve the several denominations of standards set forth in the schedule hereto as new denominations of standards for electrical measurement." The schedule "set forth" the ohm coil, and does not mention the mercury column; it sets forth the ampere balance, and does not allude to silver deposition, and sets forth the voltmeter without mentioning the Clark cell.

Unlike any other country, the order in council declares the limits of accuracy attainable, and this should be remembered in connection with the words "and is represented," which occur in each definition. The United States law uses the expressions "substantially equal to" and "practically equivalent to." Germany uses the expression "practically equivalent to," and France and Belgium "sufficiently well for practical purposes," and Austria "for commercial purposes."

In 1894 it was necessary to use definitions of the units, but now that so much work has been done on absolute electrical measurements it appears that, if we were starting afresh, the centimetre-gramme-seconds' definition would suffice for the units, and the selection of standards may be left to the officials of each country. Those officials will naturally be in touch with the scientific authorities, and will keep themselves informed about the values of their standards in absolute measure when important absolute redeterminations of the units are made.

Among the many important pieces of work which have been undertaken by the National Physical Laboratory are the absolute determination of the ampere and of the ohm. When the results are declared, the Board of Trade may or may not take official action in declaring a correction or corrections. The result will be so well known to the scientific world that anybody could apply them for himself. At present there is no reason to suppose that the standards of Great Britain differ from the units by more than the limits of accuracy which have been laid down. The mercury column is as good a definition for international purposes as could be devised. The 106.3 centimetres may be revised from time to time as more refined research work is carried out, and the revised figure will indicate the correction to be applied to the standard by those who are engaged in physical work involving absolute measurement. It has been suggested that the method of silver deposition described in the specification attached to the order in council is capable of improvement; for example, that stratification of the solution should be prevented by stirring. But the method of silver deposition is not introduced here for the purpose of defining the ampere by means of the electrochemical equivalent of silver, it is introduced for the purpose of recording the research of Lord Rayleigh who used that particular method. This method formed the link between Lord Rayleigh's work and the ampere standard balance of the Board of Trade. When a new determination is made other links might be devised for scientific purposes, but the precision of the silver deposition is ample for all purposes of trade.

The only part of the work of the committee of 1890 which needs revision is the definition by the Clark cell, and the specification of that cell. "The Board of Trade volt standard" has nothing to do with the Clark cell; it was not verified with reference to that cell, and it is in good working order. Without going outside the Board of Trade electrical standard laboratory, a discrepancy has been discovered between the declared value of the Clark cell and its observed value. He has taken steps to let it be known, semi-officially, that this value appears to be 1.4329 instead of 1.434 at fifteen degrees centigrade, or is 1.434 at fourteen degrees centigrade.

He is not convinced that this discrepancy of 0.788 in 1,000 is of appreciable importance "for use in trade." It is on the limits of practical importance in connection with lamp testing, for it is equivalent to nearly 0.4 of one per cent of candlepower.

The specification of the Clark cell appended to the order in council is now out of date. He can not recommend that form of cell for work of the highest accuracy. He thinks that large cells as suggested by Professor Schuster are better, and it is probable that a Cadmium cell is better still. Knowing the liability of Clark cells to dry up, he would prefer a saturated cell, with a higher temperature coefficient, to a semi-saturated cell with an almost negligible temperature correction.

Experience of the last fifteen years has shown that neither the Clark cell nor any improvement of it is necessary in a standard laboratory as a standard, while, on the other hand, such cells are very valuable pieces of apparatus, both for scientific and for trade purposes.

While he is not prepared to recommend the Board of Trade that any amendment of the order in council is necessary, if an amendment were to be made he would recommend that the definition of the volt should not contain reference to the Clark or to any other standard cell, but that Great Britain should fall into line with Germany, Austria, Belgium and Switzerland.

Professor McClelland has recently shown that the emanation of radioactive substances does not carry an electrical charge, and the same conclusion is arrived at by means of a different form of apparatus by Professor Batlelli, and F. Maccarroul *(Physikalische Zeitschrift, No. 6)*. —*Nature, London.*

Digitized by Google

NEW YORK ELECTRICAL SOCIETY.

PAPER AND DISCUSSION ON "LIGHTNING PROTECTION FOR HIGH-VOLTAGE CIRCUITS."

The 250th meeting of the New York Electrical Society was held on April 26. Mr. N. J. Neall lectured on "Lightning Protection for High-Voltage Circuits."

Mr. Neall's lecture had for its object a presentation of the possible ways in which this problem might be solved for potentials above 50,000 volts, and reviewed the development of commercial lightning arresters and the study to date of lightning phenomena.

Lightning was considered from the engineering standpoint in its twofold effect: induced charges and direct strokes. To offset the former the first lightning arrester came into existence with the development of the telegraph, and was a simple air-gap between line and ground. The importance of a good ground was early recognized and has always been the *sine quo non* of such protection.

Power transmission later brought the need of suppressing a short-circuit arc at the time of discharge over these gaps between line and ground; in order to accomplish this nearly every known scientific means of extinguishing an arc has been carried into a patent.

Besides lightning arresters, the choke coil came early into use, although its function was not at first fully appreciated. This type of protection has developed as follows: first, used as an integral part of the lightning arrester; Wurts pyramidal form; multispark coil; compensated coil; static interrupters; single coil; Elihu Thomson's skin effect arrester; "Gola" lightning arrester.

After a discussion of these features, it was shown that little has been accomplished in the way of protecting against direct stroke, although overhead grounded wires have been proposed and metal towers are expected to do some good. Wood poles have been badly shattered, but owing to short wire suspensions the service has not been seriously impaired.

The scientific investigation of lightning phenomena has been greatly neglected, little having been done since the work of Franklin, Shaffner and Lodge. The present problem calls for a careful study of all such phenomena and their effect on transmission lines. The general conditions have been sufficiently well understood to enable arrester design to advance. Lightning, however, can not be studied directly at any and all times, and to enable commercial development of protective apparatus it must be studied by imitation of service conditions.

A method of this kind whose value has been highly commended is the equivalent spark-gap method, which was first used by Wurts, and later developed by Thomas.

Slides were shown giving the comparative value of lightning arresters based on this test, as well as the protective power afforded by choke coils to transformers. From this was reduced the law of protection: "complete lightning protection must consist of a choke coil and lightning arrester; the former to have a high equivalent spark-gap, the latter a low one."

Mr. Neall held that neither through commercial development nor through scientific study of lightning phenomena has anything yet developed to give an arrester with an air-gap lower than that of air for the normal voltage for a static disturbance and greater for the current which tends to follow. Many styles will fail from inherent weaknesses of mechanical development. The existing types have already divided themselves into those for low voltage and those for high voltage. Many of the inventions in lightning arresters are highly scientific in theory, but toys in development. The principal need at the present time is clearly for a quantitative as well as for a qualitative development. The possible ways in which the problem may be solved rest on the fact that the disturbing conditions are electromagnetic and electrostatic.

In choke coil protection we already have a final form—a spiral or simple construction, its insulation and strength depending on given conditions.

The lightning arrester on account of possible reduction of short-circuits, grounds, etc., to a minimum, will be reduced to taking care of induced lightning discharges.

The winding type must be simple in form and construction, and may be based on the principle of the horn arrester.

The effect of electric inductance and skin effect in modern work was discussed, showing the great part this plays, not only in all types of resistance, but in the transmission line itself. The freedom of disturbance from static discharges, said to exist in California, may arise from this skin effect of the wires themselves in holding back discharges of the capacity of the line.

For direct strokes metal towers and lightning rods may be employed.

For high-voltage direct current, say 70,000 volts, as was experimentally tried in Switzerland a short time ago, there would be no difference in the lightning protection required, excepting that the multi-gap type will be thereby cut out and the final type of arrester would be based on the horn and coherer principles.

Uninterrupted service will be more and more an important requirement in this development. short-circuits of even two seconds being objectionable.

In general the problem may be said to be far from solution, the natural development of transmission work having exceeded that in lightning arresting. The workers in the field are few in number and their efforts are not united. Much has been done by the large manufacturing companies, but much can also be done by practical men as well as by the scientists; the large number of technically trained men now in the field should exercise an appreciable influence on this investigation. The equivalent spark-gap method offers a means limited only by cost for meeting fully the commercial development involved in this problem.

A number of slides were shown of such arresters as are in commercial use to-day with an explanation of the carrying out of the principles involved in their construction.

DISCUSSION.

H. C. WIRT: I will have to take exception to some of the suggestions made by the lecturer. I believe that a static machine test or inductorium test should not be considered as entirely proving whether an arrester is effective or not; the real test comes when the lightning arresters are placed on the line and observations made in actual practice. Even reports received from service conditions have to be considered very carefully.

It is probable that the design of high-tension arrester will have to be materially modified. A desirable form of arrester will be one that is simple in construction and takes up a small amount of room in the station. At present they all are built on very much the same principles, as they all have series resistance in one form or another. The horn arrester that the lecturer has mentioned, when carefully examined, is seen to be very similar to arresters made in this country. In the latter the arc is divided by small gaps with resistance in series with them, and in the horn arrester we have a single gap. Comparative tests have shown that a higher resistance is required to break the arc with a single gap than with multiple gap, so it is difficult to see any advantage in the horn arrester.

Regarding the use of devices to keep down the pressure between wires, there is no question but what such devices are necessary. Examination of a large number of standard low-voltage transformers, 2,000-volt primary, has shown that these rarely burn out between primary and secondary, but that the outside layers of the primary from line to line burn out; and the remedy for this is to place a spark-gap across the connection board of transformer, which will short-circuit when high-potential exists between line and line, causing the fuses to blow. One hundred and fifty of

Digitized by Google

these transformers are now being tested in actual service conditions.

F. W. JONES: Prior to 1880, the telegraph electricians were able to successfully cope with all ordinary lightning discharges to prevent their harmful effect upon electrical apparatus in telegraph stations. The method that was found to be economical and efficient was what is known as the plate arrester, which consisted of a small brass plate having a surface of about six square inches separated from a similar ground plate by a sheet of mica which had been perforated by a few small holes. The thickness of this mica was adjusted to prevent the current used for telegraph purposes from jumping across from the line-plate to the earth.

For the protection of telegraph poles out in the open country a length of telegraph wire was run from a coil of the wire placed under the foot of a pole up the side of the pole through staples terminating about three inches above the top of the pole. Since 1880, after the introduction of overhead electric light and power wires which form a network under and over telegraph wires throughout the country, the telegraph company was compelled to increase the space between the line-plate and the ground-plate to such a distance that the high-voltage currents from electric light and power wires would find it impossible to jump across the space between the plates and so result in a destructive arc. These arresters are used at intermediate and other stations that are closed for the night, but a more sensitive arrester having a space of only ten mils is used at our large terminal stations which are kept open during the twenty-four hours. At these stations, besides the sensitive arresters, there are employed cartridge fuses which are regulated to blow at one-half ampere at seventy degrees in about thirty seconds, but at all intermediate offices that close for the night it is found necessary to use cartridge fuses which do not blow under twenty amperes, for the reason that lightning would be constantly opening sensitive fuses and deprive the company of the use of the wires until the operator arrived at the office in the morning. In all such offices, the instruments are kept cut out of the circuit when not required for use, and in the instrument circuits there are as sensitive fuses and arresters as the signaling currents will permit.

During the lightning season in the Far West, our overland Pacific lines are occasionally interrupted by lightning cutting the hard-drawn copper wires between the poles, the same as if cut by pliers, excepting that the ends of the wires are melted to points, and the wires, sometimes for two or three inches, on both sides of the cut have very fine globules of copper adhering longitudinally in a row on the underside. Lightning rods have been erected upon every fifth pole.

The Postal Telegraph company recognizes the importance of a good earth in the rules which are contained in its book of rules governing the "Wiring of Offices."

H. L. CARPENTER: From the telephonic standpoint, lightning protection presents a number of interesting points. Telephone apparatus in general is of a most delicate and highly inductive nature. The great number and extent of telephone lines, the general character and location of the equipment, and the nature of the service given with it, require that adequate protection against any high-potential discharges be provided. The extremely low potentials and currents carried over normal telephone lines mean that very little stress need be given to the dissipation of telephone-current arcs, which is apparently the most important element of high-tension lightning protection.

Very much as Mr. Jones has just mentioned, aside from lightning discharges, it is essential to provide means to dissipate any unfriendly currents traversing along telephone lines, due to crosses with other high-tension power circuits. If we find any stray heavy currents on telephone lines, we wish to get rid of them as rapidly and completely as possible, rather than keep them with us.

Experience has proven that the most prominent source of complaint resulting from high-tension charges on telephone lines is the breaking down of apparatus due to induced lightning discharges. It is not an infrequent occurrence in outlying districts where aerial lines predominate for a single lightning discharge, which perhaps does not strike any telephone lines, to produce inductive charges on several hundred telephone circuits. If it were not for the individual lightning arrester protection on these lines great damage to apparatus would result. With the protection, the discharges all pass to ground, with perhaps the only bad result of a few grounded lines caused by loosened carbon dust bridged across the small air-gaps of the lightning arresters.

A somewhat new phase to the question of telephone-line protection is being introduced by the development of the loaded aerial toll-line circuits. These circuits, as is probably generally known, are of a highly inductive nature, the individual loaded sections being practically isolated inductively from other sections when considering high-frequency lightning discharges. Where these loaded lines leave aerial circuits to enter underground cables, I believe special choke coils are being considered, if not in some cases already provided.

RALPH D. MERSHON: I agree with Mr. Wurts that the spark-gap method of comparing lightning arresters is not a reliable one. I think that at best it is a very rough measure of the ability of the lightning arresters to afford the easy path for lightning discharges. I think that by making use of such a method of test almost any result desired could be obtained by properly varying the frequency of the discharging current. If it were possible to know what the frequency of the lightning discharge would be and such a frequency were used in the measurement, then the comparative method Mr. Neall describes might be satisfactory, but under any other conditions it seems to me that it is open to question.

So far as I can see now, there is every evidence that for the higher voltages at least lightning protection will be much simpler than at present.

I am inclined to think that the trouble with most of the high-voltage arresters is that of too high an inductance in the arresters themselves. It does not do much good to make use of choke coils and other elaborate devices for "piling up potential," if after the potential is "piled" the lightning arrester can not take care of it, and I believe that most of the lightning arresters, as now constructed, are faulty principally because of the fact that their inductance is too high to allow the lightning discharge to readily pass.

J. L. STREEVER: My experience in the matter of the effect of lightning on transformers has been of a practical rather than laboratory character.

I noticed several years ago that a direct stroke of lightning which would leave an iron smokestack and choose a path to ground *via* a guy wire attached to a yellow pine guy-stub or one that would splinter a new chestnut pole into kindling wood and completely ignore a set of approved arresters installed on the same pole and grounded to a water main, was beyond the control of any apparatus on the market.

I also observed that on circuits strung through sections where there were a great many trees and where numerous tree-grounds were practically unavoidable in wet weather and where it might be assumed that any static charge on the lines would be promptly dissipated, the damage to transformers was as great, if not greater, than on circuits that were known to be free from contact with anything but the glass insulators.

It also appeared to me that the current induced into the lines by a lightning discharge in the vicinity had a decided inclination to cross over from one wire to the other and found an easier path through the transformers than by traversing the two sets of air-gaps in the arresters.

In most cases the ensuing short-circuit destroyed the evidence desired as to the exact course taken by the discharge through the transformer which could not have been by following the windings on account of the choking effect, but rather by bolting across *via* the points of least resistance; in some instances where the case was quite full of oil the transformer showed little damage except that the gases generated smashed the cover.

The facts noted led to the conclusion that one feature of the problem might be solved by providing an easy and safe path by means of which the difference in stress on parallel wires might be equalized.

Acting on this assumption, during the summer of 1904 we installed a number of six-gap arresters directly across the lines with a primary cutout and a five-ampere fuse in series; every arrester so installed gave evidence of having performed the work intended and in only one instance was a fuse blown; the results were so satisfactory that the scheme will be tried on a larger scale this season.

Digitized by Google

THE ALUMINUM ELECTROLYTIC CONDENSER.[1]

BY CLARENCE IRVING ZIMMERMAN.

"The Aluminum Electrolytic Condenser" was the subject of a paper by the writer at a former meeting of this society.[2] The peculiar condenser behavior of a cell consisting of two similar asymmetrical conductors was analyzed and discussed. It was shown that the aluminum cell approximated these conditions.

In connection with these points it was mentioned that the film coating the aluminum electrodes has a thickness of from less than 0.000005 centimetre to, in exceptional cases, more than 0.000050 centimetre. This result was arrived at by observing the interference colors presented. The films are too thin to be measured with a high power microscope. It was shown that under some conditions

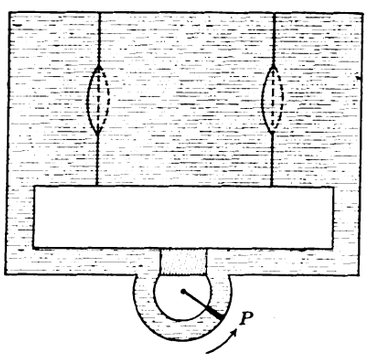


FIG. 1.—REPRESENTATION OF TWO TINFOIL CONDENSERS IN SERIES.

the film may have a very high disruptive strength. The various sources of energy losses were discussed, and it was stated that 110-volt condensers having efficiencies[3] of over ninety-five per cent had been made. Comparisons with tinfoil condensers were made.

This paper is a continuation of the previous one. There will be presented some additional information and data relating to the above points, together with a discussion of unsymmetrical condensers and polyphase condensers.

HYDRAULIC ANALOGY OF THE ALUMINUM ELECTROLYTIC CONDENSER.[4]

A clearer conception of the behavior of the aluminum condenser may perhaps be obtained by comparing the electrical circuits and pressures to hydraulic circuits and pressures moving back and forth in the hydraulic circuit. The tension in the membrane corresponds to the potential of the electrostatic coulomb charge in the film. The space traversed by the membrane from the position of minimum surface represents the coulomb charge.

In Fig. 1 two tinfoil condensers are represented in series connection. P is a pump, which by some external means causes the liquid contained in the vessel to move back and forth and thus sets up displacements of the two elastic membranes, first in one direction and then in the other.

In Fig. 2 the aluminum condenser films or dielectrics are represented by a combination of membranes and valves. The latter allow the liquid to flow out from the middle compartment (the electrolyte), but not into it. An examination of the tensions that must exist in the membranes will make it clear that both valves remain closed after one of the membranes has been stretched to its maximum value, no matter what lower pressure exists subsequently in the outer compartments. The instant of maximum tension in the membranes corresponds in the aluminum condenser to the instant of maximum impressed pressure. The membranes are stretched alternately, but always toward the middle compartment. The middle compartment (the electrolyte) thus remains under a lower pressure than the outer compartments (the electrodes and the electrical circuit as a whole).

RESISTANCE, DIELECTRIC STRENGTH AND INDUCTIVITY OF FILM.

The values the author gives below for the resistance, dielectric strength and inductivity are merely approximations, due to the method employed in measuring the thickness. The statements made in regard to these points in the previous paper were based upon similar calculations. Mott calculates the specific resistance of the film (as an anode film) to be of the same order as other solid dielectrics.[1] He gives an example of a certain film whose specific resistance was 10^{11} ohms per cubic centimetre. While this is somewhat lower than that of good dry insulators, the author agrees with the same general conclusions if it be assumed that the leakage current is due more to the disruption of the film than to the uniform conduction of the observed current flow. The figures below give an example of results which the author has obtained with a certain film 0.000075 centimetre thick:

Aluminum anode, eight centimetres by twelve and one-half centimetres; area of anode, 200 square centimetres; electrolyte, nearly neutral solution of

$$(NH_4)_2C_4H_4O_6 + KNaC_4H_4O_6$$

saturated; thickness of film, 0.000075 centimetre; pressure on film, 100 volts; current flowing, 0.002 ampere; hence, specific resistance (resistance per cubic centimetre) equals 1.33 by 10^{11} ohms per cubic centimetre.

DIELECTRIC STRENGTH.

In the previous paper it was stated that the dielectric strength was apparently greater than that of mica. The dielectric strength, as calculated by the author, of numerous films upon which various pressures up to 500 volts were impressed, gives results a little higher

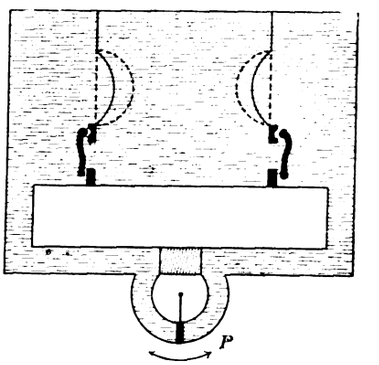


FIG. 2.—REPRESENTATION OF ALUMINUM CONDENSER FILMS.

than that of 1,000,000 volts per centimetre obtained by Mott.[1]

The results below indicate the values obtained:

Volts Withstood.	Thickness in Centimetres.	Dielectric Strength in Volts per Centimetres.
360+	0.000060	6,000,000+
100+	0.000020	5,000,000+
150+	0.000030	5,000,000+

The dielectric strength of mica has been recently calculated to be between 1,000,000 and 2,000,000 volts per centimetre for a thickness of 0.01 centimetre.[2] Steinmetz gives the gradient of 4,000,000 volts per centimetre for mica at zero thickness.[3]

INDUCTIVITY OF FILM.

That the inductivity of the film is apparently high for a solid is indicated by the measurements and calculations below. The author has not attained as high

[1] Abstract of a paper read at the seventh general meeting of the American Electrochemical Society, Boston, Mass., April 25, 1905.

[2] "The Aluminum Electrolytic Condenser," Trans. A. E. S., April 9, 1904. Vol. v, p. 147.

[3] By "efficiency" is meant the ratio of volts × amperes divided by volts × amperes plus losses.—Report of A. I. E. E. Committee on Standardization, 1898—Appendix i.

[4] ELECTRICAL REVIEW (N. Y.), vol. xliv, No. 18, 4-30-'04.

[1] *Electrochemical Industries*, vol. ii, No. 9, September, 1904.

[1] *Electrochemical Industries*, vol. ii, No. 9, September, 1901.

[2] *Electrician* (London), December 19, 1904.

[3] Trans. A. I. E. E., February, 1898.

Digitized by Google

a figure as eighty, as might possibly have been inferred from the previous paper.[1]

The formula for the capacity of a cell in microfarads is

$$C = \frac{K}{900000} \times \frac{S}{4\pi d}$$

where C = capacity of cell in microfarads.

K = inductivity (specific inductive capacity or dielectric constant).

S = area of dielectric in square centimetres.

d = thickness of dielectric in centimetres.

By substituting the values of C, S and d obtained from an aluminum condenser, we may obtain K, the inductivity,

C = 220 microfarads.

S = 5,110 square centimetres.

d = 0.000030 centimetre.

From which the inductivity

K = 14.6.

CELL LOSSES.

It was stated in the previous paper that the cell losses consist of (1) film losses,

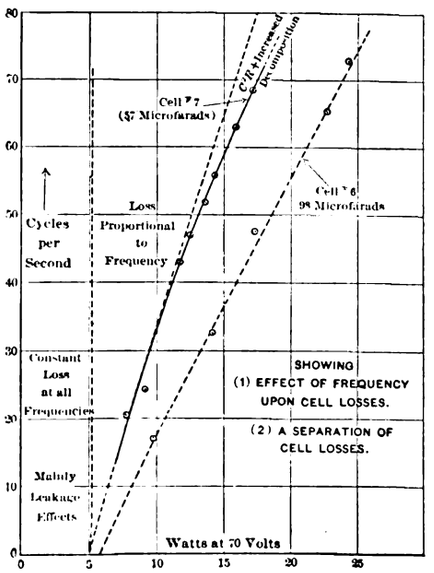


FIG. 3.—GRAPHIC REPRESENTATION OF CELL LOSSES.

(2) I^2R losses, and (3) electrolytic decomposition losses; and that the film losses (1) consist of (*a*) leakage through film and (*b*) losses proportional to the frequency. The latter are in general larger than the other losses in the cell and are of a nature not clearly understood. A crude graphical representation of these losses is given in Fig. 3, where there is plotted a curve between watts and frequency. The observations were made upon two cells in which the electrolyte consisted of an aqueous solution of commercial borax. All the losses were increased considerably by this impure electrolyte. The separate losses are graphically shown.[1]

That these losses can be reduced is evident from the figures on other cells made by the author, shown in the table below:

Capacity of Cell in Microfarads.	Pressure on Cell (60 Volts.)	Watts Lost.	Current Flow.	Efficiency.
40	110	8	1 65	96.2
40	80	3	1.21	97.0
58	110	14	2.41	94.9
58	80	6	1.74	95.9

The power measurements were made with sinusoidal waves and with carefully calibrated non-inductive watt dynamometer of the Siemens type. The current was measured with a Kelvin balance.

EFFECT OF FREQUENCY ON CHARGING CURRENT.

The condenser charging current varies in proportion to the frequency where the impressed pressure is kept constant and the frequency varied. At low frequencies, however, the watt consumption shows a slight deviation from a straight line law, due to the predominating effect of the leakage current. At the higher frequencies, the capacity component practically suppresses the power component.

ALTERNATING AND UNIDIRECTIONAL PRESSURES IN THE SYMMETRICAL CELL.

In the previous paper it was shown that the theoretical ratio of the alternating pressure (E) impressed upon the cell terminals to the unidirectional pressure between the electrolyte and a point neutral to the alternating pressure is equal to the impressed pressure (E) divided by $\sqrt{2}$. The actual values obtained are smaller than these, due chiefly to the imperfect asymmetry and partially to the cell resistance, to film leakage, and to polarization pressures.

Fig. 4 shows the relations existing in a cell, each of whose plates had a capacity of 114 microfarads. The electrolyte consisted of a saturated solution of borax with a small amount of glycerine added. The curve is practically a straight line above ten volts alternating pressure. Below this point, the unidirectional pressures keep close to the zero value, owing to the slight asymmetrical effect of the film at such low values and to the polarization pressures between the aluminum and the carbon. If the straight part of this curve be projected until it crosses the horizontal line representing the zero of alternating pressure, the unidirectional value is 4.5 volts. Part of this pressure is probably produced by the chain aluminum = electrolyte = carbon. The dotted line in the diagram represents the theoretical relation based upon the assumption that there is perfect asymmetry, that there are no polarization pressures, and that the losses in the cell are zero.

These pressure relations do not materially vary with any small change in frequency, and since such a cell can be easily set up, this scheme may be used for the purpose of calibrating alternating pressure instruments where extreme accuracy is not desired. For the purpose of calibration, it is only necessary to connect the alternating-current instruments across the cell terminals and the direct-current instruments between an auxiliary carbon electrode (electrolyte) and one of the aluminum electrodes.

UNSYMMETRICAL CONDENSER.[1]

By the term unsymmetrical condenser is meant a cell having two electrodes with different electrostatic capacities. For example, we may have two plates of the same size but having different film thicknesses, or we may have electrodes of different sizes but having the same film thickness, or we may have a combination of these two cases.

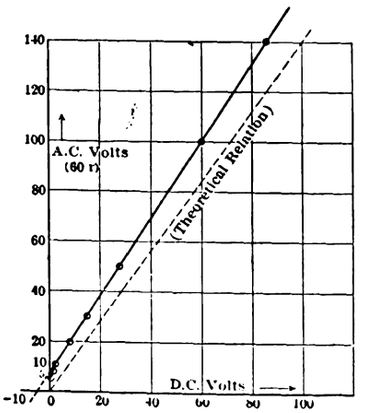


FIG. 4.—RELATIONS EXISTING IN A CELL WITH PLATES OF 114 MICROFARADS CAPACITY.

The limiting case of an unsymmetrical condenser consists of one large electrode and an aluminum point for the small electrode. All other unsymmetrical cells may be considered to be some stage between the symmetrical and the limiting case of unsymmetrical cells.

In studying the unsymmetrical cell we have the same general rules to follow as in the symmetrical cell, namely, that the con-

[1] Trans. A. E. S., vol. v, 1004, p. 149.

[1] While the values of the frequency and the power were plotted from careful measurements on a certain low efficiency cell, the exact limits of the shading as shown in the figure are to be considered only as an aid to a clear understanding and not as an accurate separation of them.

[1] The term "unsymmetrical condenser" should not be confused with the term "asymmetrical cell." The latter designates an electrolytic cell composed of an electrolyte in which there is one electrode coated with a film, and one electrode which is incapable of producing an insulating film.

Digitized by Google

denser behaves on an alternating-current circuit like two tinfoil condensers having capacities corresponding to those of each of the aluminum electrodes, and that there is automatically stored up in the cell a constant coulomb charge. This charge distributes itself in the cell according to the direction and value of the externally impressed pressure.

The effects of this constant coulomb charge in a symmetrical cell consisting of two similar electrodes of aluminum immersed in an electrolyte were given in a previous paper before this society.

In an unsymmetrical cell it can be shown that the coulomb charge in the cell is independent of the electrostatic capacity of the smaller electrode. It is equal to the maximum charge held by the larger electrode. In Fig. 5 is shown an unsymmetrical cell consisting of two aluminum electrodes, *'a'* and *'b'* immersed in an electrolyte, the potential of which can be measured by means of a carbon rod *c* immersed in it; *a* represents the small electrode and *b* the large electrode. Suppose the pressure in the circuit is such that the large electrode *b* is becoming

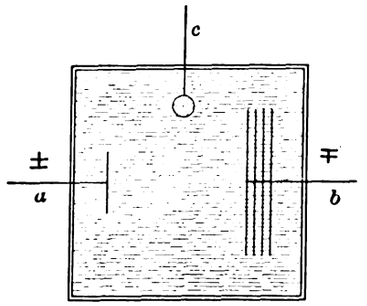


FIG. 5.—UNSYMMETRICAL CELL CONSISTING OF TWO ALUMINUM ELECTRODES.

positive to the small electrode *a*, being an anode, the film of the large electrode acts as a non-conductor. A momentary flow of current occurs while its film receives an electrostatic charge. This charge is positive on the side of the film in contact with the metal and negative on the side in contact with the electrolyte. The temporary current flow finds a ready path out of the cell since the small electrode *a* allows passage in that direction. When the impressed pressure reaches its maximum value the large film becomes charged to its full extent. (This is equal to $c_1 E_m$; where c_1 is the electrostatic capacity of the large plate and E_m is the maximum value of the alternating pressure impressed upon the cell.) When the pressure decreases the charge has to remain on the large plate because the electrostatic capacity of the small electrode is negligible and upon the reversal of the current the small electrode quickly becomes charged to its full pressure, thereby stopping the current. When the pressure reaches its maximum value in the direction opposite to that we assumed at the start, the pressure on the large film and the impressed pressure act in series. Thus the pressure between the small electrode and the electrolyte reaches a theoretical maximum value of twice the maximum value of the pressure of the alternating wave upon the cell. In actual cells I have calculated that instantaneous pressures of 250 volts were reached with a maximum of 141 volts impressed upon the cell terminals. These calculations were based on measurements given in the table below.

This interesting point is shown graphically in Fig. 6, where *b-b* represents the potential of the large electrode, taken for reference; *a-a* is the potential of the small electrode with respect to the large one; that is, it represents the impressed pressure; *c-c* represents the potential of the electrolyte which, as we observed before, must remain negative to and at a constant potential difference from the large electrode. The pressure between the small electrode *a-a* and the electrolyte *c-c* is represented by the ordinates between the corresponding curves in Fig. 6.

In Fig. 7 is an hydraulic analogy of the unsymmetrical cell. With the previous hydraulic analogies in mind, this diagram is self-explanatory.

Measurements which have been made on various cells approaching the limiting case are given in the accompanying table. They do not reach the limiting theoretical values, because (1) the small electrode in some cases had a capacity of several microfarads; (2) the measuring instruments absorb some of the charge; (3) there are cell losses; and (4) the film is not a perfect asymmetrical dielectric. These readings were obtained with various cells at different times and with different electrolytes.

It will be observed that the pressure in the twelve microfarad cells in columns C and D and in D and F are nearly the same, showing, first, that the pressure on the large electrode is a nearly uniform unidirectional pressure, and second, that the average pressures on the two plates are the same.

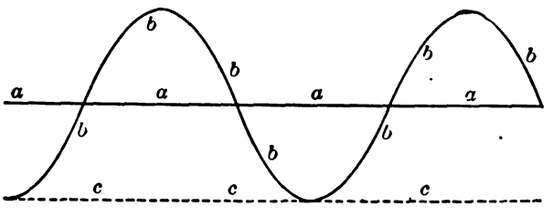


FIG. 6.—GRAPHIC REPRESENTATION OF ATTAINMENT OF MAXIMUM PRESSURE IN CELL.

PRESSURES OBSERVED IN VARIOUS UNSYMMETRICAL CONDENSERS.

(A) Capacity of Large Condenser Plate.	(B) Impressed A. C. Pressure.	(C) A. C. Vm. Pressure on Large Plate.	(D) D. C. Vm. Pressure on Large Plate.	(E) A. C. Vm. Pressure on Small Plate.	(F) D. C. Vm. Pressure on Small Plate.
(1) 8 mf.	88.0	85	97.0	121.5	96.5
(2) 8 mf.	71.0	68	78 5	92 5	78.0
(3) 12 mf.	108.0	110	111.0	144 0	110.0
(4) 12 mf.	102.0	104	102.0	143.0	105.0
(5) 12 mf.	51.0	60	56.5	....	....
	50.5	....	....	79.5	57.0

MATHEMATICAL ANALYSIS OF CELL.

The fundamental equations of the aluminum condenser differ from the corresponding equations of two tinfoil condensers in the two following points:

(1) The pressures on the two aluminum films are in opposition to one another, while the pressures on the tinfoil condenser dielectrics act in unison.

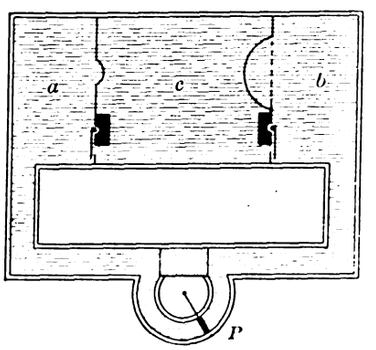


FIG. 7.—HYDRAULIC ANALOGY OF UNSYMMETRICAL CELL.

(2) The sum of all the coulomb charges in the aluminum cell is constant and is equal to the maximum charge capable of being held on one electrode in the cell. In the tinfoil condensers the coulomb charge varies with the pressure on the terminals.

The "equivalent" capacity of an aluminum cell is $\frac{c_1 c_2}{c_1 + c_2}$, where c_1 and c^2 are to electrostatic capacities of the two dielectrics. This ratio is also the equivalent capacity of two tinfoil condensers operating in series, the condensers having capacities c_1 and c_2. On an alternating pressure circuit a condenser composed of two asymmetrical electrodes acts like

Digitized by Google

two tinfoil condensers connected in series, having equivalent electrostatic capacities. The internal conditions, however, are quite different.

POLYPHASE CELLS.

In the polyphase condensers the same general rules that apply to single-phase condensers hold good, but some additional points relative to them will be mentioned. On a two-phase independent four-wire circuit an aluminum condenser consisting of four plates immersed in the same electrolyte may be used. Neither circuit will interfere with the other.

On a three-wire two-phase circuit a three-plate single-cell condenser causes a charging current to flow not only in the two phases, but in the phase formed by the two independent wires of the three-wire system. The pressure between these two wires is considerably greater than the pressure of the normal phase. Because of this extra wattless current such a cell might be objectionable on a two-phase three-wire circuit.

In a three-phase condenser consisting of three similar plates in a single cell, we have an interesting problem for solution. The properties of this cell are briefly summarized below.

The sum of the coulomb charges on the three plates is constant, and is equal to the maximum charge capable of being held by the cell with a given impressed pressure.

This maximum charge does not collect at a time when the pressure across two of the plates is a maximum, as it does in the single-phase condenser. It collects when two of the three plates are at an equal positive potential with respect to the third plate. This point is shown in Fig. 8, at the point 0-0. The constant coulomb charge is equal to $(2c)\sqrt{3}/\sqrt{2}$ E, where c is equal to the electrostatic capacity of one of the three similar plates and E is the delta alternating-current pressure impressed upon the cell.

This coulomb charge theoretically sets up a constant unidirectional pressure between the electrolyte and the neutral point of the three-phase circuit. This pressure is equal to the maximum value of the star voltage of the circuit or its equivalent.

If one of the three electrodes be disconnected from the circuit, the constant unidirectional pressure drops to the normal single-phase value. This is equal to $\frac{1}{\sqrt{2}}$ E, or 0.707 times the impressed delta pressure.

The total energy stored in the condenser is constant at all times, and is equal to $(3/2)\ C\ E^2$, where C is the capacity of one of the plates and E is the delta pressure impressed upon the cell.

The figures below are actual measurements made upon a three-phase aluminum condenser. The observed voltages are somewhat lower than the theoretical voltages.

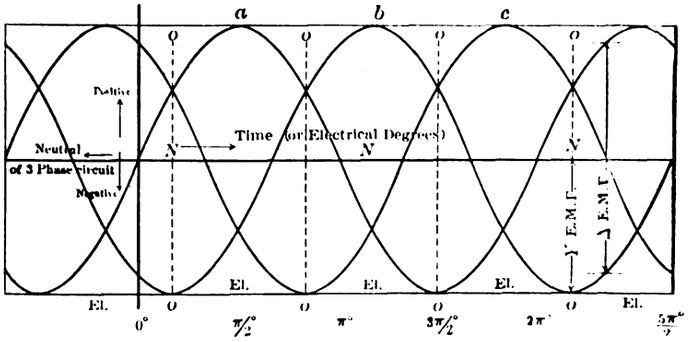


FIG. 8.—DIAGRAM OF PRESSURES IN A THREE-PHASE CELL.

THREE-PHASE CONDENSER PRESSURES.

	Phase.	Volts.
Impressed pressure (delta voltage)	1	108
	2	107
	3	108
Constant unidirectional pressure to neutral point		81
Theoretical value to neutral point		92.5
Pressure with one of the electrodes disconnected		63
Theoretical value		79

ROTATING CHARGE.

An interesting point in connection with polyphase cells is that one may arrange the electrodes in a circle in the electrolyte and produce a rotating negative electrostatic charge in the electrolyte. In the single-phase condenser it was pointed out previously that the negative charge may be considered to be sent back and forth from one electrode to the other.

In Fig. 8 is shown a diagram of the pressures in a three-phase cell. The zero line represents the potential of the "neutral" point of the three-phase circuit. The sinusoidal curves represent the potentials of the three electrodes with respect to the neutral point. The potential of the electrolyte is represented by the straight line E1-E1. Losses in the cell due to leakage are intermittently supplied near the nodes *o-o, o-o, o-o,* where two of the plates are positive to the third.

The equivalent capacity for each phase of a three-phase condenser such as is discussed is one-half the capacity of one electrode.

STREET LIGHTING IN NEW ENGLAND.

THE SUCCESSFUL ADAPTATION OF NERNST LAMPS.

West Hartford, a beautiful suburb of Hartford, Ct., serves as the location for the residences of the business men of the city; there being very little commercialism and no manufacturing in this immediate vicinity.

While its streets are of generous width, they are for the most part lined with large shade trees, so that in the consideration of a proper system for lighting the streets it was deemed advisable to place the source of illumination as much below the foliage as practicable. For this reason it was decided to use a system of small units, placing them well under the foliage and somewhat closer together than usual.

The choice lay between the single-burner gas lamp and the single-glower Nernst lamp; the final decision being in favor of the electric system as having a higher practical efficiency and lower running cost.

The Hartford Electric Light Company is now supplying the Nernst single-glower units to the borough of West Hartford for $18 per lamp-year on an all-night schedule of 3,750 hours, whereas the sixty-candle-power gas unit would not be furnished under $27 per year, using artificial gas at $1 per thousand cubic feet.

The sixty-cycle current, supplied both for the house and street lighting of West Hartford, is generated at the main power plant of the Hartford Electric Light Company, at Tarriffville, fourteen miles away. From there it is transmitted at a pressure of 11,000 volts, three-phase, to the substation in Hartford. Here it is stepped down to 2,400 volts, single-phase, and is carried over two-wire mains to West Hartford, four miles distant. Then the current is again lowered to 230-115 volts pressure for the Nernst and incandescent lamps respectively.

One of the outside wires supplying the Nernst lamp is led through a time switch which may be set to throw the lamps on or off at any desired time.

The primaries of the transformers are fed through single-pole high-tension fuses; lightning arresters being used on the mains only at the Hartford substation.

With the exception of one six-glower unit located in the centre of the district, the installation at present consists of 224 one-glower lamps. These are grouped on thirteen separate circuits, the number of lamps on each varying from ten to

Digitized by Google

twenty-eight, and each circuit being supplied from a five-kilowatt transformer, centrally located.

The lamps are mounted as shown in Figs. 1 and 2 at an elevation of about twenty feet on standard goose-neck brackets, such as are used in series incandescent systems.

Fig. 1 shows the mounting of the high-tension fuses, transformers and automatic time switch; the latter being placed on the pole within easy reach from the ground. The lamps are placed on alternate poles with a regular spacing of 200 feet.

While the lamps were originally equipped with clear globes, these are gradually being replaced as they become broken with opalescent globes, as the latter seem to give the best results.

The system is regularly patrolled each day before 8 A. M. and after 4.30 P. M. by three boys mounted on bicycles. Each boy carries in a suitable case a number of repaired holders with which he replaces any burnt-out holders he may discover. The latter are returned to the maintenance department for repairs.

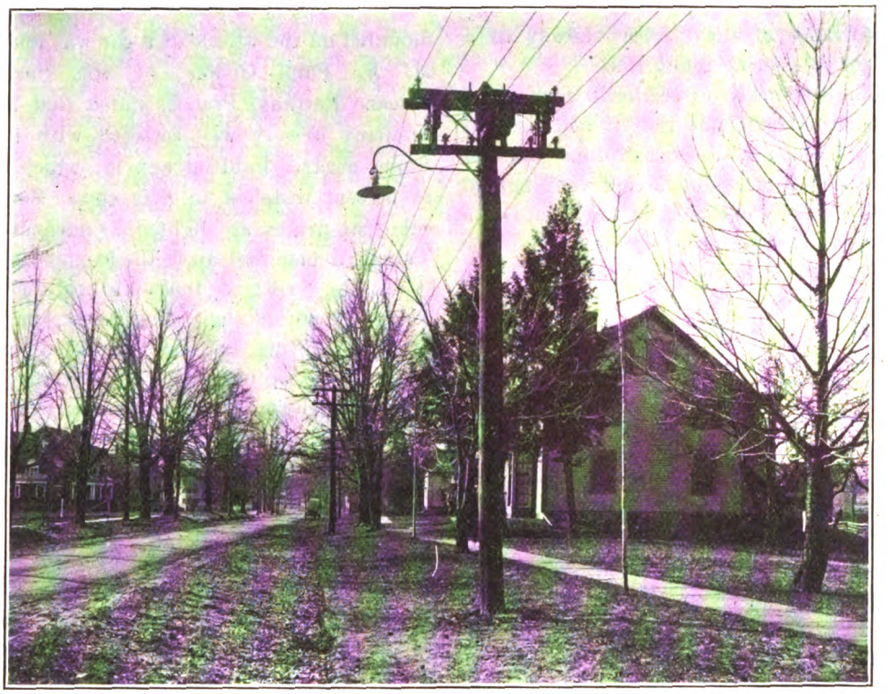


FIG. 1.—NERNST LAMPS FOR STREET LIGHTING IN WEST HARTFORD, CT.

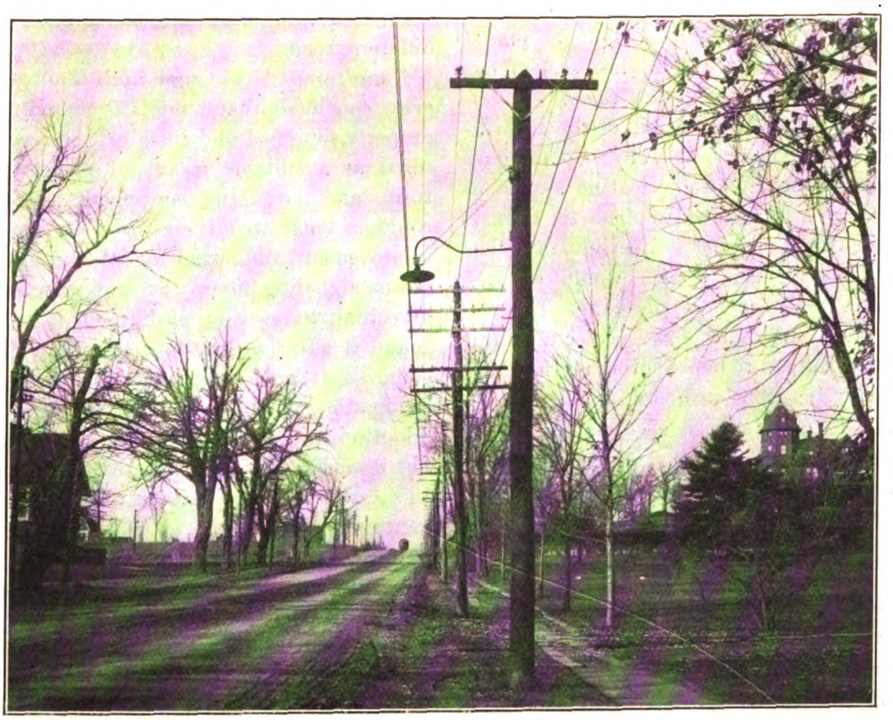


FIG. 2.—NERNST LAMPS FOR STREET LIGHTING IN WEST HARTFORD, CT.

In addition to this repair work, all the inspection and repairing necessary in connection with the Nernst installations in the city of Hartford, amounting to a total of about 2,500 glowers, is done by one man located at the lighting station.

The records kept by the company indicate that the total average cost for maintenance of the commercial and street lighting system amounted to $1.26 per glower for the first six months of the past year. This represents the most recent information available.

The regulation is said to be within five per cent, that is, two and one-half per cent either side of normal, and the life of the glowers is found to be slightly in excess of 800 hours on an average. The company has been asked to install eighteen additional street units shortly.

Two villages Unionville and Farmington, distant thirteen and nine miles respectively from the city of Hartford, both have Nernst street lighting systems similar to that in West Hartford, and are supplied with current from the power plant located at Unionville.

Although not over 200 horse-power in capacity, this plant is strictly up to date in its design and equipment. The normal lighting load of eighty horse-power is supplied from a seventy-five-kilowatt three-phase generator driven by a water turbine. An extra steam-generating unit with sufficient capacity to carry the normal load of the station is held in reserve. The three-phase, sixty-cycle current is transmitted at 2,300 volts pressure from the station to the step-down transformers in both villages, over three No. 4 main conductors; and the transformers which are mostly of ten-kilowatt capacity are connected to these mains through G. E. high-tension cutouts and Wurts lightning arresters. The line has also the usual lightning protection at the station. Both the Nernst street lights and the commercial Nernst and incandescent lighting are supplied from these transformers through three-wire, 112-224-volt secondaries of No. 8 gauge.

The system with a total of 188 single-glower lamps is divided up into six circuits of approximately twenty-eight lamps each; of the total seventy-seven lamps are used for street lighting in Unionville, eighty-six for street service and twenty-five for commercial service in Farmington.

The street lamps are mounted similar to those in West Hartford on standard goose-neck brackets at an average elevation of about twenty feet with a spacing of from 125 to 375 feet between lamps, depending upon the location.

All the lamps are inspected and the necessary renewals made by a boy once every two days. The glowers are allowed to burn out their natural life and the complete records show an average life of 803 hours with a total cost of maintenance per lamp-year, including labor, interest and depreciation, of $2.80; or 8.5 mills per kilowatt-hour.

Digitized by Google

The International Railway Congress.

Washington, D. C., May 3 to 13—Closing Sessions.

WITH the general meeting at the New Willard Hotel on the afternoon of May 13, the International Railway Congress concluded its formal sessions. On Saturday evening the members of the permanent commission of the congress entertained the American Railway Guild at dinner at the New Willard. On Sunday evening the delegates departed on several tours which had been arranged for them under the direction of the American Railway Association. The next congress will be held in 1910 at Berne, Switzerland.

After the general meeting on Saturday afternoon, a meeting of the permanent commission was held, and all of the old officers were reelected, as follows:

President: A. Dubois, ingenieur, honorary administrateur of the state railways of Belgium, president de la Societe Nationale Belge des Chemins de fer Vicinaux, president de la Societe des Chemins de fer et Minieres Prince-Henri.

Vice-presidents: Alfred Picard, of France; Ramaeckers, of Belgium.

Secretary general: Louis Weissenbruch, engineer in chief of the state railways of Belgium, directeur aux Chemins de fer de l'Etat Belge.

Secretary-treasurer: Edouard Holemans, chief of the division of railways of Belgium aux Chemins de fer de l'Etat Belge.

The following new members were elected: Mr. Paul Morton, Secretary of the Navy; Mr. George E. Stevens, of the Chesapeake & Ohio Railroad; Mr. Charles M. Hay, of the Grand Trunk line; Mr. Frank Barr, of the Boston & Maine Railroad; M. Kologrivoff, of Russia; M. Petri and M. Sarre, of the German government.

The topics discussed by the congress during the closing sessions covered every division of both light and heavy railroading. The application of electricity in various branches of the work excited considerable attention. The most important probably was the discussion taken up under question 8, on "Electric Traction." In addition to this, however, the subjects of "The Lighting, Heating and Ventilation of Trains" and "Automatic Block Signals" were discussed by section 3.

Section 5, in discussing light railways and in considering the question of traffic conveyed by automobiles, recognized the importance of the electric railway as a feeder to existing trunk lines.

The conclusion of section 3 concerning suburban traffic was that it had listened with interest to the description given of the use of electric traction in England and France, but that it was not in a position to express its preference for one or the other method of traction—steam or electricity.

Mr. C. B. Dudley, reporter for America for section 3, on the subject of "The Lighting, Heating and Ventilation of Trains," concluded that the use of candles was being abandoned, except in cases of emergency, and that the same is largely true of oil lamps. The carbureter system seems to have given good results on branch lines. The use of oil gas is being largely extended, while that of coal gas is disappearing. Electric lighting has been tried on a large scale, in five distinct forms: first, by the use of movable storage batteries; second, by the use of storage batteries placed permanently under the cars and charged during stops of the latter; third, by the use of dynamos operated by the motion of the car axle; fourth, by the use of a dynamo placed in a baggage car; fifth, by means of a steam turbine driving a dynamo placed on the locomotive. This last system has been tested only in a few cases.

M. L. Rouet de Journal, of the Madrid-Saragossa-Alicante Railway, Spain, gave complete data on the Vicarino system of electric lighting, as applied to twenty-three cars belonging to his company. The net cost of this system would be 1.55 francs per 1,000 candle-power (French measure) per hour, forty per cent of this being charged to depreciation and interest, twenty per cent to operation, fifteen per cent to maintenance of dynamos, eleven per cent to maintenance of accumulators, seven per cent to keeping up of belts, and seven per cent to maintenance of lamps.

M. Karl Steinbiss, of the royal management of the Altona Railway, Prussia, described experiments in electric lighting undertaken for his railway. The first experiment, undertaken three years ago, consisted in driving a dynamo by a De Laval turbine mounted on the locomotive. The lighting worked well, but the consumption of steam was excessive. This system was abandoned, and a dynamo mounted on the wheels of a car was tried. M. F. Paul Dubois, of the Paris-Orleans Railway, France, stated that his company is very well satisfied with the Stone electric lighting system, which is at present installed in fifty cars. Some suburban trains are lighted by means of a single dynamo set up in the baggage car.

M. C. Boell, of the state railroads, France, reported that, after having tried electric lighting, without great success, by moving accumulators, his management has adopted for the principal trains the Vicarino system, which gives excellent results.

Mr. Anderson, of the government railroads of India, said that lighting by electricity has been considered as a great improvement in Europe and America, and it is almost a necessity in the Oriental countries, because it absolutely avoids heat, and, still better, permits the use of fans by the same current. On the main lines of India about ninety-five per cent of the cars are lighted by electricity, and it is certain that the use of gas will completely disappear.

The conclusion of the congress regarding electric lighting is that systems of electric lighting are giving satisfaction on different roads.

Concerning block signaling, the congress concludes that automatic signaling, properly designed and installed, be recognized as a suitable means of protecting train and switching movements. The congress notes that there has been much improvement and extension of the automatic signaling since the last congress, and that those who have used it have found it effective for their purpose. The congress is not prepared to recommend automatic block signaling for general adoption to supersede existing systems, but it considers that there are cases where this system may present special advantages.

Section 5 concludes, with reference to the influence of light railways on the main lines, that these light railways merit, in the highest degree, the attention of public authorities.

Mr. W. D. Young, reporter for America, on question 8 of section 3, described the General Electric Company's experiments with the single-phase compensated motor at Schenectady, N. Y. Mr. Young's conclusion is that progress

Digitized by Google

in heavy electric traction requires greater attention to economy of distribution. This means higher voltages, elimination of distribution to substations, and perfecting the alternating-current motor. The present year will be memorable as the inauguration of practical operation with single-phase electric traction in the United States. In January the Indianapolis & Cincinnati single-phase line was opened, and forty miles of track are now finished. The trolley pressure is 3,300 volts, and the transmission line pressure, 33,000 volts, twenty-five cycles. This line, which was installed by the Westinghouse Companies, was described in the ELECTRICAL REVIEW for February 18. In February the Bloomington, Pontiac & Joliet single-phase electric railway was placed in operation. The trolley pressure is 3,300 volts.

The first road in Europe to be operated with single-phase commutating motors is the Stubai Valley road, running into the mountains from Innsbruck, Switzerland. The line is twelve miles long, and for half its length the average grade is more than 200 feet to the mile. The cars are equipped with Winter-Eichberg motors, four motors of forty-horse-power each on each car. The transmission is at 10,000 volts, the current being delivered to the motors at 250 volts, forty-two cycles. Between Murnau and Oberammergau, Switzerland, a single-phase electric line was opened early in the year. Current is generated at 5,000 volts, sixteen cycles, and fed directly into the line at this pressure. The motors are of the single-phase commutator type, made by the Siemens-Schuckert Company.

The objection to the three-phase system is shown to be the use of three conductors, with the resulting complications. It appears to be adapted to long lines where the traffic requires few stops. It is also well suited to mountain railways where the current is returned to the line while running down grade, when the motors act as generators.

In connection with the single-phase motor, the problem of collecting the current requires careful study. On account of the high voltage it is necessary to place the conductors out of reach, and the overhead wire should be used. The third rail, which has caused so much discussion, and which results in complications at crossings and terminals, will doubtless be abandoned in favor of the overhead conductor where the single-phase motor is used.

Mr. Ernest Gerard reported for Great Britain and Belgium. The conclusion that Mr. Gerard reaches is that, in England, electrification is attended with an increase in the number of trains and in the facilities offered to passengers. This is followed by an immediate increase in the number of passengers and in the receipts, with a material decrease in the cost per train-mile, an increase in speed, and a considerable improvement in comfort.

M. Victor Tremontani, in his report for all other countries, concludes that electric traction offers many advantages and few objectionable features. From his observation, he concludes that the technical and financial advantages resulting from the application of electric traction to steam roads are worthy of the attention of the managements, and a large number of steam lines would profit by being electrified.

During the discussion on electric traction, Dr. Friedrich Schulz, head of the German delegation to the congress, presented an interesting paper on the Berlin-Zossen high-speed experiments. He also exhibited many photographs of the track equipment and electric conductors. Dr. Schulz was chairman of the investigating committee for high speeds which built the Zossen railway.

Mr. J. F. Aspinall, of the Lancashire & Yorkshire Railway, England, stated that the results have shown that, with electric traction, the cost per ton-mile is greater, and for the train crews, less. Electrification of the line cost about $100,000 per mile, or about three and one-half times the cost of steam equipment. Electric traction makes possible a volume of passenger business that can not be handled at terminals by steam locomotives, and it thus becomes profitable, in spite of its apparently increased cost when measured on the ordinary basis.

Throughout the stay of the delegates to the congress at Washington they were most hospitably entertained by the officers of the American section. Mr. and Mrs. Stuyvesant Fish held a number of formal receptions. The reception tendered by Mr. George Westinghouse on the evening of Wednesday, May 10, was one of the most brilliant of the season, and was attended by nearly all the delegates and a large proportion of Washington society. Visits were made to all of the historical points in and about Washington, and on the afternoon of the last day of the session the Honorable Theodore Roosevelt, President of the United States, received all the members of the congress and others at a garden party in the White House grounds.

The American Railway Appliance Exhibition, which closed its doors on the evening of May 13, was brilliantly successful. That this success was possible is largely due to the principal officers in the management of the exhibition—Mr. George A. Post, chairman; Mr. J. Alexander Brown, director, and Mr. Charles A. Moore, treasurer. The exhibits were unique in their characteristics, devoid of decoration and spectacular features, designed to show to experienced and expert railroad men the detailed construction and practical operation of every device. The various exhibits were frequently visited and carefully studied, especially by the foreign railroad officials, who expressed astonishment and gratification at the wonderful accomplishments of American manufacturers. Success must be the final word in any account of the International Railway Congress and the American Railway Appliance Exhibition. While many prominent officials of the two organizations are entitled to much credit for these results, the satisfactory outcome is really due to the spirit of concord, the friendly cooperation and the intelligent enterprise of every man connected with the congress and exhibition. Among the American officials of the congress, Mr. Stuyvesant Fish is entitled to particular credit, and Secretary W. F. Allen, of the American section, was constantly at his post keeping everything running smoothly.

On Sunday the members of the congress departed from Washington on the various tours. Two general tours were established—one designated as the long tour, and the other as the short tour. The long tour brings the delegates to Altoona, Pa.; Pittsburg, Pa.; Cincinnati, Ohio; St. Louis, Mo.; Chicago, Ill.; Buffalo, N. Y.; Niagara Falls, N. Y.; Montreal, Canada; Schenectady, N. Y., and Saratoga, N. Y. This tour occupies the time from Sunday, May 14, to Saturday, May 27, the total length of the trip being about 2,700 miles.

The short tour brings the delegates to Altoona, Pa.; Cleveland, Ohio; Buffalo, N. Y.; Niagara Falls, N. Y.; Schenectady, N. Y., and Boston, Mass. This tour occupies the time from Sunday, May 14, to Tuesday, May 23. The total length of the trip was about 1,500 miles.

At Schenectady the delegates will be entertained by the officers of the General Electric Company. The great works of this company will be visited, and the new electric locomotives being built for the New York Central & Hudson River Railroad Company will be offered for inspection and demonstration.

At Pittsburg, Pa., the delegates are the guests of the Westinghouse Electric and Manufacturing Company. A large part of the time spent in Pittsburg is to be occupied in going through the extensive works of this company.

At Cincinnati, Ohio, a number of the party journeyed to the Norwood works of the Bullock Electric Manufacturing Company, where they were entertained after an inspection of the shops.

Digitized by Google

PROGRESS IN THE DEVELOPMENT OF THE ELECTRIC DRIVE.[1]

BY SIDNEY B. PAINE.

In April, 1895, a paper was presented before the New England Cotton Manufacturers' Association on "The Electrical Driving of Textile Establishments." In that article a general description was given of the system and methods which had been adopted in the first textile mill in this or any other country, to be driven electrically throughout. At that time, the first mill had been running about nine months. Much progress has been made during these ten years. The writer has a record in detail of 128 different textile corporations which are using about 90,000 horse-power of electric motors. It is a conservative estimate that approximately 175 textile mills in this country are using electrically about 140,000 horse-power. The census of 1900 showed that 1,165,048 horse-power was used by the cotton, woolen, worsted and silk mills in the United States. Assuming an increase in the last five years of twenty-five per cent we find that about ten per cent of all the power used in these industries is obtained from motors. When we consider the fact that, at the outset, the electric system was as new to engineers as to the manufacturers, we can understand why the progress has not been even more marked. It may be of interest to analyze the above 90,000 horse-power of which the above record has been kept in detail. Fifty-four thousand horse-power is generated by steam, 33,000 horse-power by water power and about 3,000 horse-power by water and steam combined. Forty-two new mills have been built in which the electric drive was adopted at the outset. In twenty-eight of these forty-two mills, the energy is generated by steam and in fourteen by water power. Most significant, however, is the large number of mills which are operated from central power stations. Twenty-two mills are thus driven entirely by current generated by an outside and independent corporation, while twenty-two mills purchase 5,586 horse-power to supplement the power generated upon the premises. This indicates very clearly the tendency toward "centralization of power," which the writer has advocated for several years. This movement has not been confined to this country, for in England two large power companies have been organized, in Yorkshire and Lancashire respectively, which are soliciting business from the textile mills. Two years ago a prominent English manufacturer remarked to the writer, "we have been watching your progress in America, and believe that your experimental work is nearly completed. We are about ready to adopt your system." The signs are not lacking that they are on the eve of a forward movement in this direction.

In all its essentials, the system followed to-day is the same as that adopted ten years ago. In some few details, improvements have been made. The principal change has been in the direct connection of the motor to the spinning-room shaft. In the first mills this arrangement was adopted for the picker room only. There has been a marked advance, however, in the recording and indicating instruments. At first we had to depend upon the ammeter and voltmeter. The use of these instruments was found to be unsatisfactory, as the readings of the ammeter had to be corrected by the readings of the voltmeter, and did not even then give a correct indication of the amount of energy furnished by the motor. The use of the indicating wattmeter corrected this difficulty, but no continuous record could be kept by that instrument. Then followed the curve-drawing wattmeter, by which the record was drawn by a pen on a revolving disc. This was open to the objection that its record, especially on light loads, was too short to be of much service. The latest instrument to be developed is the registering wattmeter, by which the record is drawn upon a strip about three inches wide, at the rate of three or six inches per hour, as may be desired. The duration of this record depends upon the length of the strip.

A test was made in a fine goods mill and continuous record curves were obtained. The speed on each strip was such that three inches passed under the pen in one hour. Fifty such continuous curves were taken in this mill, each representing the record of half a day. In addition, five special tests of shorter duration were made. A recording wattmeter was also connected in the circuit to record the total energy, and an indicating wattmeter was used to give instantaneous readings at ten-minute intervals and to check the registering wattmeter. Careful record was made of temperature outside and also inside the mill and of the humidity both relative and actual. Memorandum was made of all particulars connected with the machinery driven. Great difficulty was experienced in determining the actual number of machines in operation at a given moment, but especial care was used to have the record as accurate as possible. The curves are the record of a run for a Saturday morning and the first five days of the following week, of a 200-horse-power motor in a ring spinning room, and indicate the current delivered to that motor during the period. The writer knows of no method which can determine accurately the friction losses of a system, either mechanical or electrical, under working conditions. The friction load tests do have a comparative value, however, for they detect any change or undue losses from day to day. No importance has been attached to the tests of portions of machinery to determine the power required for a single frame or number of frames. Such a test depends for its value upon the assumption that all the machines of the same description consume the same amount of power. This is manifestly an incorrect hypothesis, especially on spinning frames. What we are all interested in, is the amount of power required to run a room or a section containing a given number of spindles, together with the necessary shafting and belting.

The 200-horse-power motor under test operated fifty-two frames, aggregating 11,648 spindles. The spindle speed was supposed to be 9,000 revolutions per minute, but at that time we had no instruments suitable for determining the accuracy of this assumption. The gauge was two and three-fourths inches, diameter of the ring one and one-half inches, and the traverse six inches. During this test one frame spun No. 40 yarn; seven frames spun No. 50 yarn; nine frames spun No. 60 yarn; eight frames spun No. 65 yarn; eighteen frames spun No. 70 yarn; five frames spun No. 80 yarn; four frames spun No. 100 yarn.

The following facts may be deduced from the results obtained on the five days of the following week:

	Percentage of Machinery in Operation.		Spindles per Horse-Power.	
	A. M.	P. M.	A. M.	P. M.
Monday	93.6	94.6	69.41	75.97
Tuesday	93.9	98.4	71.97	76.67
Wednesday	95.1	97.1	72 64	74.37
Thursday	94.2	94.6	71.04	74.21
Friday	96.3	96.7	72.32	74.03
Aver. for 5 days	94.6	96.3	71.48	74.61
Total average	95.4		72.95	

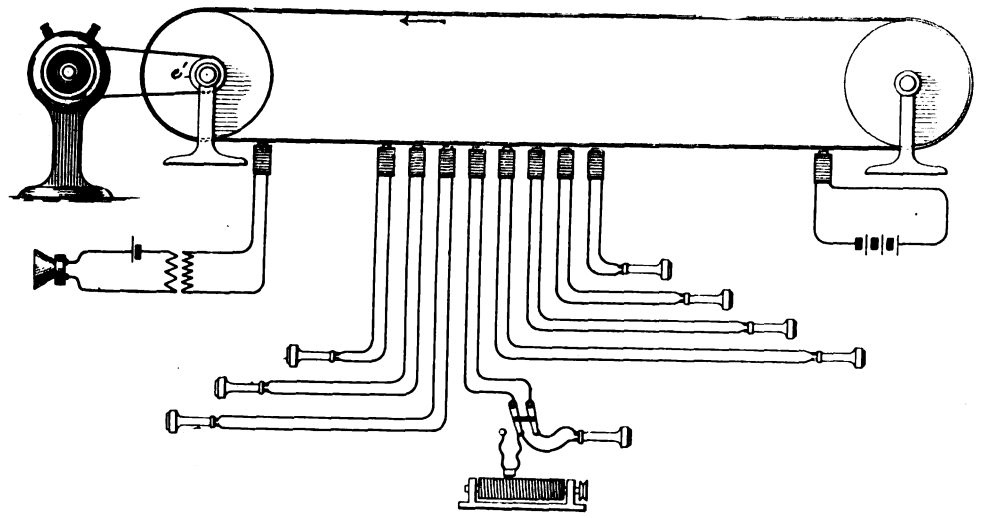
The results obtained in these tests illustrate the difficulty, to say the least, which would be experienced in an attempt to obtain similar information by means of indicator cards taken at the engine cylinder. The power required to operate machinery varies from day to day and even between forenoon and afternoon of the same day. If all the frames were in operation at the time of the test, the result would be misleading, as it would be more favorable than if normal conditions had prevailed. The advocates of the electric system believe that by its use much valuable information may be obtained and that thereby the manufacturer can keep himself informed as to what is transpiring within his mill.

[1] Abstract of paper presented at the annual meeting of the New England Cotton Manufacturers' Association, April 26-27, 1905.

Digitized by Google

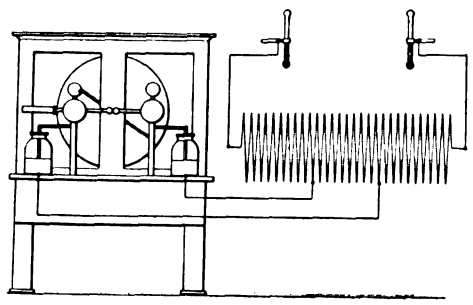
Electrical Patents.

Valdemar Poulsen, of Copenhagen, Denmark, has patented in the United States an apparatus for electromagnetically receiving, recording, reproducing, and distributing articulate speech, etc. (788,728, May 2, 1905). The present invention utilizes the principle disclosed in a previous patent granted to Mr. Poulsen, on November 13, 1900, and numbered 661,619. In the patent referred to, a method is described of recording electrical impulses which are created by sounds or other means in an electrical circuit, which consists in tracing a magnetic record thereof in a steel body by means of an electromagnet, through which the said impulses flow. The steel body retains the magnetic record or impression, and when it is desired to reproduce the speech or signal the magnet is subjected to the magnetic impressions, and electrical impulses of the same character are again created in the circuit containing the magnet. If the original impulses be created by the voice acting upon a telephone transmitter, the reproduced impulses may be caused to affect a telephone receiver which will then give out the same message that was spoken into the transmitter. As above stated, the present invention utilizes this principle, but consists of a means whereby the recorded message is substantially simultaneously reproduced and distributed to an indefinite number of receiving instruments immediately after it has been recorded, thereby rendering it possible for a number of persons or instruments to receive the same message at a number of different points. The apparatus therefore becomes useful as a means for distributing information or news of any character to an indefinite number of subscribers simultaneously.



SPEECH-RECORDING, REPRODUCING AND DISTRIBUTING APPARATUS.

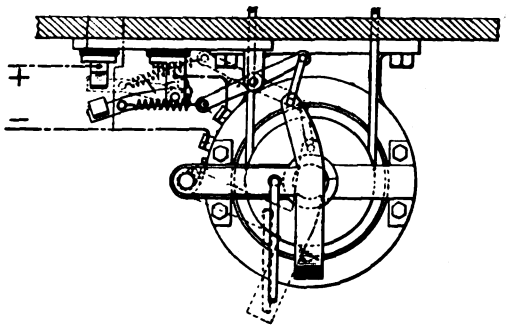
An electrotherapeutic apparatus is the invention of Charles F. Marsh, of Pensacola, Fla. (789,040, May 2, 1905). The object of the invention is to provide a device of a simple and effective nature for producing a current of such high frequency and potentiality and such low amperage that it is extremely valuable for therapeutic purposes, the current being rich in penetrative force. Another object is to provide the apparatus with electrodes of novel construction whereby an increased quantity of ultra-violet rays is produced, together with a ray more potent than the ultra-violet and less injurious to tissues than the X-ray, this new ray being between the ultra-violet and the X-rays. In carrying out the invention a resonator is provided. A source of alternating current is connected with the coils of the resonator at points equidistant from each other and from the ends of the coils. Vacuum



ELECTROTHERAPEUTIC APPARATUS.

electrodes are provided, containing a resistance material, and electrical connections are located between the resistance material in the electrodes and the respective terminals of the coil. An electrode is employed comprising a handle, a yoke thereon, and a strap hinged to the yoke. A vitreous vacuum tube is enclosed by the yoke and the strap. Carbon is placed in the tube, and a circuit is established from the yoke to the carbon by a conductor provided for that purpose.

Herbert B. Coho, of Mount Vernon, N. Y., has assigned by mesne assignments a one-half interest in a patent obtained by him on switch and connection controlling electric motors and power transmitters to Wheeler & Wilson Manufacturing Company, of Connecticut, and the Emerson Electric Manufacturing Company, of St. Louis, Mo. (788,518, May 2, 1905). The invention relates to an improved switch or cutout and its connections with an electric motor and power transmitter, and has for its object to provide simple, compact, and efficient mechanism of this character so arranged that the switch may be very quickly adjusted to cut the motor into and out of circuit to avoid injury to the switch-contacts, and so that after cutting in the motor it will start and attain full speed before the power transmitter is adjusted by the switch-controlling means for operating a machine to be driven. The invention is more especially adapted for use in operating a sewing machine, but it may be used in whole or in part for other electric power transmitting purposes. In the embodiment of the invention, the connections comprise two binding-posts, one



SWITCH AND CONNECTIONS CONTROLLING ELECTRIC MOTORS AND POWER TRANSMITTERS.

serving as a contact, the other having a switch-lever fulcrumed to it, which lever carries a contact adapted to the first-named contact. An operating lever is employed to which is connected one or more springs, these springs being also connected to the switch-lever and quickly opening and closing the switch as the switch-lever is adjusted by the operating lever. An electric motor is provided. A power transmitter including a wheel is loose on the motor shaft, the loose power transmitter wheel being engaged by a controlling lever with the motor-driving wheel. Means are also provided for coupling the controlling lever with the switch-operating lever.

Electrical Project in India.

The Kashmir project in the state of Mysore, India, has been sanctioned, and plans are being made to carry out this great scheme. The proposition includes a 17,000-horse-power hydroelectric installation, to supply power for a 200-mile electric railway, a large electric dredging outfit, besides light and power for other purposes. It is not improbable that the single-phase, alternating-current system will be used on this road.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Electrical Repairs at Sea.

According to the author of this communication, the electrical expert on the man-of-war is greatly hampered by a lack of adequate testing apparatus, and he is often forced to devise crude expedients for conducting the required tests. For instance, on a British man-of-war a large number of Leclanche cells are used for gun circuits, bells, telephones and all manner of open-circuit work. It is necessary to test these continually to see that they are in good working order. The test that is laid down is based upon the capability of each cell to fuse a certain length of platinum-silver wire, equal to that of an ordinary gun fuse, through a specified resistance. It is practically impossible to test all of the cells in this way. The writer gets over the difficulty by selecting one cell which gives the required current. He then, by means of a so-called detector—which is simply a crude galvanometer—adjusts the circuit to obtain a given deflection when this cell is in circuit. By replacing the cell consecutively by all those to be tested, the ones which give the required current are easily picked out. On shipboard no potentiometer is supplied, but a convenient little instrument is constructed by splitting a good drawing pencil in two, which may be done by soaking in water until the glue is soft. That half of the pencil which contains the graphite core is used as the potentiometer. The graphite core must, of course, not be broken. Connections are made at the two ends simply by twisting copper wire around the wood and graphite, being sure that good contact is made. The sliding bridge consists of a loop of copper wire also twisted around the wood and graphite, but loose enough to be slipped along. A scale is laid off upon the wood, and the detector mentioned above serves as the galvanometer. By means of this little device tests have been carried out satisfactorily even in out-of-the-way corners. Another crude form of potentiometer is obtained by connecting the searchlight resistance in series across the supply circuits, as each of these has a definite resistance so that the fall of potential between any two points can be estimated. This arrangement has been used to check the ammeters and voltmeters which are used throughout the vessel.—*Abstracted from the Electrical Review (London), April* 28.

Some Notes on the Efficiency of Steam Plant.

A comparison is here made by Mr. Walter A. Vignoles between the fuel economy of electric generating plants and marine engines. The figures are taken from English practice only. The lowest coal consumption recorded was at the Glasgow tramway power station, where the figure was 3.64 pounds per kilowatt-hour. The highest figure was for black coal, where it was 15.4 pounds per kilowatt-hour. The best results for the marine engine were obtained during the trial of the first-class cruiser Monmouth, when developing 16,326 indicated horse-power. The coal consumption per indicated horse-power-hour was 1.45 pounds. The poorest results were given by the sloop Clio, when developing 311 indicated horse-power. The coal consumption was then 2.32 pounds per indicated horse-power-hour. If an efficiency of eighty-five per cent from the engine to the switchboard is assumed, for the first figure the coal equivalent per kilowatt-hour would be 2.28 pounds. Assuming an efficiency of eighty per cent, for the performance of the sloop Clio the equivalent coal per kilowatt-hour would be 3.88 pounds. The author endeavors to determine why marine practice gives better results than stationary practice, and he concludes that the load-factor has only a small effect upon the pounds of water evaporated per pound of fuel burned; that the steam consumption in a central station equipped wth a number of sets, compared with the total load on the dynamos, may be shown by an approximately straight line—in fact, the "Willans law" for a steam engine is applicable to a central station; that the average steam consumption during any period may be determined by working out the average load, when the consumption can be read from the curve; and that the load-factor does not give sufficient information about the conditions of the load, but that the capacity of the station should be substituted for the maximum load observed in working out the load-factor. The large consumption of coal in many central stations may be due to the small plant load-factor resulting from excessive steam consumption. Too much attention can not be paid to economizing steam at light loads, and, to do this, greater attention must be paid to the economy of auxiliaries, not only at full load, but at light load. All steam pipes should be kept as short and as small as possible. It is probable that in plants of considerable dimensions the unit system now being adopted will be the best, keeping each unit as compact as possible, and reducing steam pipes and connections to a minimum.—*Abstracted from the Electrician (London), April* 28.

The Test of a 5,000-Kilowatt Alternator.

The method adopted for testing the 5,000-kilowatt alternators installed in the Seventy-fourth street power station of the Interborough Rapid Transit Company, New York city, is here described by Mr. L. L. Gaillard. Each machine is rated at 5,000 kilowatts, 11,000 volts, twenty-five cycles, at 700 revolutions per minute. They were built by the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., and each is direct-connected to a double horizontal-vertical Allis-compound engine. It being impracticable to measure the iron losses in the usual manner, test rings were made up of samples of the material used for constructing the armature. The losses were determined for these rings. The total iron loss was found to be 38,693 watts. The resistance of the armature is 0.3493 ohm; the resistance of the field, 0.8206 ohm. From these figures the efficiency of the machine has been computed for different loads. They are as follows: one-quarter load, 91.29 per cent; one-half load, 96.50 per cent; three-quarters load, 97.71 per cent; full load, 98.06 per cent; one and one-quarter load, 98.24 per cent. The no-load saturation curve was obtained in the usual manner, simultaneous readings being taken of the field current and armature voltage at constant speed. The short-circuit characteristic was obtained by short-circuiting the armature and running the machine at full speed, the armature and field currents being noted. This characteristic is a straight line passing through the origin and a point corresponding to 750 amperes in the armature and 180 amperes in the field. The insulation tests were made by using a 250-kilowatt, 40,000-volt transformer. The regulation of the machine was calculated, and was found to be 4.5 per cent. This is probably too small, but it was not convenient to check it by an actual test. Temperature measurements

Digitized by Google

gave the following results after a run of seventeen hours with an average load of 5,000 kilowatts: the temperature rise above the air for the field winding was 22.5 degrees centigrade; for the armature winding, 22.6 degrees centigrade, and for the armature laminations, 25.5 degrees centigrade.—*Abstracted from the Electric Club Journal (Pittsburg), May.*

A New Dynamo for Train Lighting.

An interesting method of lighting trains is described here by Dr. A. Rosenberg. The author first explains the H. Rosenberg system, from which the new one has been developed. The original system consisted of a small dynamo driven from the car axle. Upon the same shaft was a small auxiliary dynamo, which served to excite the former. This machine was itself excited from the storage batteries on the car. The peculiarity of this system is that, when the direction of motion of the car is reversed, the direction of rotation of the exciting dynamo is reversed, although its excitation is not changed. This reverses the excitation of the main dynamo, and hence maintains its polarity unchanged. To obtain regulation, a second or series winding was placed upon the auxiliary machine, which winding carried the whole current of the main dynamo, and acted in opposition to the battery excitation. By this means a practically constant current was obtained independent of the speed of the car. This system is inconvenient because of the number of parts, so that the author sought to simplify it by doing away with the exciting dynamo. In explaining it, a two-pole machine is assumed, which has a constant excitation due to the battery. The armature of this machine has two windings, one of them having a fairly high resistance. The brushes for this winding are placed midway between the poles in the usual position, and are short-circuited. This is the exciting winding. The brushes for the working winding are placed at an angle of ninety degrees to the others, and hence come midway under the poles. As the machine is revolved, the magnetic field due to the battery excitation sets up electromotive forces in both windings. Due to the positions of the brushes, there is no difference of potential between those which deliver the working current, but a current will flow through the exciting winding. This winding is arranged so as to set up a strong armature reaction, and, due to the position of the brushes, this distorts the magnetic field set up by the field winding. According as the machine revolves right-handedly or left-handedly, this distortion will be to the right or the left, and, due to it, a difference of potential will be produced between the brushes of the working winding. Due also to the fact that this effect is reversed with a reversal of the direction of rotation, the polarity of the working brushes is not changed. The machine thus automatically takes care of change in the direction of motion of the car, and is self-exciting. The characteristics of this machine are peculiar. As the speed increases, the current delivered rises rapidly, but soon becomes nearly constant. Results were shown for a particular machine, in which the current becomes practically constant at about 1,000 revolutions, and changes very little from here up to 2,400 revolutions. By changing the current through the field winding, this characteristic can be shifted, and the machine be made to deliver a constant current whose value may be anything between ten and fifty amperes. The system, in other details, differs but little from previous systems. The dynamo is suspended from the car trucks and is driven by a belt. The voltage at the lamps, however, is controlled by means of fine iron wire resistances enclosed within coils similar to the ballast coils of the Nernst lamp.—*Translated and abstracted from Zeitschrift für Elektrotechnik (Vienna), April* 30.

The Use of Caustic Alkalies in the Nickel-Iron Accumulator.

Some instructive suggestions regarding the use of caustic alkalies in accumulators are here given by Dr. M. U. Schoop and M. Charles Liagre. Those liquids having the best conductivity are the most suitable as electrolytes for accumulators. They are acid and alkaline solutions. The salt solutions have a greater resistance. Among the acid solutions, sulphuric acid alone has been employed with success. The others—hydrochloric acid, nitric, etc.—have a lower conductivity, and at the same time they are not as suitable for taking part in reversible reactions. In the lead accumulator the use of sulphuric acid is justified both on account of its conductivity and because the lead sulphate formed on the electrodes is insoluble in the solution. In view of this condition, it is interesting to examine all solutions of sodium and potassium, so as to determine the best conditions for using them. Solutions of potassium hydrate, as is true of sulphuric acid, show a maximum conductivity when containing twenty-nine per cent of potassium hydrate. A fifteen per cent solution of sodium hydrate gives the highest conductivity. Of these three solutions, sulphuric acid is the best conductor. Then comes potassium hydrate, the sodium hydrate being the poorest. Although a solution of potassium hydrate for a given concentration has a greater resistance than a similar solution of sulphuric acid, since the electrodes in the alkaline accumulators are separated by distances much less than those in the lead accumulator, the total resistance of the electrolyte in the cell is less than that of the lead cell. It is this latter resistance that enables the alkaline accumulator to discharge at such high rates. Potassium hydrate forms a better solution for the alkaline accumulator than sodium hydrate because it is a better conductor, and the change in conductivity with temperature is less rapid. During use, the concentration of the electrolyte in the alkaline accumulator varies for different levels, due to the action of gravity and to the different speeds of migration of the potassium and hydroxyl ions. The effect is similar to what takes place in the sulphuric acid solutions. There is a tendency to form potassium ferrate in concentrated solution, which is undesirable, and as a more dilute solution requires less potassium hydrate, a twenty per cent concentration is generally used instead of the twenty-nine per cent, which gives the maximum conductivity. An objection to the alkaline solutions is their caustic nature. They blister and destroy the skin, and form wounds which are difficult to heal and sometimes dangerous. To prevent this a solution of boric acid or citric acid should be kept handy to neutralize the alkali. It is particularly necessary to protect the eyes from the alkaline spray. The clothing should be protected by aprons of canvas. To prevent the formation of carbonates, the electrolyte must be protected from the air, which may be done by coating the surface with a non-saponifying oil, but the gas set free forms a foam and may give rise to explosions. In the laboratory the best and simplest way is to cover the jar with a plate of glass. The density of the solution should be watched carefully so as to keep it at the correct point. An ordinary hydrometer may be used, but for more accurate work a more sensitive instrument has been devised by M. Schoop. It is very important to use pure materials in forming the solution. Commercial alkalies often contain chlorine, and organic matter which is deleterious to the cell; hence it is also essential to add only distilled water to the electrolyte. Because of the dangers and difficulties arising from the use of the caustic alkalies, substitutes for them have been sought. M. T. von Michalowsky suggests the aluminates of the alkali. As in these aluminates the oxide of zinc is insoluble, he recommends a nickel-zinc cell. These electrolytes are not changed by the passage of the current if the two electrodes are insoluble. The action is similar to that supposed to take place in the nickel-iron cell. Unfortunately the conductivity of the aluminates is not so good, and this condemns the cell.—*Translated and abstracted from L'Éclairage Électrique (Paris), April* 29.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Fort Wayne Induction Integrating Wattmeters.

The Fort Wayne Electric Works, Fort Wayne, Ind., has developed a new single-phase integrating wattmeter known as the type W. The exterior appearance of this instrument, with glass case, is shown in Fig. 1. The instrument occupies a space eight and one-quarter by seven by four and five-eighths inches, and weighs less than ten pounds complete. The interior construction is simple and compact, but ample space is allowed around all the operating parts. It is so built that it may be easily assembled or dismantled.

All connections with the line are made

FIG. 1.—FORT WAYNE WATTMETER WITH GLASS CASE.

to binding-posts, which are protected from accidental short-circuits. These are located inside a separately sealed terminal box on top of the meter. No shunt-circuit wires need be extended, and no soldered connections need be outside the meter. Both sides of the two-wire circuit, or the outside wires of a three-wire circuit pass through the terminal box.

The register has four dials, and is mounted on slotted projections held by two screws to the dial bracket on the mechanism frame. This assures accurate alignment with the rotating element. No constants are necessary. The smallest reading is in kilowatt-hours.

The upper bearing for the rotating shaft is inverted. The end of the shaft is hollow, and rotates about a stationary, flexible steel needle mounted in the top bearing stud. The flexible feature is designed to eliminate noise and vibration, and the hollow top of the shaft permits lubrication, if desired, without the possibility of oil being drawn to the worm-wheel by capillary attraction. This construction also permits freedom of motion of the upper end of the shaft without liability of permanently bending the upper bearing.

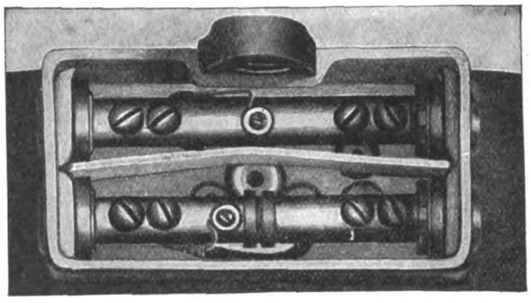


FIG. 2.—INTERIOR OF TERMINAL BOX.

The rotating element of the meter is a small aluminum disc, which is mounted on a short phosphor-bronze shaft, and held in place on the shaft by a set screw. The disc may readily be moved vertically to permit adjustment with the air-gap of the magnet.

The lower end of the phosphor-bronze

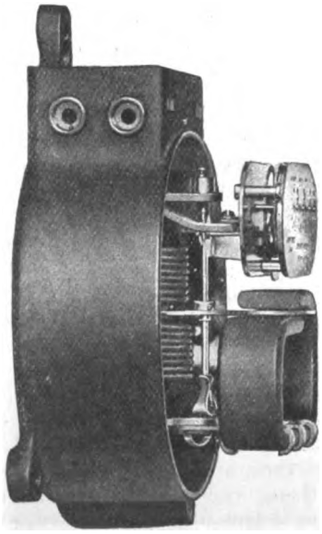


FIG. 3.—SIDE VIEW OF WATTMETER, SHOWING POSITION OF PERMANENT MAGNET.

shaft has set into it a small hardened steel tip with a rounded end. This tip bears on a sapphire jewel, which is elastically supported on a carefully adjusted spring mounted in the jewel screw. The jewel screw is the only movable part of the lower bearing. For relieving the jewel from pressure when not in operation, the jewel screw is partially withdrawn, allowing a spring clamp to close on the shaft and hold it in place until the jewel screw is again tightened. This forces the spring to release the shaft. The clamp acts horizontally, and exerts no strain whatever on either bearing or shaft.

The permanent magnet is in front of the shaft, as shown in Fig. 3. It is attached to the lower bearing bracket by two screws, which engage with slotted lugs on the magnet clamp. It is maintained in position with relation to the centre of the disc by a sliding gauge, which can be locked. After the gauge is set, the magnet may be removed and replaced freely without further adjustment. The gauge is a part of the magnet clamp, and is not changed by the removal

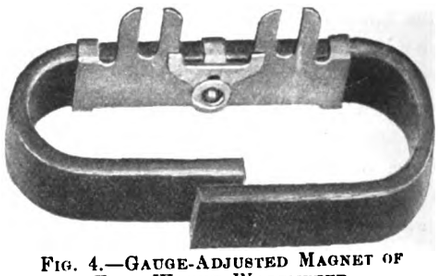


FIG. 4.—GAUGE-ADJUSTED MAGNET OF FORT WAYNE WATTMETER.

of the magnet. The gauge-adjusted magnet is shown in Fig. 4.

The two series coils are fitted with spiders, each attached to the main frame with a single screw, and located opposite the shunt coils in the back of the meter. For three-wire circuits they are double-wound to avoid the effects of unbalanced loads. The shunt coils are mounted on the upper and lower arms of the magnetic circuit.

For sixty-cycle circuits the type W meter has a lagging connection on the outside of the lower shunt coil. The 140-cycle meter has a 140-cycle lagging connection on the upper shunt coil, in addition to the sixty-cycle connection below, and it can be altered for use on the lower frequency. The meters are wound for 110 to 220 volts, and two or three-wire service. They are made in capacities of five, ten, twenty and forty amperes, without transformers.

Digitized by Google

New Decade Resistance Box.

The Leeds & Northrup Company, Philadelphia, Pa., has recently placed on the market a new line of Wheatstone bridges and resistance boxes of the decade type. In the accompanying illustration is shown

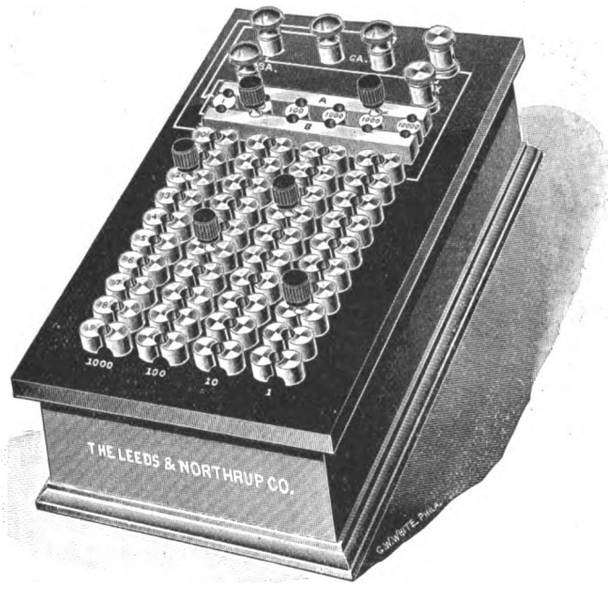


FIG. 1.—NEW DECADE RESISTANCE BOX.

a resistance box with four rows of resistance, ranging from one ohm to 10,000 ohms in the rheostat, and with six resistances in the bridge, all of which may be used in either arm. The advantages claimed for the decade plan of connecting

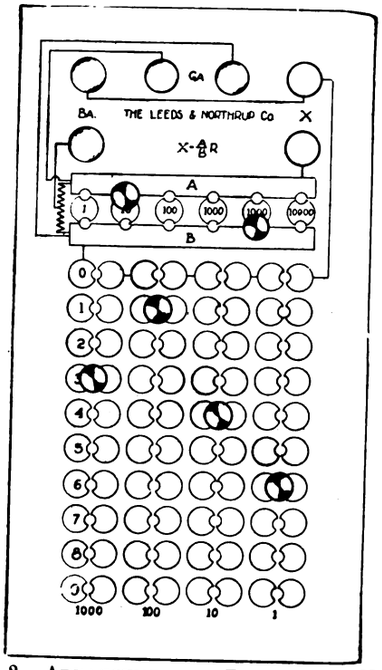


FIG. 2.—ARRANGEMENT OF RESISTANCES, NEW DECADE RESISTANCE BOX.

the coils in the rheostat over the regular post office or other plug-out methods are as follows: each decade requires a single plug, which is never out of use. The plug is either in the zero position or set at some value, and is consequently not easily lost while being laid aside. As each decade requires but one plug, the value can be read from the position of the plug, without the addition of any series of values, as in the other plans of connection. No block in the rheostat has a plug attached to two sides of it. On this account there is no possibility of a good plug fit being disturbed by the removal of a plug from the other side of the block, which is of advantage in ensuring good contacts and accuracy.

In this line of boxes there is a unique arrangement of the bridge-arms, which minimizes errors due to contacts, and facilitates interchanging the arms. Any one of the coils in the bridge may be connected to either bridge-arm. The bridge can consequently be reversed, and the coils interchanged very simply.

The resistances are made of wire which has a low temperature coefficient, and requires no correction at all for accuracies to one-tenth of one per cent for ordinary changes of temperature. The wire has also a negligible thermoelectric force against copper, and consequently no corrections have to be made in using it. An unusual thickness is given to the hard-rubber top for this class of apparatus, in order to prevent the possibility of buckling, and to ensure continued good plug fit.

The "Duplex" Mast-Arm.

The Buffalo Specialty Manufacturing Company, Buffalo, N. Y., is introducing the "Duplex" mast-arm for suspending lamps in street arc lighting. The arm is made of two lengths of one and three-eighths-inch steel tubing, approximately parallel to each other, both ends of which fit into malleable iron sockets, and braced together in the centre by means of an expansion bridge. The bridge allows the pole-ends of the two lengths of tubing to spread in order to adapt the arm to any size of pole. The necessary fittings, including pulley casings, are cast on the iron sockets. The arm is fitted with a pulley casing at each end of the tubing. These are equipped with six-inch pulleys for the cord or cable to pass over. The fittings on the pole-end of the mast-arm have two eyes, which hook over two projecting horns, attached to the pole, one on each side, previous to the erection of the arm. The tops of the projecting horns also serve to hold the glass insulators.

The arm is held in a horizontal position by a substantial supporting rod, which has a suitable adjusting device to adjust the arm in a perfectly horizontal position. One end of the rod is attached to the arm near the lamp, and the other is attached to the pole about four feet below the point where the mast-arm proper is secured to the pole. This distance will vary according to the length of arm used.

The lamp is attached to a cord or cable which passes up over the pulley, thence inside of and completely through the entire length of one of the tubes, and then over the pulley to the pole-end and down the pole. The cord is protected from the weather by passing through the tubes.

A Handsome Railway Congress Souvenir.

A very handsome souvenir catalogue is being distributed at the International Railway Congress, Washington, D. C., by the Westinghouse interests. This catalogue details the development and scope of work of the Westinghouse companies in the railway and industrial fields. The contents contain, in addition to the introduction, descriptive matter concerning the Westinghouse Air Brake Company, the Union Switch and Signal Company, the Westinghouse Electric and Manufacturing Company, the Westinghouse Machine Company, Westinghouse, Church, Kerr & Company, the Cooper Hewitt Electric Company, the Sawyer-Man Electric Company, the R. D. Nuttall Company, Nernst Lamp Company, Pittsburg Meter Company, and Canadian Westinghouse Company, Limited.

In addition to the text there are numerous views of the different works of the Westinghouse interests together with reproductions of the apparatus manufactured by the different companies. The book is replete with interesting information, and shows excellent execution in every page. A fine half-tone engraving of Mr. George Westinghouse is used as a frontispiece, and the work is handsomely illuminated in green and gold on a pebbled paper cover.

The total amount of anthracite coal produced in the United States since 1814, the date of earliest record is 2,756,175,058 tons. In 1814, but twenty-two tons were produced. The total production of both anthracite and bituminous coal since 1814 is 5,577,210,577 tons. The amount produced last year was 351,196,953 tons.

Digitized by Google

Arc Lamp Resistance, High-Tension Transformers and Autostarters.

When a group of arc lamps is connected in series across a circuit, the drop across the lamps seldom equals the difference of potentials between the lines, and it is, therefore, necessary to introduce a regulating resistance. The accompanying illustrations, Fig. 1 and Fig. 2, show a resistance used with direct-current multiple and series-multiple lamps. One resistance is used with two lamps in series

FIG. 1.—SERIES-MULTIPLE ARC LAMP RESISTANCE, COMPLETE.

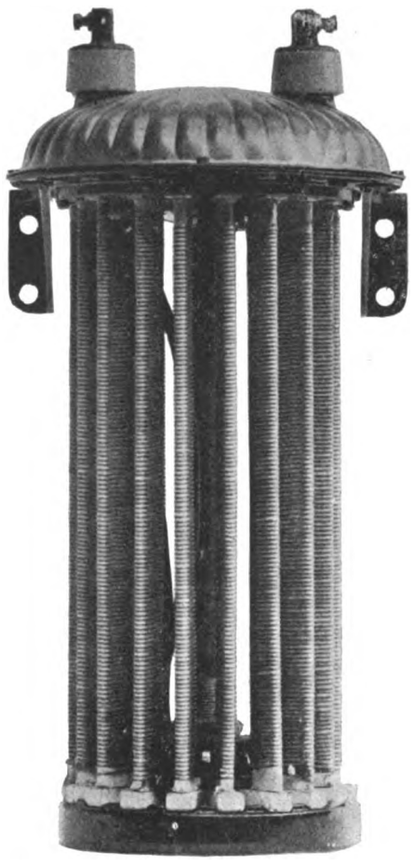


FIG. 2.—SERIES-MULTIPLE ARC LAMP RESISTANCE, WITH COVER REMOVED.

on circuits of 220 to 250 volts, and with five lamps in series of 550 to 600-volt circuits, two resistances are used. The successful operation of such a system requires that the resistance be reliable in every particular. Recognizing this fact, the Westinghouse Electric and Manufacturing Company has developed and placed upon the market this resistance which may be suited to a varying range of conditions, is well insulated and thoroughly waterproof, besides having a neat appearance. The wire furnishing the resistance is wound on asbestos-covered bars, which are insulated from the frame by porcelain blocks. This combination of asbestos and porcelain affords protection against fire. A terminal block at the bottom furnishes means for adjustment, so that five different resistances may be obtained by merely changing these connections.

The case and cap are finished in black. The binding terminals are insulated from the metal top by heavy petticoated porcelain insulators; both the terminals and insulators have square stems which prevent them from turning and becoming loose, or twisting off the connections. By means of substantial brackets just under the cap, the assembled outfit may be fastened with screws to the wall or other suitable support. The weight of the resistance complete is thirty pounds.

Transmission systems operating at potentials of from 5,000 to 20,000 volts are to-day in common use. While the main object of these systems is to transmit power from a generating station to the centre of distribution, it is often of decided financial advantage for the operating company to retail power along the transmission line. This power may be used for pumping, for the irrigation of farms and ranches, for mill, mine and factory purposes, and for the lighting of small outlying communities. As the volume of business does not always justify the maintenance of a substation, the Westinghouse Electric and Manufacturing Company has developed a line of transformers for this class of service known as the high-tension O. D. type.

The severe conditions of service which these transformers have to withstand have been given great consideration in their design, and a line of apparatus of great ruggedness and durability has been produced. Particular attention has been given to insulating these transformers to withstand the strains due to lightning and static disturbances which occur on high-tension lines. The same method of insulating has been followed as in the large high-voltage apparatus. They are all designed for operation in oil, which acts both as an insulator and as a cooling medium. The transformers have given universal satisfaction wherever installed and have proven themselves to be exceedingly long lived under the most trying conditions.

The smaller sizes (Fig. 3) of high-tension O. D. transformers are mounted in cast-iron cases, larger sizes (Fig. 4) in cases having corrugated sides of heavy sheet steel with heavy cast-iron tops and bases. All cases are absolutely waterproof. The smaller sizes are provided with lugs and hanger irons for mounting on poles, and their light weight makes them convenient to install.

The high-tension winding of these transformers is provided with two taps, by means of which five, ten or fifteen per cent of the total number of turns may be cut out, and the effective winding correspondingly reduced. By applying normal high-tension voltage to any one of these taps, secondary voltage may be boosted in proportion to the number of turns cut out, or the normal low-tension voltage may be maintained when the primary electromotive force falls below its rated value. This flexibility of ratio is a valuable feature.

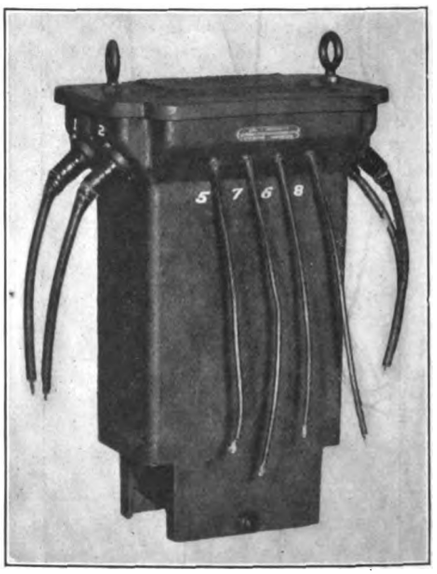


FIG. 3.—FIVE, AND SEVEN AND ONE-HALF-KILOWATT HIGH-TENSION TRANSFORMER.

These transformers are manufactured in sizes from one to fifty kilowatts for primary voltages up to 16,500 with 440

Digitized by Google

and 220 or 220 and 110 as standard secondary voltages. A line with capacities of from ten to fifty kilowatts is arranged for 2,200 and 1,100-volt secondaries, while another line ranging from fifteen to fifty kilowatts supplies low-tension current at 2,400, 2,300, 2,200 or 2,100 volts. The sixty-cycle type may be successfully used on circuits of 6,000 to 16,000 alternations, the twenty-five-cycle type on circuits of 3,000 to 4,800 volts. The maker states that the electrical performance of these transformers is excellent. They show good efficiency at all loads, and the regulation approaches that of central station apparatus.

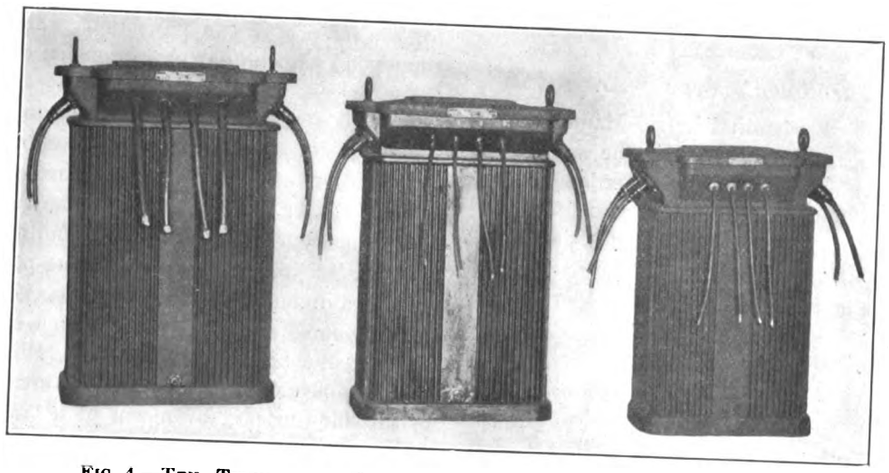


FIG. 4.—TEN, TWENTY AND FIFTY-KILOWATT HIGH-TENSION TRANSFORMERS.

Another new piece of apparatus which the Westinghouse company has placed on the market is an autostarter for a 1,400-horse-power induction motor. An induction motor may be started either by connecting the motor directly to the supply circuit or by applying a low voltage until the motor has attained a fair speed, and then by one or more steps to raise the potential until it reaches its normal value. The first method may be used only with motors under five horse-power, for when the full voltage is impressed on the motor in starting it draws a current equal to several times full-load current, which causes a heavy drop in the supply circuit and is detrimental to the regulation of the system. Further, the excessive strains thrown on the winding of the motor by starting in this manner causes deterioration in the insulation of large-size motors.

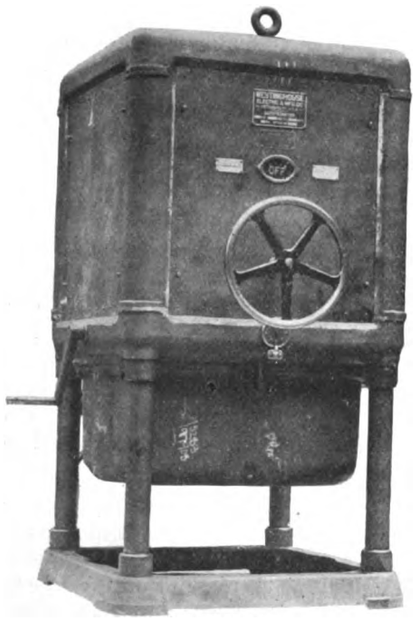


FIG. 5.—CONTROLLER BUILT FOR 1,400-HORSE-POWER, 2,200-VOLT INDUCTION MOTOR.

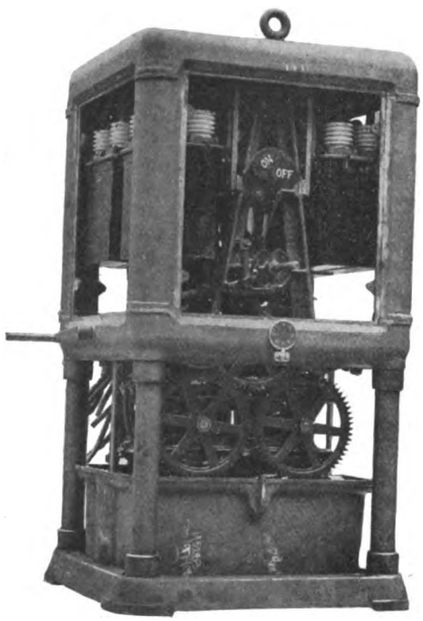


FIG. 6.—CONTROLLER WITH OIL TANK LOWERED AND COVER REMOVED.

These considerations make it necessary to provide an autostarter, which usually consists of an oil-immersed switch or switches of the drum type used in conjunction with two autotransformers, so connected as to apply gradually increasing voltages to the terminals of the motor. The number of points varies from three to nine, depending on the size of the motor. The advantages of a gradual development of torque manifest themselves both in the motor and in the line regulation.

The Westinghouse Electric and Manufacturing Company manufactures oil-immersed autostarters for use with all sizes of constant-speed induction motors from five to 2,000 horse-power, of various voltages, frequencies, and two and three-phase. The one shown in the illustrations, Figs. 5 and 6, was constructed for the control of a 1,400-horse-power, 2,200-volt motor. The switches, circuit-breakers and operating devices only are mounted in the case, and since the autotransformers are standard they are not shown.

This controller, known as type 197, has eight starting and one running points. At the first starting notch a low voltage is impressed on the motor and as each succeeding notch is passed the voltage is increased until the full line potential is reached and the motor attains its running speed. The motor circuit is never opened in passing from one starting point to another, as preventive resistances are inserted between the different notches. Destructive arcing and wear on the contacts are thus prevented, as are also the fluctuations in the line due to starting the motor. The two autotransformers mounted outside the case, in connection with the preventive resistances, furnish the necessary reductions in voltage for starting.

The type 197 controller is equipped with two automatic line circuit-breakers and two non-automatic breakers upon which the circuit is broken when changes in voltage are made, thereby saving the current-carrying contacts of the drum switches. By the first turn of the hand-wheel the circuit-breakers are closed, and the motor is connected to the first point of each autotransformer both direct and through the preventive resistances. The next step connects the motor through another set of resistances to the next higher voltage, disconnects the motor from the lower voltage and finally short-circuits the resistance on the higher voltage step. This is continued with each of the eight steps until the motor is connected to full-line voltage.

The two non-automatic circuit-breakers are actuated by cams connected to the shaft of the hand-wheel, which is turned through 180 degrees for each notch of the controller, the change from point to

Digitized by Google

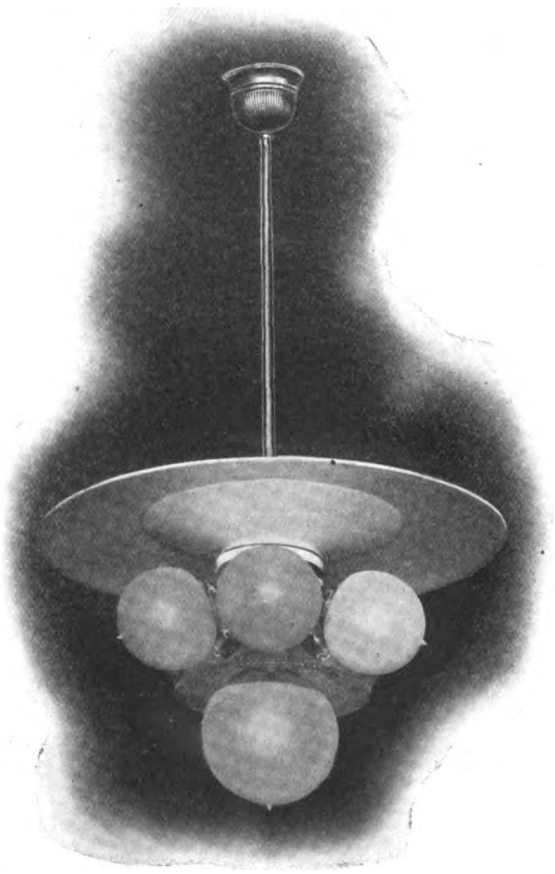
point being shown on the indicator below the wheel. At any position a slight backward turn of the hand-wheel will cause the main-line circuit-breaker to open, and the word "off" to replace the word "on" upon the shutter just above the hand-wheel. An overload on the motor will also cause this breaker to open. In either case it is necessary to return the wheel to the initial starting position before the circuit-breaker can be closed. The tripping coils are so connected that only a part of the turns are in circuit when starting, thus increasing the capacity for the heavy starting currents and ensuring greater protection when running.

The oil tank may be lowered by the crank at the side, and the upper part of the case removed, thus exposing all parts for ready inspection and repair.

This autostarter was designed for starting motors of from 600 to 2,000-horse-power capacity at 2,000 volts, either two or three-phase, the size of motor that can be handled depending on the conditions of service. Direct-current starting rheostats and controllers, though operating satisfactorily when used to start motors driving bucket conveyers where the machinery is started but once or twice a day, will, unless designed for heavy service, heat excessively if used to start motors of the same capacity when driving roll tables and soaking pits where sudden and repeated starting and reversing are required. Similarly, the heating of the autotransformers and the controller contacts depends on the frequency of starting and the starting torque required of the motor. As this apparatus is intended only for starting, it can not be used for varying the running speeds of the motor.

"Turndown" Type "Arc Burst."

The Benjamin Electric Manufacturing Company, Chicago, Ill., the well-known manufacturer of the Benjamin "arc burst," has established a new feature with its "arc burst" cluster which is designated as the "turndown" type. The centre lamp in the "arc burst" can be operated independently of the other lamps by the use of a three-point switch or two switches. This type of "arc burst" will, no doubt, become very popular, as it will make possible the securing of two degrees of illumination. The accompanying illustration shows the regular type of "arc burst." The turndown feature is added only when ordered. If the special style is not specified, the regular style of "arc burst" with one switch will be furnished.



"Arc Burst" Cluster.

New Form of Lamp Socket.

The Electric Lamp Socket Company, 167 Chambers street, New York city, has brought out a new form of lamp socket (patent applied for) for both exterior and interior work. The socket is made in two pieces, constructed of porcelain. The lower portion carries two lugs containing screw holes by which the socket may be attached to the wall of a building. The upper portion contains the screw socket for the lamp, and two projections which correspond with similar projections on the lower piece. The upper portion of the socket has a dowel pin, which fits into a recess in the lower portion, and ensures correct alignment. The wires pass through round holes at the extremities of the two projections, and are screwed to binding-posts on the projections. One binding-post is located in the lower portion of the socket. It is mounted on a brass strip which extends to the centre of the socket. Electrical connection with the lamp is made to this binding-post by means of a brass screw which passes through the centre of the upper portion and enters a tapped hole in the brass strip. The head of the screw bears on one terminal of the lamp. The other binding-post, which is likewise mounted on a brass strip, is located in the upper portion of the socket, and is connected directly to the metallic screw socket of the lamp.

The socket is well designed and strongly constructed, and is especially adapted for outdoor use. The New York Board of Fire Underwriters, and the New York city department of water supply, gas, and electricity have both approved this socket as complying with their regulations when properly installed. About 4,000 of these new sockets were used on the exterior work of the New York Hippodrome, which was described in the Electrical Review for April 29.

The Canadian Westinghouse Company, Limited, Hamilton, Ont., recently sold to the Edmonton (Alberta) Street Railway Company a 200-kilowatt railway generator and a number of double equipments of railway motors. The city of Edmonton is the most northerly point on the American continent to operate an electric street railway. Another recent sale made by the Canadian Westinghouse Company, Limited, was that of a 500-kilowatt, enclosed type turbo-generator unit to the Canadian Pacific Railway Company. This unit is to be installed at Fort William on the Canadian Pacific and to be used for supplying power to the various grain elevators at that point. This unit is to operate three-phase, 600-volt, 7,200 alternations, 3,600 revolutions per minute.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW TELEPHONE COMPANY IN MANILA—A telephone company is being organized in Manila, P. I., with a capital of $300,000. It is proposed to install a thoroughly modern system.

PROPOSED STOCK INCREASE OF THE TWIN CITY RAPID TRANSIT COMPANY—The stockholders of the Twin City Rapid Transit Company, Minneapolis, Minn., are to vote, on May 31, on a proposition to issue $5,000,000 of new common stock. One million of this will be offered to holders at par immediately. The money is to be used in new extensions of the company's lines.

NEW WATER-POWER PLANT IN COLORADO—A company of eastern capitalists, headed by L. W. Beard, proposes to erect a water-power plant near Glenwood Springs, Col. The plant will be the largest in the state. Water will be taken from the Grand river, and, with a 300-foot fall, will develop 100,000 horse-power. Work is to be started in a short time, and the power will be transmitted to Denver.

FORMATION OF HOLDING COMPANY FOR CINCINNATI ELECTRIC ROADS—The Union Traction Company, of Ohio, is being formed under the laws of Ohio, with a capital of $16,000,000. The new corporation proposes to take over the Union Traction Company, of New Jersey, which owns the Cincinnati Traction Company. The object of the movement is to do business under the laws of the state in which the corporation operates. The details of the change are not yet completed.

ESTIMATED COST OF ACQUIRING CHICAGO STREET RAILWAYS BY THE CITY—Mayor Dunne, of Chicago, Ill., has stated that the properties of the Union Traction Company and its consolidated lines, the Chicago City Railway Company, and all other street railways within the city, may be purchased for $50,000,000. Mayor Dunne formerly estimated the price as $77,000,000, based on the valuation of the properties made by Bion J. Arnold. The present estimate is based on the figures submitted by John J. Cummings, a contractor who has been investigating the possibilities of constructing municipally owned lines.

SALE OF THE RIO JANEIRO (BRAZIL) LIGHT, POWER AND TRAMWAY PROPERTIES—The Rio de Janeiro Light, Power and Tramway Company has acquired, through F. S. Pearson, all the lighting companies of the city. This gives the company a monopoly of the light, heat, power and street railway business. The company proposes to install electricity for lighting in place of gas. At the present time there is no electric supply in the city. It is understood that the price paid for the properties was between $6,000,000 and $7,000,000, and it is estimated that the cost of the lighting branch will amount to $1,250,000.

CONSOLIDATION OF PENNSYLVANIA ELECTRIC ROADS—The Pennsylvania & Mahoning Valley Railroad Company and the Youngstown, Sharon & Newcastle Railway Company contemplate a consolidation. The Pennsylvania & Mahoning Valley Railroad Company operates ninety-two miles of road between Newcastle, Pa., and Leavittsburg, Ohio. It has branches to Mineral Ridge and Struthers, Ohio, by way of Youngstown, Newcastle, Niles and Warren. The Youngstown, Sharon & Newcastle company controls forty miles of road between Youngstown, Ohio, and Sharon, Pa. The capital of the former company consists of $5,000,000 common stock and $3,000,000 preferred stock.

ELECTRIC ROAD BETWEEN ATLANTA, GA., AND MACON, GA.—The Atlanta-Macon Interurban Railway Company and the Atlanta Construction and Development Company have been formed with a capital stock of over $2,000,000, in order to build an electric road from Atlanta to Macon, a distance of about seventy-five miles. The road will pass through Forsyth, Barnesville, Griffin, Hampton, Jonesboro, East Point and Hapeville. The survey has already been commenced. The road will be built by the Atlanta Construction and Development Company, and the Atlanta-Macon Interurban Railway Company will operate it. The directors of the two companies are identical. The principal promoters are Charles J. Canfield, of Chicago; George W. Sweigart, Macon; William F. Wocher and J. A. Johnson, of Indianapolis.

SALE OF THE LEHIGH VALLEY AND THE PHILADELPHIA & LEHIGH VALLEY TRACTION COMPANIES—The sale of the Lehigh Valley Traction Company and the Philadelphia & Lehigh Valley Traction Companies has been ordered by the United States Circuit Court under foreclosure proceedings. The Lehigh Valley Traction Company controls all the electric railways in Allentown, Pa., and vicinity. It owns fifty miles and leases 147 miles of road. The Philadelphia & Lehigh Valley company's stock is owned by the Lehigh Valley company, which also guarantees the former company's bonds. It operates a road between Philadelphia and Allentown, Pa., a distance of fifty-two miles.

ELECTRICAL NOTES FROM ARGENTINA—Urien, Shine & Company, of Buenos Ayres, Argentina, have applied to the municipality of Tecuman for a concession to build and operate an electric railroad in that city. The concession for an electric railway system at Buenos Ayres, recently granted to Sawyer & Lacaze, of that city, has been taken up by a company formed of Belgian and Dutch capitalists. The capital of the company is $2,000,000. Plans are being developed for the building of the road. Bids are to be asked from American concerns for the electrification of all the existing horse tramways in Rosario. Particulars of the mileage to be constructed and other terms may be obtained from the Argentine Legation, Washington, D. C.

LEGAL NOTE.

STANLEY TRANSFORMER PATENT DECISION—The United States Circuit Court of Appeals has rendered a decision in the suit of the Westinghouse Electric and Manufacturing Company for a preliminary injunction against the Montgomery Light and Power Company, for alleged infringement of the Stanley transformer patent, reversing the decision rendered by the lower court. The court of appeals holds that in the present motion the depositions deal "with an abstruse and recondite subject, and present conflicting theories which can not safely be accepted without the searching elucidation which a cross-examination of the experts may afford." The court concludes that the right of the parties should be reserved for decision until the final hearing of the cause.

NEW MANUFACTURING COMPANIES.

INDIANAPOLIS, IND.—The Meier Electric and Elevator Company has been incorporated with a capital of $5,000. The incorporators are Frank L. Lewis and Maggie Meier.

BOSTON, MASS.—The Gilman Manufacturing Company has been incorporated with a capital of $100,000 to do a general electrical business. The officers are: president, H. Winthrop Chandler, Auburndale, Mass.; treasurer, James R. Powers, Boston, Mass.

ROCK ISLAND, ILL.—The Tornquist Electrical Manufacturing Company has been organized with a capital of $30,000, to succeed to the business of the Star Metal Stamping and Plating Company. The company will continue the business of the Star company, and, in addition, will manufacture a patent switchboard, a lightning arrester and other electrical appliances. The officers are: president, J. A. Tornquist, of Clinton; vice-president, George L. Osborn; secretary and treasurer, George J. Barker.

NEW PUBLICATION.

RACING RULES OF THE AMERICAN AUTOMOBILE ASSOCIATION—The American Automobile Association has issued bulletin No. 2, which includes the racing rules of the association. In addition to the racing rules are the usual introduction, the lists of officers, directors, committees, members, and reports of directors, and racing board meetings.

Digitized by Google

ELECTRIC RAILWAYS.

OWOSSO, MICH.—An electric railroad will be built within a few months to West Haven, six miles north of Owosso.

FORT SMITH, ARK.—The Fort Smith Light and Traction Company contemplates making an addition to its power-house.

ALEXANDRIA, LA.—T. G. Bush, of Mobile, Ala., and G. N. Horde, of New Orleans, contemplates the construction of an electric street car line in Alexandria.

BOISE, IDA.—An electric railway line is to be constructed in the Boise valley, reaching Caldwell, thirty-two miles from Boise and the Pearl mining camp, twenty-five miles.

SHAWNEE, O. T.—A franchise has been granted by the council of Tecumseh for an electric railway in that city. The construction of a line to Shawnee must be commenced within ninety days.

PHILADELPHIA, PA.—Directors of the Philadelphia & Easton Street Railway Company have elected new officers as follows: president, George Egolf; secretary and treasurer, A. C. Patterson.

SPRINGFIELD, MO.—The Springfield Traction Company has elected the following directors: W. B. Sanford, A. J. Eisenmayer, H. B. McDaniel, L. H. Murray, W. D. Tatlow, J. Fenton and C. B. McAfee.

BOYERTOWN, PA.—A franchise has been granted to the Boyertown-Palm Electric Railway Company. The line will run through Gilbertsville and Swamp to Limerick where it will connect with the Schuylkill Valley line.

HAVANA, CUBA—The Havana Central Railway Company has organized by electing the following officers: president, Edwin Hanson; vice-president, William L. Bull; secretary and treasurer, C. W. Van Voorhis. The road will extend 120 miles into the interior from Havana.

GALLATIN, TENN.—An electric railway will be built from Gallatin to Cumberland River and Castalian Springs. Those interested are: C. A. Whitesides, J. T. Durham, W. G. Schamberger, William Hall, Lewis Payne, E. O. Buchanan, Granville Johnson, C. B. Brown and C. H. Fidler.

PROVIDENCE, R. I.—The Groton & Stonington Railway was opened for traffic on May 6 from Stonington to Westerly. The entire line from Groton to Westerly, a distance of nineteen miles, is now in operation. The running time is one hour and a half, and one-half-hourly service is maintained.

MEXICO, MO.—An electric line is to be built north and south from Jefferson City, Mo., through Mexico and north to Elden, Iowa, thence to Ottumwa. The road will be built by a Chicago syndicate and will follow the route of the Elden & St. Louis railway, which was surveyed two or three years ago.

ROCKFORD, ILL.—The Chicago & Milwaukee Electric Railroad Company will build a line from Rockefeller to Wauconda, and thence to McHenry, Woodstock, and Belvidere, where it will connect with the Rockford & Interurban company, giving communication with all the larger cities in northern Illinois.

CHARLOTTE, N. C.—James D. Patton and M. M. Martin, of Richmond, Va., and others will build suburban electric lines between Charlotte and Concord, a distance of twenty-four miles, and Charlotte and Gastonia, a distance of twenty-two miles. They will organize a $500,000 company to undertake the work.

LOUISVILLE, KY.—The Louisville & Eastern Electric Railway Company proposes to extend its present line from Beards to Shelbyville, connecting with the Prospect line of the Louisville & Interurban Company with which a freight agreement will be made. Passengers will be transferred to the present line at Beards.

FORT WAYNE, IND.—The Fort Wayne & Wabash Valley Traction Company will build an interurban road from Fort Wayne to Marion, Ind., a distance of fifty miles. It will there connect with the lines of the Union Traction Company. The right of way for the line to Marion has already been secured.

LANCASTER, PA.—Two new lines of electric railway will be built in Lancaster County. One of these is the Lancaster & Eastern Line, between Lancaster and Christiana, seventeen miles, passing through Soudersburg, Leaman Place, Williamstown, Gap and Kinzer. This road will cost $400,000. The work will be finished by next winter. Work is now in progress on the Lancaster & Quarryville trolley road. A third important line is that from Lancaster to Mount Joy, by way of Rohrerstown, a distance of more than twelve miles.

GAINESVILLE, GA.—The Gainesville Electric Railway Company has elected officers and directors as follows: president, A. J. Warner; secretary, W. H. Slack; directors, A. J. Warner, W. H. Carlisle, C. W. Merrick, F. M. Marriott, E. S. Greenleaf, W. H. Slack, H. H. Dean. The Gainesville, Dahlonega & Northern Railway Company has elected as directors: H. J. Warner, W. H. Carlisle, J. F. Moore, C. W. Merrick, E. P. Kirby, W. A. Charters, H. H. Dean. The Gainesville & Dahlonega Electric Railway Company has conveyed to the Gainesville Electric Railway Company all the street railway constructed and completed in Gainesville, and in Hall County, Georgia, and the electric plant on the Chestatee river, together with its dam, pole-line, substations and other property, including franchises. The same company has conveyed to the Gainesville, Dahlonega & Northern Railway the right of way and roadbed from Gainesville to Dahlonega.

TELEPHONE AND TELEGRAPH.

HAMILTON, OHIO—The Home Telephone Company will soon put in an exchange at Trenton.

LYNCHBURG, VA.—The Southern Bell Telephone Company will erect a central office building at Lynchburg.

MINNEAPOLIS, MINN.—The Sleepy Eye Telephone Company will put in seventy-five miles of pole lines this summer.

WELLSBURG, W. VA.—The Home Telephone Company has installed a new switchboard, which will accommodate 400 drops.

ITHACA, N. Y.—Work has been commenced on rural lines to connect Ovid Centre, Kidders, Sheldrake, Covert and Kelly Corners.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company is extending its lines to Parkton, *via* the York turnpike.

ROCHESTER, N. Y.—The Seneca County Home Telephone Company is extending its line north to Tyre, and will extend it through the south end of the county.

RENO, NEV.—H. E. L. Reid, president of the Reno street railway, has filed a petition with the Reno city council, asking for a franchise to operate a telephone system.

LONG BRANCH, N. J.—The New York & New Jersey Telephone Company is extending its line between Freehold and Ely. It is expected that connections can be had with Ely in a few days.

WESTERVILLE, OHIO—The city council has granted a franchise to the Bell Telephone Company for the use of its streets and alleys for poles and wires. An exchange is to be put in at once.

STEPHENS, ARK.—The Stephens city council has granted the Southwestern Telephone Company a twenty-five-year franchise for a local telephone exchange. It will be put in as soon as the material can be secured.

READING, PA.—The Pennsylvania Telephone Company will establish an automatic exchange at Fleetwood, the necessary number of subscribers having been secured. The subscribers live in the town and surrounding district.

PARKERSBURG, W. VA.—The Southern Bell Telephone Company, of Charleston, has purchased from A. H. Humphries the telephone line from Charleston to Sissonsville, and will extend it to Parkersburg, making a direct connection with that part of the state.

MONTPELIER, VT.—The Vermont Telephone and Telegraph Company at its annual meeting elected the following directors:

Digitized by Google

Jasper N. Keller, Francis Houston, E. W. Longley, Carl T. Keller and W. J. Denver, of Boston, and A. C. Brown and J. G. Brown, of Montpelier.

GAGE, OKLA.—A company has been formed, of which J. L. Pryor will act as president, L. Yount as vice-president, Edward T. Massey as treasurer and C. H. Holmes as secretary. The company will put in a complete telephone exchange system at Gage, and extend rural lines through the country.

TROY, N. Y.—The Automatic Telephone Company held its annual meeting recently, when the following directors were chosen: Willis Wendell, James T. Sugden, John K. Stewart, William B. Charles, A. W. Breedon, Louis E. Harrower, Samuel Wallin, Archie R. Conover, Burton Fisher, George McClumpha and Daniel Ostrom.

RENO, NEV.—The first stretch of what the United States government plans to be a big telephone system of its own in Nevada was completed recently, when fifteen miles of wire in Churchill County was placed on a circuit. The new line works in a satisfactory manner. The government will construct many more miles before the end of the year.

YOUNGSTOWN, OHIO—The Warren & Niles Telephone Company, at its directors' meeting, decided to extend its present line from Champion to Bristolville, North Bloomfield and possibly Orwell. At North Bloomfield the company will make connection with home lines from Greene, Mesopotamia and Orwell, thus giving good service to all parts of Trumbull and Ashtabula counties.

ALBANY, ORE.—The Independent Telephone Company has begun work with a large force of men, and expects in a short time to have a switchboard established and several lines from the rural districts connected and in working order. The county is now united with a network of rural telephone lines, and when the connection with Albany is established the system will be practically complete.

HIGH BRIDGE, N. J.—A local telephone line has been organized at Junction, with the following officers: president, T. B. Fulper; secretary and treasurer, Peter S. Shurts; directors, Harry M. Bigelow, Jacob B. Smith, Hiram L. Parcell, W. W. Suppler, Henry Krauss, B. F. Apgar, T. S. Bray and Frank Hopkins. Arrangements will be made by the company to connect with other local lines round about.

CHARLOTTE HALL, MD.—The stockholders of the Southern Maryland Telephone Company have elected the following officials and directors: J. F. Coad, president; J. B. Ballenger, vice-president; L. J. Canter, secretary and treasurer; Zachariah R. Morgan, George M. Thomas. The company is pushing its work vigorously, and will have long-distance connection through the Chesapeake & Potomac Telephone Company at Brandywine, Md., within thirty days.

LINCOLN, NEB.—The annual meeting of the stockholders of the Lincoln Telephone Company was held recently. The reports of officers showed that the Lincoln exchange has 3,343 connecting telephones, including those in College View, Havelock and Cheney, where 318 are in use. Farm line extensions are now in progress. Propositions looking to the building of exchanges in University Place, Waverly and Hickman were discussed and referred to the board of directors.

HARTFORD, CT.—The Southern New England Telephone Company is perfecting plans for rural service, under which farmers and others will have the use of the telephones at a minimum cost of nine dollars per annum, or seventy-five cents per month. The company will offer this arrangement to rural communities everywhere in the state, and will assist in the formation of these rural systems by furnishing telephones, wires, etc.—in fact, the entire equipment desired, except poles, at minimum cost.

ASHTABULA, OHIO—The Ashtabula Telephone Company held its annual meeting on May 1. The company now has 1,545 telephones in commission, a gain of 300 over last year. The stockholders elected the following directors: E. E. Beam, F. E. Henry, V. D. Latimer, J. A. Paisley, W. H. Morrison, B. B. Seymour, S. W. Crosby, W. R. Flower, P. O. Remick. The directors met later and chose the following officers: president, P. O. Remick; vice-president, W. R. Flower; secretary, S. W. Crosby; treasurer, B. B. Seymour. All directors and officers are the same as during the past year.

EASTON, PA.—A new telephone company to operate in Northampton and adjoining counties has been organized with offices at Finesville. The company will be known as the Mutual Telephone Company. Two miles of the line is now being constructed between Finesville and Hughesville, and will connect with the long-distance company at Riegelsville, about half way between these points. Several telephones have been subscribed for and will be in operation about June 1. The following officers have been elected: president, Charles H. Boyer; treasurer, W. I. Jacoby; secretary, W. B. Laubach.

SAN FRANCISCO, CAL.—The Home Telephone Company has filed articles of incorporation. The directors are Henry T. Scott, John J. Mahony, Mark L. Gerstle, Vanderlynn Stow and Richard M. Hotaling, of San Francisco; J. S. Torrance, of Pasadena, and Thomas W. Phillips, of Los Angeles. The last two are directors of the Home Telephone Company, of Los Angeles. The capital stock is $10,000,000, of which $70,000 has been subscribed by the seven directors, each investing $10,000. It is the intention of the new company to install a plant of the best possible construction, including a large conduit system.

WASHINGTON, D. C.—Sealed proposals will be received at the office of the engineer, United States Reclamation Service, Boise, Ida., until two o'clock P. M. June 15, 1905, and thereafter opened, for the construction and completion of a pole line and telephone system about eighteen miles in length, in connection with the Minidoka project, near Minidoka, Ida. Specifications, form of proposal, and particulars may be obtained by applying to H. A. Storrs, electrical engineer, Chamber of Commerce Building, Denver, Col., to the engineer of the Reclamation Service, Boise, Ida., or to the chief engineer of the Reclamation Service, Washington, D. C.

DETROIT, MICH.—Amended articles of incorporation have been filed by the Peninsular Telephone Company, increasing its capital stock from $25,000 to $100,000. The increased capitalization is to provide for building new lines from Detroit to Jackson; Detroit through Pontiac to Flint, and from Detroit to Port Huron, to connect with the Cooperative company in that city. Coincident with the increase in the capital stock in the Peninsular company has come a change in the management of the Cooperative company, C. O. Trask, of Alma, succeeding A. A. Cowles as secretary and manager of the company. Mr. Cowles was elected vice-president at the annual election, at which C. M. Burton was elected president, and J. Ward Howland, treasurer.

FONDA, IOWA—At the regular annual meeting of the stockholders of the Northern Telephone Company the following directors were elected for the ensuing year: L. S. Straight, of Fonda; George Sanborn, Sr., of Fonda; A. S. Wood, of Fonda; L. A. Rothe, of Fonda; M. G. Coleman, of Fonda; M. O. Miller, of Storm Lake; W. P. Miller, of Aurelia; G. F. Tincknell, of Alta, and Jesse J. Allee, of Newell. At the conclusion of the meeting of the stockholders the directors met and elected the following officers: president, L. S. Straight; vice-president, L. A. Rothe; treasurer, A. S. Wood; secretary, M. G. Coleman, all of Fonda. An executive board, consisting of L. S. Straight, George Sanborn, M. G. Coleman, M. O. Miller and W. P. Miller, was elected. An eight per cent dividend was declared.

DRYDEN, N. Y.—The Baldwin County Telephone Company has completed its new telephone line to Bon Secour and Shell Banks, and will lay a cable from Blakely to Mobile, where it will connect with the Southern Bell Telephone exchange, thereby giving day and night service to all parts of Baldwin County. This new line will pass through and have stations at Daphne, Montrose, Fairhope, Battle, Point Clear, Fish River, Baldwin, Rodger Camp and Magnolia Springs, Lyon and Swift's Bon Secour and Shell Banks, besides quite a number of private residences. This is the third telephone line that has been constructed in Baldwin County in the last twelve months. The Home Telephone Company also has a line running down as far as Bon Secour, with quite a number of private connections; also a line from Fairhope to Silver Hill and Albert, Ala.

Digitized by Google

ELECTRIC LIGHTING.

VERMILLION, S. D.—The voters of Vermillion have declared for municipal ownership of the electric light plant.

BRECKENRIDGE, MO.—The town has voted to issue $10,000 bonds for the purpose of putting in an electric light plant.

ST. LOUIS, MO.—The Union Electric Light and Power Company has had plans prepared for a three-story substation, 33 by 153 feet.

ST. AUGUSTINE, FLA.—J. Clifford Foster, of Tallahassee, Fla., will erect an electric light, heat and power plant in St. Augustine, at a cost of about $50,000.

BLUFFTON, OHIO—The Frederick electric light plant at McComb has been purchased by the village for $3,000. Extensive improvements are to be made.

DETROIT, MICH.—The Peninsular Electric Lighting Company has been granted a thirty-year franchise in Woodmere. The rates are to be those prevailing in Detroit.

PUTNAM, CT.—The Putnam Light and Power Company has elected George H. Hammond president. Allen W. Bowen has been made treasurer and general manager.

PANA, ILL.—The Pana electric light plant has been purchased by H. H. Beckman & Company, of New York. The company has been granted a twenty-five-year franchise by the council.

SAVANNAH, GA.—The Savannah Lighting Company has elected the following officers: president, J. J. Cummings; vice-president, Lawrence McNeil; secretary and treasurer, William Ellis.

TOPEKA, KAN.—The Santa Fé Railway Company plans to build an electric plant sufficient to furnish power for the Argentine shops and light for the yards and offices. The cost is estimated at $48,000.

GRAND RAPIDS, MICH.—The Flint Light and Power Company has elected officers as follows: J. E. Durham, president; D. D. Aitken, vice-president; A. G. Bishop, secretary and treasurer; F. A. Beard, superintendent.

MONTPELIER, VT.—The Vergennes Electric Company has elected directors as follows: E. S. Marsh, C. A. Parker, F. K. Goss; president, C. A. Parker; vice-president, E. S. Marsh; secretary, F. K. Goss; treasurer, C. A. Parker.

NORTH TONAWANDA, N. Y.—A franchise to construct poles and cables in the town of Wheatfield for the distribution of light, heat and power, has been granted to the Niagara, Lockport & Ontario Power Company.

ST. PAUL, MINN.—A franchise has been granted by the city council of South St. Paul to the South St. Paul Heat, Light and Power Company, which will build an electric light plant, and also install a heating system.

BROWNS VALLEY, MINN.—The town of Browns Valley contemplates the installation of an 800-light electric plant. W. D. Graves is chairman of a committee investigating the question. The power used will probably be producer gas.

NEW YORK, N. Y.—The New York Edison Company will build a four-story power-house on the east side of Crosby street, north of Broome street. It will cost $50,000. The company filed plans for $40,000 alterations to its East 121st street power-house.

SHERBROOKE, QUE.—The Power, Light and Heat Company has decided to offer to sell to the city for $233,000. This offer includes the gas works, the real estate and the company's Rock Forest property, which is estimated to be of considerable value.

READING, PA.—An electric light plant is to be built in Tower City by H. T. Bressler. It will provide light for Tower City, Williamstown, Lykens, Wiconisco, Reinerton, Johnstown and Renier's City. Rights of way have been secured in all the above towns.

GOLDENDALE, WASH.—The city council of Goldendale has granted an electric light franchise to H. W. Fellows, of Spokane. He will erect a water-power plant on the Big Klichetal river, fourteen miles west of Goldendale, and supply current for light and power.

WYNNEWOOD, I. T.—A contract has been closed, whereby S. E. Hutchins, of Whitehall, Wis., is to furnish electric light to Wynnewood. The franchise is for fifteen years. Work must be commenced on the plant within sixty days, and it must be in operation in six months.

BLOOMINGTON, ILL.—The Bloomington, Decatur & Champaign Interurban Company has bought the Consumers' electric light and heating plant in Bloomington for $130,000. The new owner will use the plant for a power-house for the new chain of interurban railways to be built shortly.

NILES, MICH.—It is announced that the owners of the Hen Island dam, in the St. Joseph river, seven miles above South Bend, Ind., will build a dam in the river at Bertrand, four miles south of Niles, and that the work will commence soon. Electric power will be transmitted to surrounding towns.

EAST ST. LOUIS, ILL.—The city council of East St. Louis has granted the St. Clair Light and Power Company, of East St. Louis, a franchise to erect poles and stretch wires over the principal business streets in the city. The company must erect an electric light plant, to cost not less than $50,000, within one year.

BAKER CITY, ORE.—The Baker City Light and Power Company has been incorporated with a capital stock of $400,000. The incorporators are F. N. Averill, J. H. Parker and C. A. Johns. The company will take over the properties of the Baker City Gas and Electric Company and the Rock Creek Power and Transmission Company.

COVINGTON, GA.—The White Shoals Power Company will supply electric light to Covington at a cost approximately one-half that of operating the municipal plant. The company has a capital of $150,000, and will build a plant on the Alcovey river, ten miles from Covington. Power will be generated to furnish light to towns within fifteen miles, and eventually power will be furnished to operate cotton mills and other industries.

UTICA, N. Y.—The directors of the Utica Gas and Electric Company have elected the following officers: president, Anthony N. Brady; vice-president, William E. Lewis; treasurer, George H. Stack; secretary, William J. Cahill; executive committee, John S. Maynard, William E. Lewis, Charles S. Symonds, Charles B. Rogers, Samuel A. Beardsley and Anthony N. Brady. M. J. Brayton was made general manager of the electric department, and William J. Cahill general manager of the gas department.

PATERSON, N. J.—The stockholders of the Paterson Electric Light, Heat and Power Company have elected the following directors: Thomas J. Arnold, Ralph Baer, Henry F. Bell, James G. Blauvelt, John S. Cooke, Mangold H. Ellenbogen, William H. Fletcher, Robert Gaede, Isaac A. Hall, John Kane, Angelo H. Knapp, John B. Mason, Charles D. McKelvey, Frederick R. Reynolds, Edward Sceery, Grant Sipp, Leonard J. Tynan, Peter S. Van Kirk. The election of officers by the directors resulted: president, Thomas J. Arnold; vice-president, Peter S. Van Kirk; secretary, Frederick R. Reynolds; treasurer, M. H. Ellenbogen.

PERSONAL MENTION.

MR. L. B. ORME has been appointed manager of the Bristol exchange of the Tennessee Telephone Company, succeeding Mr. Ernest Williams, resigned.

MR. JAMES W. SCOTT, of St. Louis, Mo., has been elected treasurer of the San Marcos Valley Interurban Railway Company, which is building a line in Texas from San Marcos to Luling.

MR. P. A. McCARTHY has been reappointed city engineer of Lufkin, Tex., for a term of two years. He has appointed Mr. J. P. Starns chief deputy and Mr. Frank McCarthy deputy.

MR. PERCY TOWNSEND has taken the position of superintendent of the Wildwood Traction Company, Wildwood, N. J. He was formerly superintendent of the Millville Traction Company.

MR. A. H. PATTERSON celebrated his silver wedding anniversary at his home, 1079 Bergen street, Brooklyn, N. Y., Friday evening, May 12. About one hundred friends were gathered to congratulate Mr. and Mrs. Patterson on the event, and a most

Digitized by Google

delightful social evening was spent. Mr. Patterson is vice-president and general manager of the Phœnix Glass Company, and is very well known in business circles in New York city and Pittsburg.

MR. LAMAR LYNDON, of New York, the well-known consulting engineer and author, has moved from the Park Row Building to a new suite of offices at No. 80 William street.

MR. WILLIAM CARROLL has been appointed city electrician of Chicago, Ill., in place of Mr. Edward B. Ellicott who has accepted a position with the drainage board. Mr. Carroll has been Mr. Ellicott's first assistant.

MR. FRANK HOFFMEISTER, Winnipeg, Manitoba, has been appointed electrical superintendent of the British Columbia Electric Railway Company, with headquarters at Vancouver. He will assume his new duties June 1.

MR. W. W. ALDERSON has retired from the management of the Central Union (Bell) Telephone Company, Newark, Ohio. He will be transferred to some other department of the company. Mr. Alderson is succeeded by Mr. John A. McManman.

MR. A. C. GARRISON, president of the Columbia Incandescent Lamp Company, St. Louis, Mo., was a visitor in Chicago last week. Mr. Garrison stated that business was very good with his company, and that the outlook was extremely encouraging.

MR. FRANK L. BEAM has resigned his position as general manager of the Citizens' Telephone Company, of Columbus, Ohio. He will devote his entire attention to the Ohio Independent Telephone Association, of which he was recently reelected president.

MR. A. W. PRATT has been appointed district superintendent of the Public Service Corporation of New Jersey, with headquarters at Elizabeth. He will have charge of the operation of the street cars in the city. Mr. Pratt succeeds Mr. J. F. Sparrow who has been transferred to Montclair.

MR. J. T. DARLING has resigned his position as secretary of the Montgomery (Ala.) Street Railway Company. Mr. Darling was the oldest street railway official in Montgomery in length of service, having been associated with the Montgomery Street Railway Company for fourteen years.

MR. ARTHUR E. JACKSON has resigned his position as superintendent of the Willimantic Electric Light and Power Company to take a position in Boston as manager of the Adams-Bagnall Electric Company, of Cleveland, Ohio. He will also be agent for the Gardner Electric Drill and Machine Company. His new office will be in the Boston *Journal* Building.

MR. SAMUEL G. McMEEN delivered an address on May 8, at the Armour Institute of Technology, Chicago, Ill., before the student branch of the American Institute of Electrical Engineers. Mr. McMeen's subject—"Telephone Engineering"—was interesting and instructive, and the young engineers gained considerable information concerning the requirements of an up-to-date telephone engineer.

MR. JOHN GAVEY has been nominated as the president of the Institution of Electrical Engineers, of Great Britain, for the session of 1905-1906. Mr. Gavey is one of the old telegraph engineers of Great Britain. He was born in Jersey in 1842, and entered the service of the Electric and International Telegraph Company in 1860. When the telegraphs were taken over by the state in 1870 he was appointed superintendent of the Southeastern, and afterward the Great Western subdivisions of the southern division of England. In 1878 he became superintending engineer of the South Wales district. In 1892 he was made chief technical officer of the general post office in London. In 1897 he was made second assistant engineer-in-chief. In 1899 he was raised to assistant engineer-in-chief and electrician, and in 1902 he became engineer-in-chief upon the retirement of Sir William Preece. Mr. Gavey has done much to develop and improve the British telegraph system, and deserves a large share of the credit given for the introduction of trunk telephone lines in that country, as he brought about the erection of the first trunk telephone line in 1881. He has contributed numerous papers to the institution and other societies, and is a prominent member of a number of technical organizations of Great Britain.

ELECTRICAL SECURITIES.

Notwithstanding a very apparent nervousness, with irregular fluctuations, the stock market appears to have settled down to a conviction that further retrogression is not in accord with the generally healthy condition of affairs in all industries. In some directions it is a fact that the supply has been creeping up to more than meet the demand, but this is not regarded with any degree of apprehension. The crop outlook, which from now on will be of possibly greater importance than any other index, is decidedly reassuring at the present time. The apparent determination on the part of the great powers involved in the far eastern difficulties to maintain a peaceful situation will also do much to promote a monetary ease which will make possible the financing of any really good proposition which may come along for some time.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 13.

New York:	*Closing.*
Brooklyn Rapid Transit	60⅞
Consolidated Gas	185¾
General Electric	177½
Interborough Rapid Transit	204
Kings County Electric	200
Manhattan Elevated	164⅜
Metropolitan Street Railway	115¾
New York & New Jersey Telephone	171½
Westinghouse Manufacturing Company	190

Consolidated Gas directors have declared a quarterly dividend of 2 per cent, payable June 15. Books close May 26 and reopen June 16. This is a reduction of one-half of one per cent from the previous payment.

At the annual meeting of the General Electric Company, held May 9, the following directors were elected: Gordon Abbott, Oliver Ames, C. A. Coffin, T. Jefferson Coolidge, Jr., W. M. Crane, Frederick P. Fish, George P. Gardner, Eugene Griffin, T. K. Henderson, Henry L. Higginson, J. Pierpont Morgan, J. P. Ord, Robert Treat Paine, 2d., E. W. Rice, Jr., and Charles Steele.

Boston:	*Closing.*
American Telephone and Telegraph	139
Edison Electric Illuminating	247
Massachusetts Electric	64
New England Telephone	138
Western Telephone and Telegraph preferred	98

The instrument statement of the American Telephone and Telegraph Company for the month of April follows: gross output, 174,207; returned, 44,981, making the net output 129,226, as compared with 60,572 for the same month of 1904. The total number now outstanding is 4,910,962.

Philadelphia:	*Closing.*
Electric Company of America	12
Electric Storage Battery common	80¾
Electric Storage Battery preferred	80¾
Philadelphia Electric	11⅞
Philadelphia Rapid Transit	33½
United Gas Improvement	114½

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	155
Metropolitan Elevated preferred	61½
National Carbon common	60
National Carbon preferred	114½
Union Traction common	7
Union Traction preferred	33

The report of the Chicago Edison Company for the year ended March 31 follows: gross, $4,051,082; expenses, $2,627,468; net, $1,423,614; charges, $360,232, leaving a surplus of $1,063,382; dividends, $789,262; surplus, $274,120. About 10.78 per cent was earned on the stock. Owing to additions to the capital stock and bond accounts, dividend and interest payments were larger, and the final surplus shows a small reduction as compared with that of the year 1903-1904. The company's total surplus was increased about $175,000 during the year, and another $100,000 was added to the depreciation reserve.

Digitized by Google

INDUSTRIAL ITEMS.

THOMAS & BETTS, representatives of a number of large manufacturing concerns, have removed their offices to 299 Broadway, corner Duane street, New York.

THE LAGONDA MANUFACTURING COMPANY, Springfield, Ohio, has issued catalogue B descriptive of the Weinland turbine-tube cleaners for water-tube boilers.

THE ELECTRIC MOTOR AND EQUIPMENT COMPANY, Newark, N. J., has absorbed the business of the Mason monogram system, used in connection with sign lighting.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has issued bulletin No. 52, describing railway generators. The machines described range in capacity from 150 to 1,500 kilowatts.

THE TETER-HEANY DEVELOPING COMPANY is calling attention to the Heany fireproof insulated wire, which it claims is specially adapted for armature field, transformer and magnet coils.

THE WELLMAN-SEAVER-MORGAN COMPANY is distributing a catalogue entitled "Water-Power Equipment." It describes vertical and horizontal water turbines, and gives a set of power tables of standard turbines.

THE MOORE ELECTRICAL COMPANY, 52 Lawrence street, Newark, N. J., is sending out a booklet describing the Moore electric daylight. The light is produced in a vacuum tube of any length, and is stated to have the same color values as daylight.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., in bulletin No. 200 calls attention to its job-press motor equipment. This consists of a motor on a pedestal, an idler pulley for maintaining tension on the belt, a controller and stand for same.

THE STERLING-MEAKER COMPANY, 420 Ogden street, Newark, N. J., is distributing a catalogue describing accessories for street cars. These include the Sterling safety brake, the Sterling fender, trolley wheels, hand-straps, Sterling fare registers, trolley bases, etc.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has issued bulletin No. 91, describing the use of the "chloride accumulator" in the electrification of steam roads. The installations made for the New York Central and the Long Island roads are described and illustrated.

THE NATIONAL ELECTRIC COMPANY, Milwaukee, Wis., is distributing cards advertising the "Lundell" universal motor and Christensen air-brake equipments. On the reverse side of the cards are half-tone engravings of the interior of the company's erecting shop, and of a suburban car equipped with the Christensen air-brake apparatus.

JOHN M. KLEIN, president and general manager of the John M. Klein Electrical Works, San Francisco, Cal., has disposed of all his interest in that company. A new company has been incorporated, under the name of the John M. Klein Electrical Company, which will enter the field as electrical jobbers only. The company will discontinue the contracting department which was run by the old firm. The new address is 325 Montgomery street, San Francisco.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., has printed a handsome bulletin descriptive of direct-current generators. The frontispiece is a reproduction of an eight-pole Northern ring-type, engine-type generator. Numerous illustrations are given, showing installations of Northern apparatus in different parts of the country. The assembly and detail of manufacture of the Northern motors are plainly indicated, and the bulletin is well worth securing.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Ostrander, Minn.; Litchfield, Mich.; Lawnridge, Ill.; Louisville, Ky.; Columbus, Ohio; Adena, Ohio; Nome, N. D.; Plymouth, Neb.; Conotton, Ohio; Kernersville, N. C.; Clatonia, Neb.; Willshire, Ohio; Trivoli, Ill.; Brigham City, Utah; Le Mars, Iowa; Provo, Utah; Liberty, Mo.; Logan, Utah; Rochester, N. Y.; Atlanta, Ga.; Prosser, Neb.

THE WAGNER ELECTRIC MANUFACTURING COMPANY has opened an office at room 417 Rialto Building, San Francisco, Cal., to take care of its Pacific coast business. The office will be in charge of Mr. A. J. Meyers. Previous to this time the Pacific coast business of the company was handled by the Wagner-Bullock Electric Company, which also had charge of the interests of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. The Wagner company will establish suboffices in Los Angeles and Seattle.

THE ABNER DOBLE COMPANY, San Francisco, Cal., announces that arrangements have been made with the John McDougall Caledonian Iron Works Company, Limited, of Montreal, whereby the latter becomes sole licensee for the manufacture of the Doble system of water-wheels in the Dominion of Canada. The McDougall company has the most extensive machine works in Canada, its plant including machine shops, pattern shop, foundry, forging works and structural material shop. Its plant is therefore well equipped for the manufacture of water-wheels and other hydraulic machinery. The Canadian licensee is prepared to furnish the steel pipe, structural work and all machinery necessary for complete power plants, and the Doble company requests that all engineers or parties interested in water-power development in Canada address the McDougall company direct. It has retained the Abner Doble Company as its consulting engineer.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that the Harbinson & Walker Refractories Company, Pittsburg, Pa., has ordered for its plant at Hays, Pa., one heavy duty horizontal, twenty-two by forty-two-inch Reynolds-Corliss belted engine. This engine is to be non-condensing and operates at seventy-five revolutions per minute, with from 110 to 125 pounds gauge pressure. The city of Hastings, Neb., has arranged for an equipment of an electric lighting plant. The generating unit will consist of heavy duty cross-compound Reynolds-Corliss engine, with cylinders fourteen and twenty-two inches in diameter and thirty-six inches stroke, direct-connected to a 222-kilowatt, single-phase Bullock alternator. The generator is to be provided with an exciter, rheostats and other auxiliary apparatus, and a switchboard panel will be installed. The Republic Iron and Steel Company, Youngstown, Ohio, has placed an order for one horizontal cross-compound condensing Bessemer blowing engine. The high-pressure cylinder will be forty-six inches in diameter, the low-pressure cylinder eighty-eight inches, and the two air-cylinders each of seventy-six inches effective diameter. The stroke is to be sixty inches. The engine will be capable of delivering 24,000 cubic feet of free air per minute at a pressure of twenty-eight pounds per square inch.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., announces that the Newcastle Portland Cement Company, of Newcastle, Pa., has placed an order for two 175-kilowatt, three-phase, alternating-current generators; two forty-two-kilowatt exciters, and the necessary switchboards for the control of this apparatus. These machines will supply current for operating a number of type C induction motors, ranging from 10 to 100 horse-power each, which were also included in the contract. The Western Engineering and Construction Company has ordered 180 horse-power in type F, variable-speed induction motors; 130 horse-power in type C, constant-speed induction motors, and four O. D. transformers. The Cleveland Electric Railway Company will place in its power-house a 1,500-kilowatt, 500-volt, direct-current, engine-type generator and switchboard. Other orders for railway apparatus have been entered as follows: for the Cincinnati Traction Company eight quadruple equipments of No. 85 motors, with unit switch group control; four No. 85 quadruple equipments, with 2-L-4 controllers, and four No. 93-A quadruple equipments, with 2-K-4 controllers. The No. 85 motor has a nominal rating of seventy-five horse-power, and the No. 93-A motor has a capacity of sixty horse-power. The Consolidated Railways Company, of New Haven, Ct., will equip fifteen cars with four No. 93-A motors each and 2-K-6 controllers. The same order included twenty-six No. 101-B motors with K-10 controllers, and seventeen equipments of No. 110-B motors and K-6 controllers.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 21. NEW YORK, SATURDAY, MAY 27, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Telephones and Thunder-Storms . . . 835
The Electrical Driving of Shops . . . 835
The Oscillograph . . . 836
The American Railway Appliance Exhibition . . . 837
Fixation of Nitrogen . . . 837
High Speed Railways . . . 837
American Society of Mechanical Engineers . . . 838
Copper in Honduras . . . 838
Twenty-eighth Convention, National Electric Light Association . . . 838
Book Reviews . . . 839
Letters to the Editor . . . 840
The Oscillograph and Its Uses, by Lewis T. Robinson . . . 841
The Trinidad Electric and Tramway Power Plant . . . 845
Electric Cabs in Buenos Ayres . . . 845
The Production and Use of Electricity in a Russian Petroleum Field, by F. Koester. 846
Progress in the Electrolytic Alkali and Bleach Industry, by John B. C. Kershaw. 847
Test of a 5,000-Kilowatt Alternator, by L. L. Gaillard . . . 849
World's Copper Production . . . 851
New York State Independent Telephone Association . . . 852
The Gas Turbine . . . 852
Telephone Apparatus for the War Department . . . 852
American Institute of Electrical Engineers . . . 852
Paxtang Power-House Unharmed by Explosion . . . 853
An Automatic Current Regulator . . . 853
Publicity as an Aid to Manufacturers, by Arthur Warren . . . 854
Electrical Men Enjoy Planked Shad . . . 854
High-Speed Electric Railway Tests in Germany . . . 855
Taking Moving Pictures in the Subway . . . 856
Mrs. McFarland's Death . . . 856
ELECTRICAL PATENTS . . . 857
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 858
Electrical Manufacturing in Lancashire, England . . . 859
INDUSTRIAL SECTION:
A New Single-Phase Alternating-Current Crane Motor . . . 860
Electrical Ventilating Fans . . . 861
New Type of Water-Tube Cleaner . . . 862
Hubbell Pull Sockets . . . 862
An Automatic Electric Controller . . . 862
A New Oscillating Fan . . . 863
The Deutsch Train Lighting System . . . 863
Alternating-Current and Direct-Current Solenoids . . . 864
Automatic Release Starters and Motors for Heavy Duty . . . 864
New Arrangement in the Sales Organization of the Westinghouse Machine Company . . . 864
CURRENT ELECTRICAL NEWS . . . 865

TELEPHONES AND THUNDER-STORMS.

Our esteemed contemporary, the New York *Times*, while pleased to learn that we do not consider a telephone to be a particularly dangerous thing during thunder-storms, confesses that its editor feels somewhat nervous when called upon to use his telephone on such occasions. The editor knows that accidents have been reported in which telephones were destroyed by lightning, with rather terrifying consequences to the persons using them, and he has in mind the possibility of a similar occurrence to himself. If we knew how to allay this anxiety, we should hasten to do so. We must confess that telephones have been injured by lightning, but so have iron bedsteads; yet we doubt whether the *Times* would advise all who occupy these useful articles of furniture to abandon them whenever a thunder-storm occurs. Perhaps we may best describe the situation by comparing it to the daily ride to and from the office. Railway accidents are not unknown, yet how many of us hesitate before stepping aboard the train. Any one who feels nervous about using a telephone during a thunder-storm is free to do so, but on the same principle, he should just as carefully avoid all the thousand and one daily acts which involve a more or loss remote danger.

Unfortunately for the engineer, lightning is a most capricious and uncontrollable phenomenon. We have devised lightning protective apparatus on every principle which seemed at all to promise success, and yet we can not guarantee absolute protection. Lightning is not satisfied to destroy by discharging directly through the object struck; it at times causes what are known as induced flashes—secondary currents produced by the lightning discharge itself in objects through which the true discharge does not pass. The problem of lightning protection may be compared to what would be presented to the artillery engineer if he were obliged to protect his men from the report of the exploding shell, as well as from the shell itself. However, the engineer does the best he can; he adds as much protection to his electric conductors and telephone systems as he knows how; more he can not do. We believe, however, that if the *Times* will count up the number of telephones reported as destroyed by lightning during a storm in any section, and will then compare this with the total number of telephones in use for the same section, it will see how few are the accidents which do happen, and how slight the probability of any one's being injured in this way.

THE ELECTRICAL DRIVING OF SHOPS.

Viewed in one way, the electric motor has made considerable progress in shop driving. According to some figures given recently by Mr. Sidney B. Paine, at a meeting of the New England Cotton Manufacturers' Association, it is estimated that there are 175 textile mills in this country which are using 140,000 electric horse-power in their mills—a good showing for ten years' development. On the other hand, the census for 1900 shows that 1,165,045 horse-power was being used in all cotton, woolen, worsted and silk mills in the United States. Allowing an increase of about twenty-five per cent, Mr. Paine finds that only about ten per cent of the power used in these mills is applied electrically. Comparing this record with what has been done in the street railway field, it is evident that there must be some reason for the poorer showing of the mill motor.

Probably the main reason for this comparative lack of develop-

Digitized by Google

ment is the fact that driving a mill by means of ropes and shafts is more satisfactory to the operators than were the old horse-cars to the public. Nevertheless, we do not believe that this is the only explanation. There are many mill owners who do not realize the benefits to be derived by changing over to the electric drive. They, no doubt, think that it is merely a question of the relative cost of power, and they can not see how they can gain by displacing the present driving system for one which is rather expensive. While the electric system may, in some cases, reduce the cost of power, this is not its most important advantage. In fact, compared with the gains made in other ways, the cost of power is of small moment. The electric drive is beneficial because of its steadiness and because of its flexibility. Since the drive is steadier than that given by the old system, a better product is produced, and a higher speed, and consequently a larger output, results. Adding to these great advantages that of being able to arrange your machinery just where and how you wish, without regard to the disposition of other machines, it is evident that a slight difference in the cost of power one way or the other should have but little influence when comparing the new system with the old.

THE OSCILLOGRAPH.

Surely the oscillograph may be considered to be one of the most interesting instruments devised to study electrical apparatus. It is to the engineer what the kinetoscope or the phonograph is to the public, for it not only shows him what is going on in his electrical circuits, but enables him to obtain a record of what happened during an exceedingly short time. Most indicating electrical instruments are developments of some form of galvanometer, and this generalization applies to the oscillograph, which is nothing more than a galvanometer designed to have an exceedingly high period of vibration, and arranged so that the movable part will follow exactly the variations in magnetic force set up by the current to be examined.

The oscillograph, however, is used, not merely as an ordinary galvanometer, to determine a particular value of the current, it also shows how this current varies. In other words, it draws a curve corresponding to the changes in the value of the current as these take place.

There are several types of oscillograph. One is a development of the moving-needle galvanometer; another an elaboration of the D'Arsonval or moving-coil galvanometer. There are still other types, such, for example, as Professor H. J. Ryan's cathode-ray instrument and that described recently by Mr. Rudolf Goldschmidt, which was referred to in the ELECTRICAL REVIEW for May 13.

A noteworthy example of the second or movable-coil class was described by Mr. Lewis T. Robinson at a recent meeting of the American Institute of Electrical Engineers. A full abstract of Mr. Robinson's paper appears on another page of this issue. The instrument described has been constructed with a particular view to its practical use. It is not a laboratory instrument in the sense that it can not be used outside of a well-equipped laboratory where all conditions are favorable. But it must not be assumed that, since the instrument has been devised for practical work, it has lost anything in accuracy or sensitiveness. The frequency of the period of the moving part is 5,000 vibrations per second, which is evidently high enough for all practical purposes. It could be made higher if desired. While this high frequency enables the instrument to move as quickly as the variations which it is to follow take place, this characteristic is not sufficient for an accurate instrument. The motion of the vibrating part must be damped, so that it does not superpose its own natural period upon the curve to be traced. In other words, the instrument must be designed to have a high natural period, and it must then be damped so that its motion just ceases to be harmonic. When these conditions are fulfilled, the instrument follows accurately every change in the actuating force.

Another valuable feature of this particular instrument is the employment of three independent elements, each being a perfect oscillograph. This arrangement enables the variations in three currents to be followed simultaneously. Of course, other elements could be added were it desirable. Another feature is the arrangement which enables the experimenter to examine visually the wave forms of the currents. He can, while changing the conditions in his circuits, watch the effect produced by any alteration. When he has obtained the desired condition, he may then take a record. This record may be either a curve representing the average conditions of a comparatively short period during which a number of complete reversals have taken place, or it may be the record of a single occurrence. Each of these records has its value: the first shows the general operating conditions; the latter must be used when the event to be recorded is not recurring. When a trace is made of a single wave it should be remembered that the record is but a single reading and may not represent the average conditions. It merely shows what was going on when the record was taken.

Although the oscillograph has been devised for studying electrical machinery, it may be used for recording other events. For example, when attached to a telephone transmitter, speech may be recorded just as is done by the phonograph. Its use in this manner should be of value to those who, in studying the sound vibrations set up by the human voice, have been obliged to reproduce enlarged records from the phonograph.

During the discussion following the reading of Mr. Robinson's paper, an interesting suggestion was made by Mr. Caryl D. Haskins. The idea was that some scientific romancer might, in a story, substitute for our written language records of natural word vibrations, such as are recorded by the phonograph or the oscillograph. At first thought this seems to be beyond the possibilities, but if we could do it, what a convenience it would be. Letters could be dictated into an oscillograph and in a few minutes mailed to their destinations. Every telephone could be made to record conversations or messages. Of course, many difficulties might be suggested, but who will say they are insurmountable.

Digitized by Google

THE AMERICAN RAILWAY APPLIANCE EXHIBITION.

The exhibition of American railway appliances at Washington during the recent International Railway Congress attracted much attention from the foreign engineers, but it seems that it was even more appreciated by American railway men, as it offered them an unusual opportunity to examine all the latest and best apparatus. For these men it was particularly satisfactory because of its completeness. Railway exhibits at large expositions are usually made with the idea of attracting public attention. The one at Washington was an exhibit designed for railway men. The efforts of the exhibitors were not wasted, and will undoubtedly bear excellent fruit.

Speaking of this phase of the exhibit, our esteemed contemporary, *Engineering News,* makes the suggestion that a similar exhibit be made every few years for the benefit of the operating railway engineers. This exhibit, it says, might be offered in connection with the meetings of a number of bodies interested in railway work. If this were done and the plans made long enough ahead, there is no doubt that the exhibit would draw to it a number of other technical societies. In fact, it could be counted upon to attract nearly all the important engineering organizations. There is none of these but that, in some part of its work, is brought into contact with railway problems. The suggestion is well worthy of careful consideration.

FIXATION OF NITROGEN.

The importance of developing some method of fixing the nitrogen of the air so as to make it available for plant food has been dwelt upon again and again. Many attempts have been made, some of them promising final success. Heretofore the problem has been attacked in three ways: first, by taking advantage of the oxidation of the nitrogen of the air brought about by the electric arc; second, by causing chemical reaction to take place between the nitrogen of the air and calcium carbide; third, by preparing a culture of bacteria which causes the formation of nodules on the roots of leguminous plants. This culture is applied to soil which is planted in beans, clover or some other similar crop, and the ground enriched in this way, since the bacteria have the ability to fix atmospheric nitrogen.

There is now a fourth method proposed, which is briefly referred to in the *Electrical Review* (London), May 5. The process is a purely chemical one, and was invented by Professor Wilhelm Eschweiler, of the Technical High School at Hanover, and Dr. H. C. Woltereck, of London. It consists mainly in passing a stream of air mixed with steam over a mass of peat in a state of slow combustion. The effect is to cause some of the nitrogen in the air and some of that contained in the peat to become fixed by means of the hydrogen obtained from the decomposition of the steam. Ammonia is thus formed, which is then taken up by the sulphuric acid so as to form the sulphate. It is said that over five tons of sulphate of ammonia are obtained from 100 tons of peat, and that the cost of production is less than half the market price of sulphate of ammonia. With these four methods available, it should not be long before we are able to supply the threatened deficiency of nitrogenous fertilizers.

It is interesting to compare the different ways which have been devised for causing nitrogen, usually so inert, to become "fixed," that is, to form a chemical compound with some other element. The first referred to is purely electrical; the second, a chemical reaction using, however, a product of the electric furnace. The one just announced is purely chemical, while one is biological.

HIGH-SPEED RAILWAYS.

The interesting paper read by Dr. Friedrich Schulz before the International Railway Congress, at Washington, in which he gives conclusions drawn from the Berlin-Zossen high-speed tests, shows the confidence which the author feels in the practicability of very high-speed operation of electric cars. Dr. Schulz believes that the present methods of track construction are satisfactory, and that, with slight modification, our present cars can be operated at speeds of over 100 miles an hour safely, provided a clear way can be assured.

The greatest danger seems to be in the failure of the signaling system, for, during foggy weather, the track signals were not visible soon enough to be effective. This trouble was somewhat overcome by an electrically operated signal carried on the car itself, which operated satisfactorily throughout the tests. But where speeds of from 100 to 120 miles an hour are sought, it would seem to be only proper to provide a duplicate signaling system to ensure safe operation during bad weather. A high-speed road, to be successful, must be able to maintain its schedule at all times, and although the passengers on the test car may have felt safe during the remarkable experimental runs, as they knew there was no other train on the track, greater precautions seem necessary for a road designed for actual service. A possible solution of the problem would be the cutting of high-speed roads into long blocks—for example, a block from New York to Philadelphia, a second from Philadelphia to Baltimore, a third from Baltimore to Washington, etc. The longest section here is but little over ninety miles, and, with an hourly service, each block would be clear before a train left. Of course, such a road would have to be elevated over other roads or have them carried over it. Grade crossings of any kind would not be permissible.

One point brought out by Dr. Schulz in his paper is the rapid rate at which the air friction increases. He thinks that this factor may lead to the adoption of a service maintained by a few trains, rather than by a number of single cars. With such service the block problem would be simplified.

There is no doubt that a safe high-speed road connecting the largest cities would get the greater part of the through passenger traffic, but whether we are quite ready for it is not so sure. The large railroads of this country are at the present time carrying out, or planning to carry out, some very remarkable and expensive work, and they will feel some hesitation toward undertaking what will be something of an experiment. On the other hand, if they delay too long they may find that the electric roads have forestalled them, and that their through traffic is being reduced as seriously as their short-haul traffic has been cut down by the suburban electric roads. We wonder if the railway presidents do not often wish that the electric motor had never been invented.

Digitized by Google

American Society of Mechanical Engineers.

The fifty-first meeting of the American Society of Mechanical Engineers will be held at Scranton, Pa., from June 6 to June 9, 1905. The professional sessions will be held at the Young Men's Christian Association Building, corner Washington avenue and Mulberry street, on Tuesday evening, June 6; Wednesday morning and evening, June 7, and Thursday morning, June 8. The headquarters will be on the second floor of the Hotel Jermyn, corner Wyoming avenue and Spruce street. The headquarters will be opened Tuesday morning, June 6, and remain open throughout the meeting.

At the opening session on Tuesday evening the society will be welcomed by Mr. William F. Mattes, chairman of the local committee. Mr. John R. Freeman, president of the society, will respond. Professional papers will be presented at this session as follows: "The Transfer of Heat at High Temperatures," Frank C. Wagner; "Standard Unit of Refrigeration," F. E. Matthews; "Formation of Anchor Ice and Precise Temperature Measurements," Howard T. Barnes; "Some Types of Centrifugal Pumps," William O. Webber.

The second session, to be held on Wednesday morning, will be the business session for the reports of tellers and committees, and general business. Any new business outside of the professional papers will be presented at this time. After the executive business has been disposed of, professional papers will be taken up as follows: "Microstructure and Frictional Characteristics in Bearing Metals," Melvin Price; "Cast Iron, Crushing Loads and Microstructure," William J. Keep; "Smoke and Its Abatement," Charles A. Benjamin.

Wednesday afternoon is left open for visits to points of interest in and about Scranton. During the afternoon a reception and tea will be tendered to the visiting ladies by Mrs. J. Benjamin Dimmick.

The third session will be held on Wednesday evening at 8.30 o'clock, when the following papers will be presented: "Can a Steam Turbine Be Started in an Emergency Quicker than a Reciprocating Engine of the Same Power," A. S. Mann; "Note on Efficiency of Steam-Generating Apparatus," A. Bement; "Performance of a Superheater," A. Bement; "Counterweights for Large Engines," D. S. Jacobus; "Steam-Actuated Valve Gear," William H. Collier.

The closing session will be held Thursday morning, and professional papers will be presented as follows: "Note on Heads of Machine Screws," H. G. Reist; "Belt Creep," W. W. Bird; "Function of Laboratory Courses in the Curriculum of Engineering Schools," Charles E. Lucke; "Continuous Measuring and Mixing Machines," E. N. Trump; "Epochs in Marine Engineering," George W. Melville.

Arrangements have been made to entertain the visiting ladies on Thursday morning by a drive around lake Scranton, and an excursion on Thursday afternoon is being arranged for members and guests. If possible, a special train will be secured for a visit to the new car-shops and power station of the Delaware, Lackawanna & Western Railroad in the Keyser valley. The details of this excursion are not yet complete, but a printed circular will be distributed at the meeting, giving full information regarding it.

On Thursday evening at nine o'clock a reception will be tendered the society by the local members, assisted by the Scranton Engineers' Club, the Board of Trade, and the citizens of Scranton. The reception will be held at the Scranton Bicycle Club, 545 Washington avenue.

An excursion to Wilkesbarre over the Laurel line is being planned for Friday, June 9. The trip may possibly be extended to Hazleton. Full information regarding this trip will be contained in a circular to be distributed at the meeting.

Copper in Honduras.

William E. Alger, consul, Tegucigalpa, Honduras, March 29, 1905, reports a rich discovery of copper recently made in the department of Yoro, in Honduras. Those who have examined it state that the amount of ore is very large and very rich, running from fifteen to sixty per cent copper. The discoverers have located eight well-defined veins, which can be traced for miles on the surface, two of these being twelve feet wide, one ten feet, and one fourteen feet. It is calculated that the entire body will average fifty per cent copper. The consul states that taking into consideration the fact that the properties are surrounded by forests of oak and pine, a coal deposit within twenty miles, abundant water power sufficient for any machinery needed for reduction, etc., and that it is comparatively close to transportation—forty miles from the Ulua river, which is connected by canals with the bay at Puerto Cortes, from which point there is daily communication with the United States—it would appear to be a proposition worthy of the attention of American capitalists.

TWENTY-EIGHTH CONVENTION NATIONAL ELECTRIC LIGHT ASSOCIATION.

PROGRAMME DENVER-COLORADO SPRINGS, JUNE 6-11, 1905.

TUESDAY, JUNE 6.

First session, 10 A. M., convention hall, Brown Palace Hotel—Address of welcome, the mayor of Denver; president's address, Ernest H. Davis, Williamsport, Pa.

Report, "Progress," T. Commerford Martin, New York.

"The Paramount Importance of Choosing Standard in Preference to Special Machinery," David Hall, Cincinnati, Ohio.

"Insulation Testing—Apparatus and Methods," C. E. Skinner, Pittsburg, Pa.

Second session, 2 P. M.

"Automatic Synchronizing of Generators and Rotaries for Lighting and Power Sytems," Paul MacGahan, Pittsburg, Pa.

"Notes on Rotary Converters and Motor-Generators for Lighting and Power Systems," Louis E. Bogen, Cincinnati, Ohio.

"The Organization of Working Forces in Large Power-Houses," W. P. Hancock, Boston, Mass.

"Report, Committee on Steam Turbines," W. C. L. Eglin, chairman, Philadelphia, Pa.

"Operating Features of the Curtis Steam Turbine," A. H. Kruesi, Schenectady, N. Y.

WEDNESDAY, JUNE 7.

Third session, 10 A. M.

"Series Alternating-Current Motors for Industrial Work," Clarence Renshaw, Pittsburg Pa.

"A New Type of Single-Phase Motors for Elevator Work," S. Percy Cole, St. Louis, Mo.

"Long-Distance High-Tension Transmission in California," John A. Britton, San Francisco, Cal.

"Report, Present Methods of Protection from Lightning and Other Static Disturbances," Alex Dow, and Robert S. Stewart, Detroit, Mich.

"The Nernst Lamp—Its Present Performance and Commercial Status," E. R. Roberts, Pittsburg, Pa.

"The Choice of an Insulated Cable," Wallace S. Clark, Schenectady, N. Y.

Fourth session, 8 P. M.

"Some Investigations of Induction Losses," E. P. Dillon, Colorado Springs, Col.

"Mercury Arc Rectifiers," P. D. Wagoner, Schenectady, N. Y.

"Report, Advertising Methods," Percy Ingalls, Newark, N. J.

"Report, Sign and Decorative Lighting," La Rue Vredenburgh, Boston, Mass.

"Free Signs and Flat Rates," G. W. Lee, Newark, N. J.

THURSDAY, JUNE 8.

Fifth session, 10 A. M.

"Report, Progress of Electric Heating," James I. Ayer, Boston, Mass.

Digitized by Google

"Report, Purchased Electric Power in Factories," E. W. Lloyd, Chicago, Ill.

"Report, Committee on District Steam Heating," W. H. Blood, Jr., chairman, Seattle, Wash.

"Wrinkles," H. C. Abell, editor, New York city.

Sixth session, 2 P. M.

"Report, Committee on Relations with Kindred Organizations," James I. Ayer, chairman, Boston, Mass.

Executive session.

"Report, Committee on Rates and Costs," Charles L. Edgar, chairman, Boston, Mass.

"Report, Municipal Ownership," Arthur Williams, New York, N. Y.

"Question Box," Homer E. Niesz, editor. Chicago, Ill.

Seventh session, 3 P. M.

Executive session.

"Report of Secretary and Treasurer."

"Report of Executive Committee."

"Report of Committee on Relations between Manufacturers and Central Station Companies," Henry L. Doherty, chairman, New York.

Dr. Louis Bell will read a paper on the "Tantalum Lamp."

"Report of Committee on Standard Rules for Electrical Construction and Operation," Charles L. Edgar, chairman.

Election of officers.

For the accommodation of New England delegates arrangements have been completed to run a special car from Boston to Denver, leaving the Terminal station, Boston, on the Federal express at 7.45 P. M., Friday, June 2, which car will be attached to the special convention train from New York to Denver, leaving New York city June 3, at 10.25 A. M., arriving at Chicago 8.25 A. M., June 4, and arriving at Denver 2.30 P. M., Monday, June 5.

BOOK REVIEW.

"Gas-Engines and Producer-Gas Plants." R. E. Mathot. Translated from the original French manuscript by Waldemar B. Kaempffert, with a preface by Dugald Clerk. New York. The Norman W. Henley Publishing Company. Cloth. 314 pages. 6 by 9 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.50.

To the operators of gas power plants of very small capacity this purely discursive treatise of 300 pages will prove beneficial. The subject matter shows wide experience and good judgment on the part of the author in the discussion of gas engine troubles and remedies; yet, there is an unfortunate absence of much of the fundamental data which are necessary to a thorough understanding of gas engine practice. And, as a whole, the book is somewhat wearisome on account of the profusion of axiomatic demonstration. Handbooks for the operating engineer and for the consulting engineer should be separate and distinct in scope and treatment. They are utterly incompatible in a well planned and readable work suitable for any business man. The elementary nature of the one adds unessential verbosity to the other, resulting in a less forceful presentation of either phase of the subject. Mr. Mathot can scarcely be accused of undue technicality in this work, rather the reverse; and one can not help but be impressed by the fact that the reader is too frequently left in the dark with the advice that in the assumed dilemma the services of an expert should be retained, this occurring in one instance on three successive pages. On the other hand, much space is devoted to details of operation which would seem more appropriate in an elementary treatise of mechanics, particularly when the matter discussed can not fail to be inapplicable to some types of apparatus. A conspicuous fault of the work is the general paucity of basic data where such are essential. Thus, the discussion of cost in chapter i is by no means conclusive or convincing. The only practical results from gas plants are given in the closing chapter where a number of tests are quoted. In no case is mention made of the duration of the test, without which all producer as well as boiler data are wellnigh valueless. Similarly, a test on street gas includes no statement of calorific value. The results presented, if we take them without question, are, however, excellent. A pressure gas plant shows a net duty of one pound per brake horse-power-hour, a sixty-horse-power suction plant 0.86 pound per brake horse-power-hour, and a 200-horse-power suction plant 0.72 to 0.93 pound per brake horse-power-hour, all at good load. These, however, are test conditions; no results of operation over long periods are given. The author states that a lignite producer is capable of giving a duty of about 3.3 pounds per horse-power-hour, the lignite containing 9,424 British thermal units per pound. Similarly, a wood producer of the Riché type is able to give a horse-power-hour on 2.2 pounds of wood, either sawdust or waste. The propagation of the term explosion motor instead of combustion motor is, in the reviewer's opinion, unfortunate and detrimental to the gas engine industry. It creates in the mind of the operator a false impression of personal hazard. Combustion, to be sure, is rapid, but it is in no manner akin to a detonating explosion in the usual sense. Mr. Mathot very properly calls attention to the necessities of avoiding interior projections in the combustion spaces, tending to cause backfiring, also to the superiority of slotted overforged cranks. One can not help being amused in his characterization of the vertical engine as "of the steam-hammer type." The simple and effective expedient of muffling the exhaust by water spray has evidently not come within the author's observation; nor have splash lubrication and the use of power oil pumps. The overheating of cylinders due to stoppage of circulating water piping can readily be detected by tapping in at the highest point in the circulating system a small riser. This not only indicates when steam is being formed in the jackets, but also acts as an overflow in case the outflow piping becomes stopped. In either case it acts as an efficient tell-tale. In the author's discussion of the advantages of high compression one would get the impression that there is no increase in economy from its use, and that serious trouble has usually arisen when attempting to increase compression. Probably this is not what the author intended to convey. Primarily the engine must be designed strong enough to withstand the pressures ensuing from combustion, sometimes as high as 500 pounds per square inch. The compression can then be raised to as high a point as permissible with the gas on which the engine is to be operated. With coal gas it might be 120 pounds per square inch maximum, with water gas much less, with producer gas it could readily be greater without danger of spontaneous combustion. It can hardly be termed as a distinctive feature of the suction type producer, that the fire can be cleaned while the engine is operating. The author does not appear to recognize the fact that an ordinary water seal type pressure producer is much more convenient to clean during operation than the suction type. The best results obtained by him in pressure producers have indicated a consumption of one to one and one-fourth pounds of anthracite per horse-power-hour, while he has obtained with suction generators, by using similar fuels, a duty of 0.9 pound per horse-power-hour. This ratio, it is true, may hold good on producers of very small capacity, in which field the suction type is preeminent. However, it is extremely questionable whether the pressure producer will be outstripped in the larger sizes. The discussion of details of the various suction types in the latter part of the book is very complete and instructive, also the description of the construction and operation of the author's continuous explosion recorder, which could be used to good advantage by all gas engine manufacturers or engineers having to conduct tests. Finally, in calling attention in the above to some of the points which particularly impressed the reviewer in reading over this book, it is to be hoped that he has not given an entirely derogatory impression of Mr. Mathot's work. It will be of value to that class of readers which desires detailed instruction on the care of gas plants and the location and remedy of difficulties which will arise. It is primarily a work for the operator, not the engineer.

Digitized by Google

LETTERS TO THE EDITOR.

Carborundum for Meter Bearings.

To the Editor of the Electrical Review:

I have read the reports of President Lieb's address before the members of the American Institute of Electrical Engineers on the subject of "Electric Meters," and the tendency of such meters to run slow on account of the wear to the bearings. He also stated several articles which had been tried to remedy the trouble, but all were either too high in price to be practical, or else were not satisfactory. Now these matters are entirely out of my line of business, but as I read the article the idea occurred to me that "carborundum" might be used to advantage, hence this suggestion.

M. Van Every.

Buffalo, May 13.

The Proposed Alliance of the Massachusetts Institute of Technology with Harvard.

To the Editor of the Electrical Review:

There is such widespread misunderstanding of the attitude of the faculty and former students of the Massachusetts Institute of Technology toward the proposed alliance with Harvard, that the public should be definitely informed, in as few words as possible, of the real grounds of the opposition of at least ninety per cent of the men of these two bodies. College loyalty and sentiment, very properly, play a part in determining their attitude toward the suggested partnership, but it is a very minor one; the chief grounds of opposition are to be found in that common-sense, clear thinking and business caution which the Institute training does so much to foster. The theoretical advantages of such an alliance are indeed attractive; but when reduced to the practical details of a definite plan, based upon the actual conditions to be met, the objects desired can be but partially realized, if at all, and serious complications arise which make the experiment dangerous and unwarranted.

Four main arguments are used in urging Institute men to ratify this proposed alliance: (1) that it will bring in money; (2) that it will save money; (3) that it will broaden the Institute education; and (4) that it will promote the cause of higher education. Even were all these advantages to be secured, theoretically, through an alliance with Harvard, the faculty and former students of the Institute object, by an overwhelming majority, to the practical means proposed. By this "proposed agreement" Technology is called upon to sign a contract vague and unbusinesslike in form, revocable at the will of either party, wholly contingent upon legal interpretations and decisions, pregnant with misunderstandings, and requiring the Institute to assume most of the present burdens and, in case of rupture, all future losses. The plea that this is a "gentlemen's agreement" does not reassure men accustomed, as are those of the Institute, to reading contracts and weighing their probable results. Long experience has taught them that such documents must sooner or later face the courts and that the law reads them as they are written, not as "gentlemen" may be willing to interpret them.

This "agreement," moreover, requires the Institute to bury all her present resources in real estate near enough to Cambridge to share the disadvantages of that locality, but not near enough to partake of the real advantages of the collegiate environment; forces her to agree to reimburse the University in the event of annulment of the contract; and compels her to reorganize her government, to limit her choice of an executive board, and radically to change a policy which has given her the prestige she now holds—a prestige which has been attained, moreover, only because of her unique position as an independent institution.

Setting aside the question of the moral right of the University, even though she may secure legal permission, to divert bequests from their intended purposes, and assuming that the Supreme Court decides that a part of the McKay money may legally be spent at the Institute, even then this highly objectionable "agreement" does not achieve what it is supposed to accomplish. Were it to be ratified, the Institute, for a generation to come, would secure from Harvard only money enough to pay the cost of teaching the Lawrence Scientific School students and would be compelled to bear the whole burden of providing for the natural expansion of the combined institution.

The McKay endowment, under this plan of alliance, would yield to the Institute only three-fifths of the income of the net income of the estate for about fifty years, and the sum then available would be only three-fifths of the income of the accumulation of about five million dollars. To offset this, however, the Institute would lose at least two million dollars in bequests contingent upon her independence, would undoubtedly forfeit state support, and, most serious of all, would almost wholly cut off the present and future financial support (direct and indirect) of the more than six thousand former students who are now enthusiastically ready to assist her.

The plan of alliance will not save money for the Institute because it does not and—except by giving a cheaper and less thorough education—can not avoid duplication in either instruction or equipment. To save money in administration (following the example of business "mergers") is possible, but only on condition of making the Institute an integral part of Harvard University.

The plan will not really broaden the educational life of the Institute; it will merely substitute for the well recognized and thoroughly tested spirit of Technology the different spirit of the University. The students of the Institute, already pressed with the necessary work of their own courses, could find no time for intercourse with those of Harvard, even were they to be admitted (as Dr. Pritchett says they are not) to the undergraduate classes of the University. The association of Harvard and Institute professors upon one faculty is likely to lead to friction rather than to educational development, since the Harvard members to be injected are mainly heads of established courses. As to the broadening which is supposed to come from paying larger salaries to teachers, that can not take place for at least fifty years, since neither the "proposed agreement" nor the McKay endowment (until the death of the last annuitant) can provide higher salaries.

The projected alliance, finally, will injure, not help, the cause of higher education: (1) because it does away with competition, that leading stimulus to educational development; (2) because it creates a school too large for the only right kind of higher education—that which places every student under the immediate supervision of one or more members of the faculty; (3) because it restricts the choice of youth seeking a higher technological education to one kind of institution in this educational centre; and (4) because it brings to an end the great endeavor of Rogers, Runkle, Walker and their associates to build up, on a basis of science, modern languages, history and economics, a true university which shall meet modern conditions and needs more fully than can any of the older colleges.

M. I. T. Alumnus.

Boston, May 15.

Digitized by Google

The Oscillograph and Its Uses.[1]

By Lewis T. Robinson.

THE usefulness of a satisfactory method of observing or recording the wave forms of rapidly varying electric currents and pressures has been appreciated almost from the time that investigators and designers commenced working with electrical apparatus. The various methods which have been used for obtaining these records or indications have had and are having an important influence on the design of

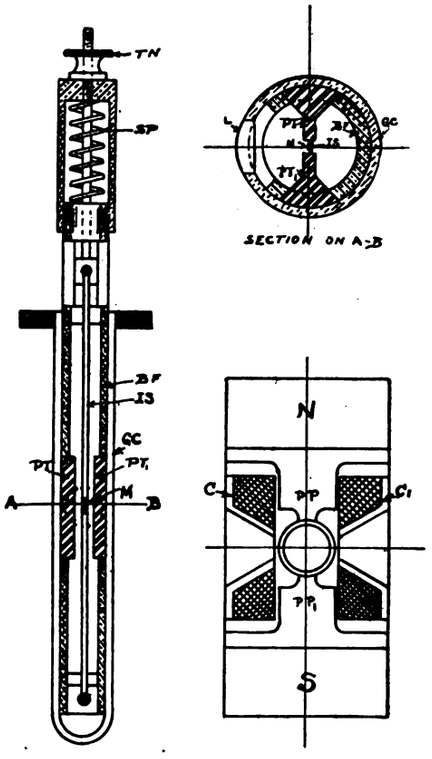


FIG. 1.—GENERAL ARRANGEMENT OF VIBRATING STRIP OSCILLOGRAPH.

apparatus and a clearer understanding of the phenomena accompanying their use.

Instruments for obtaining wave forms divide themselves naturally into two classes; those using point-by-point methods, most generally useful in connection with the investigation of recurring waves, and continuous methods which show recurring waves or record the individual waves. The first class can be traced to a common origin in the point-by-point method of Joubert,[2] and the second to the vibrating-coil device of Elihu Thomson, 1881 (not previously described), and to his later apparatus, and that of Frölich for observing the excursions of a telephone diaphragm acted upon by the current, the wave form of which is to be investigated.

Referring to the point-by-point methods we find, after various modifications, the resulting modern instruments: Hospitalier's ondograph, Rosa's curve tracer, and the General Electric wave meter. While there may be other methods in practical use at the present time, it is believed that these are the only ones which have been used commercially to any extent, at least in this country.

These instruments are not suited to commercial work on instantaneous phenomena, as they require many repetitions of the wave to be viewed or recorded before its complete form is shown. They can, however, be made to operate with very little energy from the circuit to which they are attached and can be constructed to give records of any desired size and of considerable accuracy. These records are, therefore, well suited for analysis and furnish a positive means by which records or observations by the oscillograph may be checked and the absence of errors, due to lack of critical damping and sufficiently high frequency of vibration, determined. No doubt they will for this reason continue to be used although the oscillographs are more universal in their application and may be used to study many events which, by reason of the time required to record a complete wave and the impossibility of reproducing many conditions a sufficient number of times to produce a record by means of succession of points, can not well be handled by any point-by-point method.

The true oscillograph, that is, the instrument with high period, critical damping, and comparatively good sensibility, is to-day existent in two forms, both due primarily to Blondel,[1] who has developed, to a high degree of perfection, the moving iron or vibrating strip type.

This consists of a thin ribbon of iron tightly stretched between the pole tips of a powerful magnet, thus forming a polarized needle, held in position by the directive force of the magnetic field, and, also, by the resistance to torsion of the strip itself. Two small coils, to which the circuit under investigation is connected, are arranged on the sides of this strip in such a way that the strip is acted on by the current flowing in them and at any instant the strip, having the necessary high period of vibration and critical damping, takes up a position which is a measure of the current flowing in the coils at that instant. A minute mirror is attached to the middle portion of this vibrating strip and a beam of light reflected from its surface can be made, by suitable means, to render the wave of current in the coils visible, or to record it on a suitable photographic surface. Fig. 1 shows the general arrangement of the parts.

In the plan view "C," N and S are the poles of the magnet. PP and PP_1 are the pole pieces. C and C_1 are the coils. And in the enlarged sectional plan "D," M is the small mirror attached to the vibrating strip. GC is the insulating tube and PT are the pole tips which concentrate the field on the vibrating strip IS.

The alternate type, or the vibrating-loop construction, is in reality a D'Arsonval galvanometer in which two small metallic bands constitute the moving coil, as well as the suspensions. These are located in a strong magnetic field and the varying current to be investigated is led through the strips in opposite directions. The current flowing through the strips will then, at any instant, bend them in opposite directions, with reference to the field in which they are situated, and a small mirror, attached by its edges to the middle portion of the strips, will be deflected. The deflection of this mirror can be used, as in the first mentioned type, to indicate or record the wave form of the current passing through the strips. Fig. 2 shows diagrammatically the strips in the magnetic field, traversed by a current, with the mirror deflected. At this point

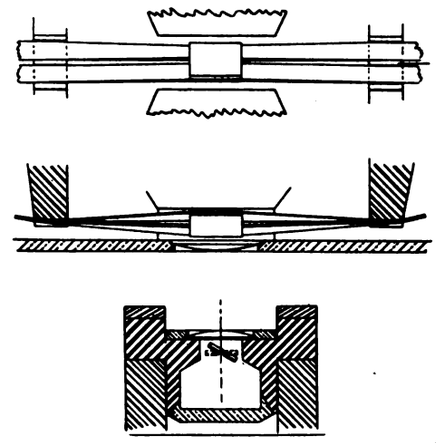


FIG. 2.—ARRANGEMENT OF VIBRATING LOOP OSCILLOGRAPH.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, New York, April 28, 1905.

[2] *Comptes Rendus*, vol. xci, 1880, p. 161; *Journal de Physic*, 1881.

[1] *Comptes Rendus*, April, 1893.

Digitized by Google

we may consider briefly the advantages and disadvantages of the two types.

An oscillograph, to give satisfactory results, should have:

1. A short free periodic time compared to the period of the wave forms being recorded.
2. Critical damping, that is, the motion just ceases to be oscillatory.
3. Negligible self-induction.
4. Sufficient sensibility.[1]

And we might add the fifth consideration: the instrument should be so constructed that the working parts are readily accessible and of sufficient size so that they may be renewed or repaired by persons ordinarily skilled in the handling of testing instruments.

Referring to these various conditions in the order given, it is undoubtedly true that the iron-strip type can be made to have a shorter free periodic time than the vibrating-loop type, unless the dimensions of the parts in the latter are reduced to an impossible degree.

Both types can be given critical damping.

The vibrating-loop type is superior as far as negligible self-induction is concerned, and it is believed that it can also be operated with less expenditure of energy than the iron-band type.

For practical work it is, in most cases, not necessary to use a periodic time shorter than that which can be conveniently obtained with the vibrating-loop type, and it is also believed that the negligible self-induction and small resistance of this type are of the greatest advantage when large currents, especially unidirectional ones, are to be dealt with. Cases have frequently arisen in practice where such currents of several thousand amperes have been measured by passing them through shunts, similar to those used in connection with direct-current moving coil ammeters, which is believed could not have been successfully handled with the iron-strip type.

Referring to accessory parts of the oscillograph, the arrangements which have been adopted for photographing and viewing the waves exist in great variety and have been developed to meet the special requirements of various investigators. We shall, however, describe those only which have been adopted for the instrument with which the writer is most familiar.

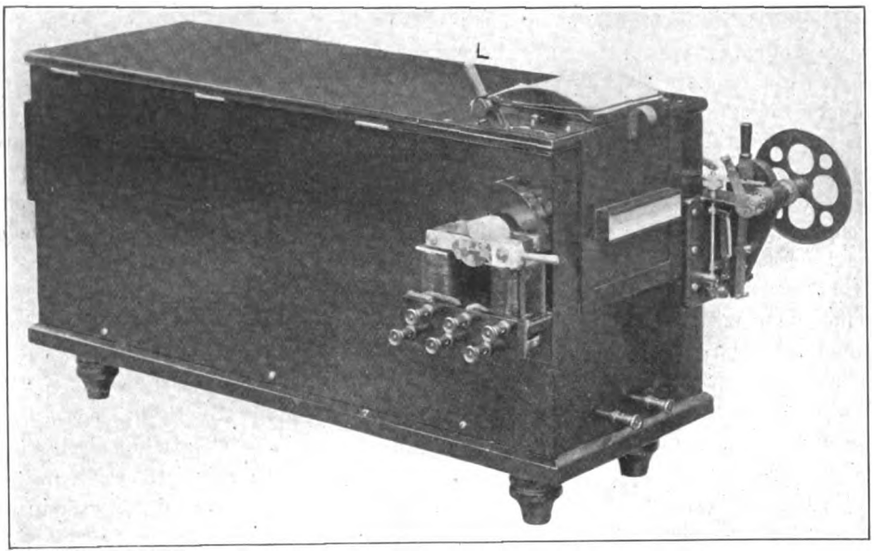


FIG. 3.—TYPE EM, FORM B, OSCILLOGRAPH, SHOWING PHOTOGRAPHIC AND TRACING ATTACHMENTS.

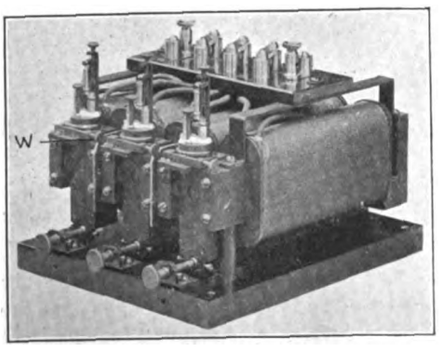


FIG. 4.—TYPE EM, FORM B, OSCILLOGRAPH—GALVANOMETER.

The instrument consists of a light tight box, Fig. 3, in which is placed a three-element galvanometer, and to which are attached devices by means of which the waves may be viewed, or photographic records of them taken.

The three-element galvanometer is shown complete in Fig. 4, and one moving element removed from it in Fig. 5. The details of the containing-cell which is inserted and held between the pole pieces of the magnets, and in which the vibrator is inserted, are shown in Fig. 6.

The principle on which the instrument operates has already been referred to in speaking of the vibrating-loop type in general. The three elements of the galvanometer are entirely complete within themselves, with the exception of the magnetizing coils, and can, therefore, be insulated from one another to stand almost any required pressure. It is then not necessary to insulate the vibrating loop from the frame which holds it, or to rely for insulation on the somewhat uncertain condition that the vibrating loop can always be kept a safe distance away from the pole pieces, between which it moves. In fact, it has been found desirable in most cases actually to connect the strips electrically to the magnet, between the poles of which they are located. In the instrument shown, a pressure of 5,000 volts has been applied between the separate galvanometer elements and between all of these and the frame to which they are attached.

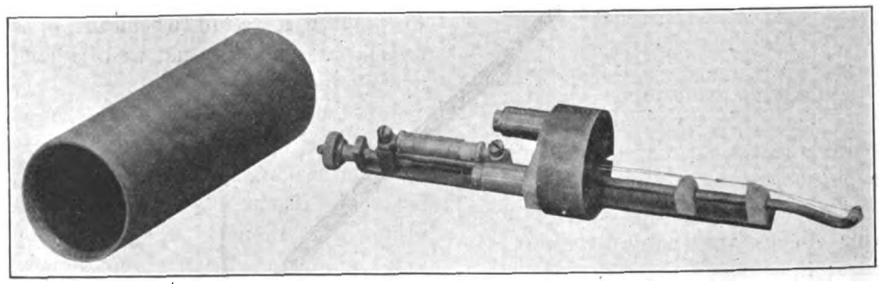


FIG. 5.—VIBRATOR FOR OSCILLOGRAPH.

Referring to Fig. 5, it will be seen that the vibrating strips, when the vibrator is removed from the containing-cell, are exposed on all sides; this is of the greatest advantage in restringing the vibrator and making any required adjustments to the moving parts. The vibrating strips, and

[1] Duddell, Institute of Electrical Engineers' Journal, vol. xxviii, No. 138, p. 7.

Digitized by Google

consequently the mirror to which they are attached, can be moved around a vertical axis passing through the centre of the mirror by means of the knurled head on the worm W, Fig. 4. The containing-cell as a whole is movable around a horizontal axis passing through the same point by means of the screw S, Fig. 4.

These two adjustments make it possible to bring the image of the mirror into the desired place on the photographic film or vibrating mirror, even though it has been attached to the vibrating strips in a somewhat imperfect manner. The containing-cell is filled with a damping liquid above the level of the bridge B, Fig. 6. The vibrating loop is usually made of pure silver hard drawn, and the mirror of silvered glass.

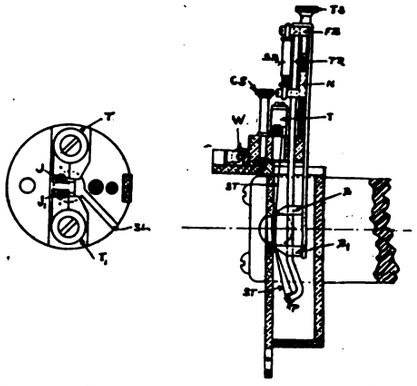


FIG. 6.—DETAILS OF THE CONTAINING-CELL.

Referring to Fig. 6, TT_1 are the terminals conveying the current to the strip ST through the soldered joints JJ_1. By means of the slit SL the loop is placed in position without being passed through any holes. CS is the clamping screw by means of which the removable vibrator is held in the containing-cell. TR is the tension rod attached to the block FB through which the pull of the spring balance SB is transmitted to the pulley P. TS is the tension screw by means of which the tension is regulated by moving the tension nut N.

In a standard pattern the period is one five-thousandth second, the sensibility about 0.007 ampere per millimetre deflection, and the resistance about one ohm.

The dimensions of the mirror which is employed are 80 by 20 by 10 mils, which is large enough to be easily handled and admits of a better photographic record than a smaller mirror. It is, of course, possible, by employing smaller mirrors, to obtain higher frequencies, up to, perhaps, 10,000; but unless such a high frequency is absolutely necessary, the advantages are more than outweighed by the difficulty in handling the very small mirror required and of reflecting sufficient light from its surface.

The advantage of silver over phosphor-bronze which has usually been employed for the vibrating loop is considerable. The resistance, and consequently the energy required to operate the vibrator, is by this means much reduced, which permits current waves to be taken with shunts having comparatively small fall of pressure, and the danger of creeping of the reflected image, due to expansion of the strips on account of the current passing through them is entirely overcome. With high-resistance alloys this is one of the limiting features.

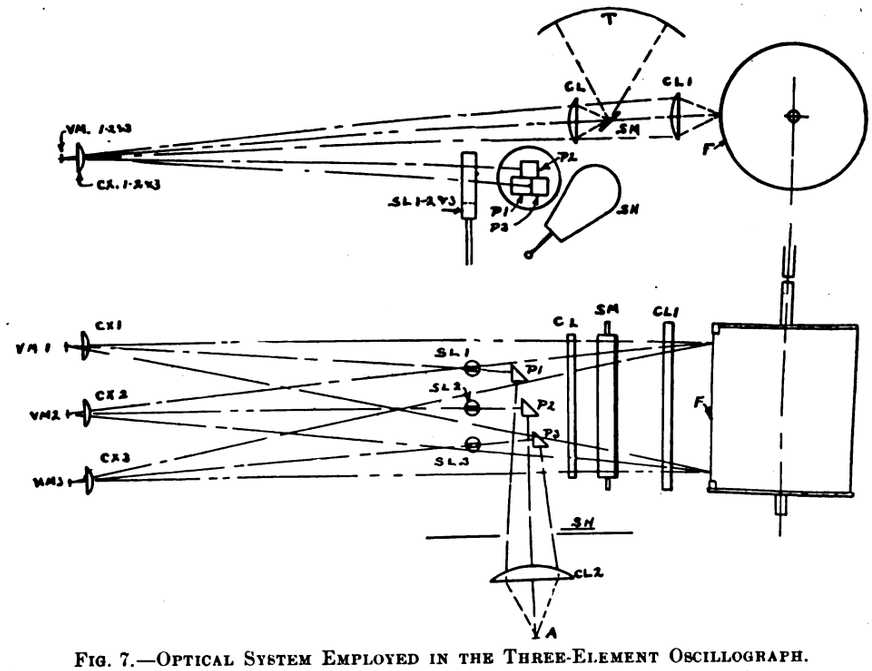


FIG. 7.—OPTICAL SYSTEM EMPLOYED IN THE THREE-ELEMENT OSCILLOGRAPH.

The optical system employed is shown in Fig. 7. We have here the source of light at A, usually an arc lamp; the condensing lens CL_2, by means of which very nearly parallel beams strike the three small prisms P_1, P_2, and P_3, and is, by this means, split up into three portions, which are directed on to the vibrating mirror *v m*, 1, 2, and 3, and from these are reflected to the photographic drum F or to the synchronous mirror SM, from which they are reflected on to the surface T where they may be viewed or traced.

In front of the photographic film is a cylindrical lens CL_1, and in front of the synchronous mirror a cylindrical lens CL. The synchronous mirror and its cylin-

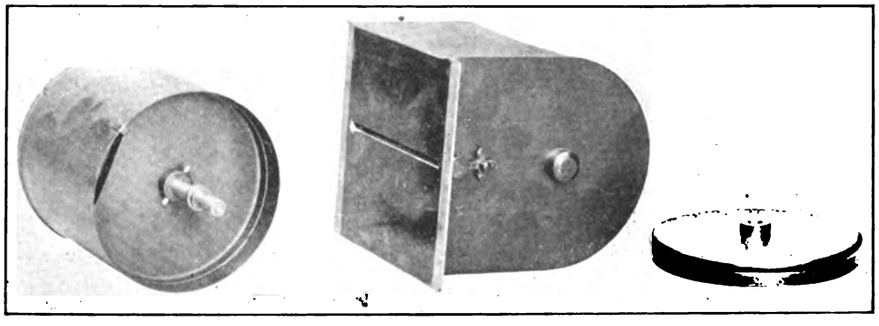


FIG. 8.—TYPE EM, FORM B, OSCILLOGRAPH—FILM HOLDERS FOR PHOTOGRAPHIC ATTACHMENT.

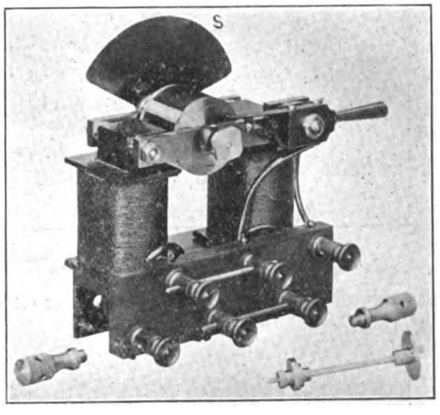


FIG. 9.—TYPE EM, FORM B, OSCILLOGRAPH—SYNCHRONOUS MOTOR.

Digitized by Google

drical lens are removed from the path of light when photographic record is to be made, in a manner which will be described in connection with the general arrangements for viewing the waves.

The light from the arc lamp is intercepted by the shutter SH, which is operated by electrical contacts by the arrangement shown at the right of Fig. 3. The shaft which operates the shutter contacts is also arranged to drive the photographic drum and usually receives its motion from a small electric motor, the motion of which is transmitted from a cone pulley through a countershaft. By this means speeds of from 6 to 600 revolutions per minute of the drum may be obtained, with a wide range of intermediate values. The photographic drum is shown in Fig. 8.

The shutter operating mechanism is so arranged that the shutter SH, Fig. 11, is open during one revolution of the drum, and for this purpose two devices are employed. In the first the shutter is opened just after passing the joint in the film and is closed when the joint is again reached. The cylinder which carries the contacts by means of which the shutter is opened and closed may be advanced by means of spring pin and holes in the ends of the cylinder, so that time required by the shutter to open may be allowed for. The adjustment required varies with the speed at which the photographic drum is rotated. For obtaining records where it is not possible to wait for the joint in the film before the exposure is made, the second device has been provided; this opens the shutter at any required instant and allows it to remain open for one revolution.

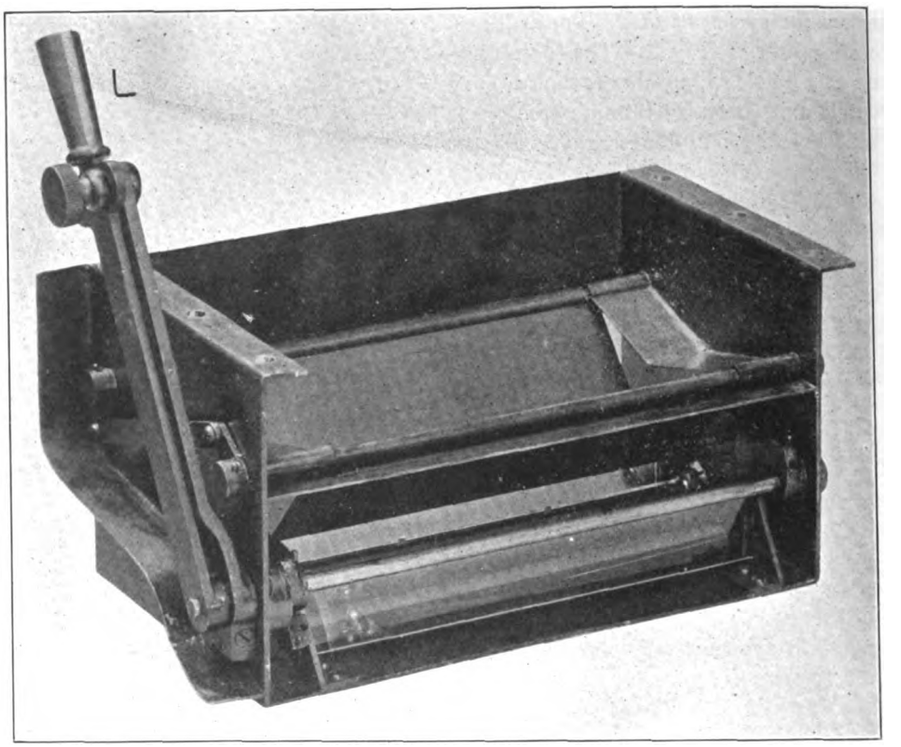


FIG. 10.—TYPE EM, FORM B, OSCILLOGRAPH, SHOWING LENSES AND SHUTTER.

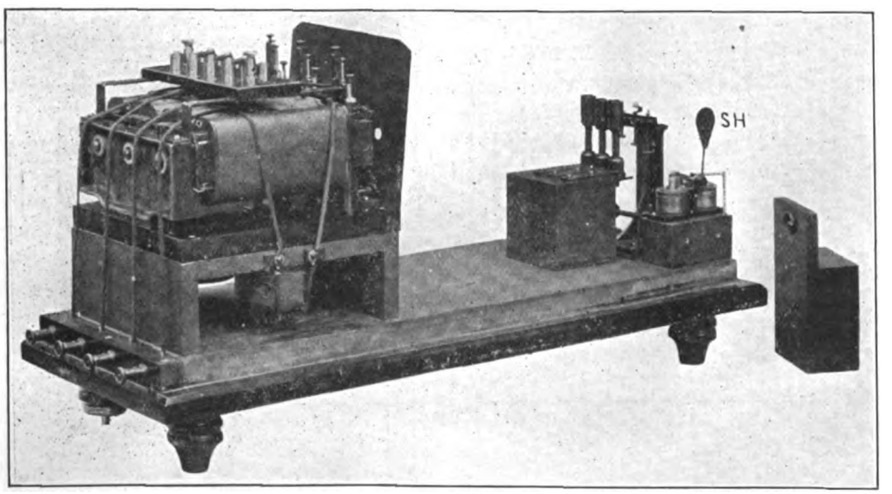


FIG. 11.—TYPE EM, FORM B, OSCILLOGRAPH, SHOWING INTERNAL ARRANGEMENT.

For viewing recurring waves the arrangement shown in Fig. 9 and Fig. 10 is used. By means of the lever L, shown in Figs. 3 and 10, the lens and vibrating mirror are lowered into the path of light and the shutters, which can not well be shown, but which close the opening to the tracing surface T, Fig. 7, are opened. The synchronous motor and mirror driven by it then being in operation and the shutter SH open, to allow the light to pass along the path indicated, the wave is visible on the surface T.

The vibrations of the mirrors having been adjusted to have a suitable amplitude, and the synchronous mirror being moved through a suitable angle during one complete cycle, the point of light on the surface T will move through a path equivalent to the figure obtained when the wave is plotted to rectilinear coordinates. As the mirror returns to its original position the shutter S, Fig. 9, cuts off the light and again allows it to pass when the mirror again moves in the di-

FIG. 12.

Spoken word "Oscillograph." Vibrator was connected in secondary of small transformer, primary of which was connected to battery and telephone transmitter.

Digitized by Google

rection first indicated. This prevents the admission of light to the surface when the mirror is not moving in the proper direction. Fig. 11 shows the internal arrangement with cover removed.

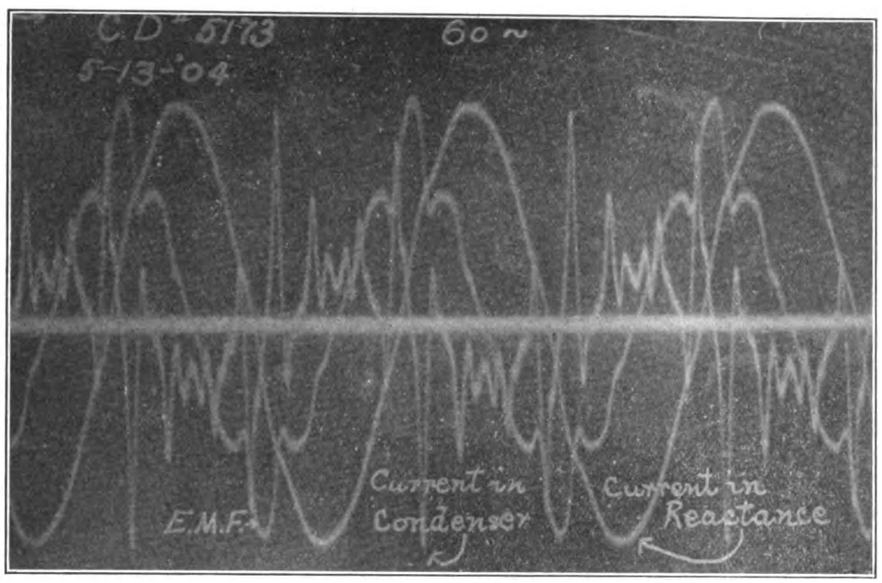


FIG. 13

Impressed electromotive force. Current in reactance. Current in condenser. Reactance and condenser connected to same electromotive force. Reactance without iron core. All three waves recorded simultaneously and having common zero. In Fig. 14 the records were made simultaneously but with separate zero lines.

Given an apparatus similar to that just described we can see and record waves of current and electromotive force in any circuit which can furnish sufficient energy to operate the device, and the frequency of which is not too high to be correctly recorded by it. In general it may be said that a frequency in the neighborhood of 5,000 is sufficient for handling most phenomena which occur on circuits up to and including those having a fundamental frequency of 125 cycles.

The tests in which such a device has been found useful are of such great variety that it is possible to allude to them only briefly and in a general way. The accompanying records which have been taken will, in connection with the description given with each one, show the field of usefulness of the instrument better than it can be described in words.

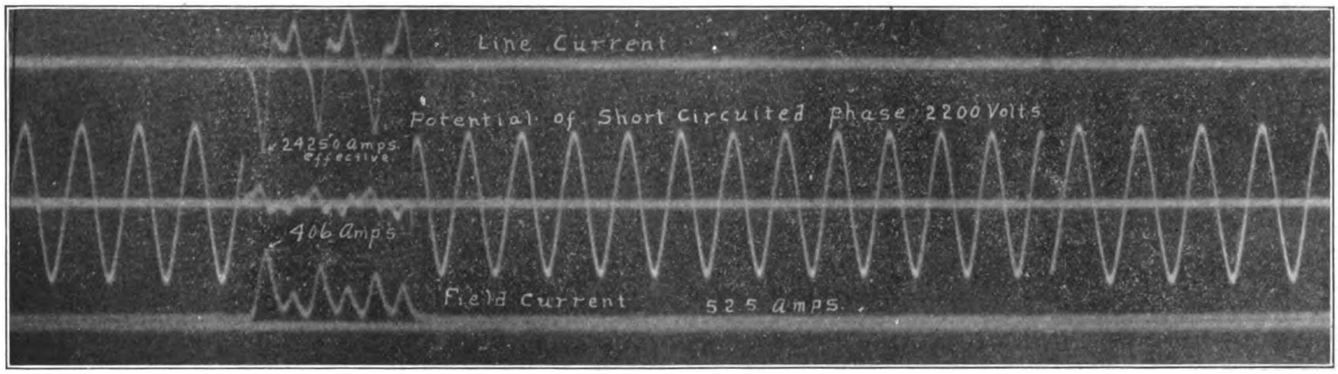


FIG. 14.

Short-circuit applied to large alternating-current generator and opened by automatic oil-switch. The film shows the current and pressure of the short-circuited phase and the reaction of the armature current on the direct current in the generator field; 25 cycles, 2,200-volts.

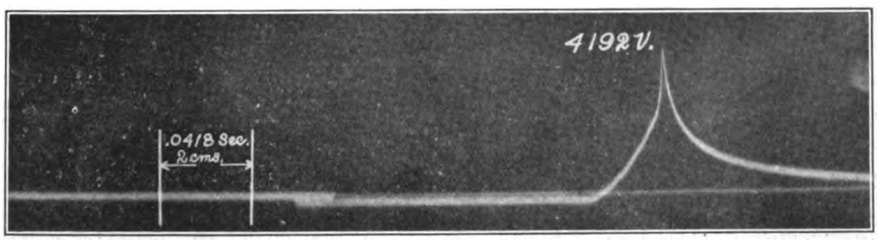


FIG. 15

Inductive rise of pressure in direct-current motor. Shunt field opened by quick-break switch.

The Trinidad Electric and Tramway Power Plant.

W. R. Holloway, consul at Halifax, N. S., reports that a number of Canadians who are taking an active part in the development of the British West Indies have realized a handsome profit from the advance in the price of the stock of the Trinidad Electric and Tramway Power plant at Port-of-Spain, Trinidad. Not only has the value of the stock increased by $750,000, but dividends of five per cent have been paid for two years, and the net earnings are equal to eight per cent on the capital earnings, which continue to show heavy increases month by month.

A still greater and more expanding revenue will be assured with the carrying out of the proposed extensions through a populous and fertile country to larger towns in Trinidad. The present power station is sufficient to supply not only the interurban tramway connection, but light and power for these further demands upon it.

Electric Cabs in Buenos Ayres.

The Compañia Alemana Transatlántica de Electricidad (the German Transatlantic Electric Company), with head offices in Buenos Ayres, Argentine, controlling the electric lighting and street railways of that city and suburbs, is making an endeavor to supplant with electric vehicles the 3,000 cabs used in the city. The company intends ordering 100 electric cabs by way of experiment. The vehicles will be mainly of the light pattern, and will not depart from the style of light victoria which has proved so successful in the present cab service. Mr. A. M. Beaupre, the American minister, suggests that the electric vehicle will come into great favor in the South American city. It will be necessary for American manufacturers to establish agencies to carry in stock all the parts of the machines, for, until a purchaser is assured that he can have missing or broken parts replaced without the delay involved in sending to the United States, the American manufacturers can not hope to make many sales.

Digitized by Google

THE PRODUCTION AND USE OF ELECTRICITY IN A RUSSIAN PETROLEUM FIELD.

BY FRANZ KOESTER.

North of Baku, which is the most important commercial city on the Caspian sea, lies the largest petroleum producing district on the Apsheron peninsula, in which are the villages of Sabuntschi, Romani, Balachani and Sabrat. About 2,000 wells in this field have been producing in recent years about 70,000,000 barrels annually.

Heretofore the power for drilling and pumping these wells was generally furnished by twin slide-valve engines of thirty to forty horse-power, which were kept in stock by local dealers by the dozen. Steam for these engines was furnished by central boiler plants at a pressure of about sixty pounds through long lengths of steam pipes leading to the different engines 500 feet or more distant. Only in later years did they take the trouble to cover these pipes, and hence the use of steam was very wasteful. Crude petroleum was burned under these boilers which, at fifteen kopeks per pud (about $1 per barrel), cost per month $450 to $600 per well.

As it is easily possible to distribute electricity at high voltage over a wide field without much loss, it was considered profitable to use this means in the petroleum fields, replacing these wasteful steam plants by motors. This is not only much cheaper in actual operation, but it is much safer from a fire standpoint, and it saves a great deal of space, because the law requires a steam boiler to be at least 130 feet from the nearest well. The law also requires that during the boring of a new well all boiler fires within 328 feet (100 metres) of the well must be extinguished until the well is completed and under control. The saving of space on account of displacing boiler plants is of great importance, especially to small fields, where they utilize all possible space for drilling new wells.

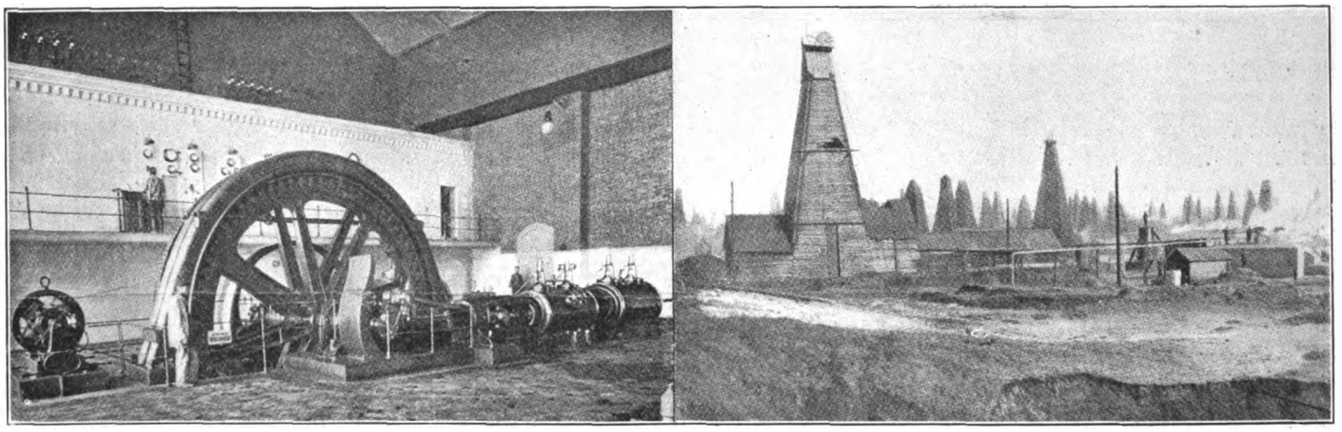
Recently a company was formed for building an electric power plant of 1,500 horse-power in the city of Baku for supplying current to operate the petroleum field. The plant is located about 650 feet from the sea, from which it obtains condensing water. It was not located directly in the petroleum field, because there was no supply of condensing water; and the only source of boiler feed water would have been distilled sea water, which was very salt. Water from wells in that district was not available.

There are four Steinmüller tubular boilers of 3,000 square feet heating surface each, with superheaters in the boiler setting. Steam is furnished at 175 pounds pressure, superheated up to 425 degrees Fahrenheit. Waste product (masut) from petroleum refineries is used for fuel. It is pumped directly from the refineries to two 1,000-barrel tanks near the boiler house, from which it runs to the steam injectors at the furnaces. A small auxiliary boiler of seventy-five square feet heating surface supplies distilled sea water for replacing wastes in connection with the surface condenser. The water from the surface condenser is collected in a cistern in the boiler house, where the cylinder oil is extracted. This feed water is pumped through an economizer of 3,000 square feet, placed in the smoke flues.

The high-pressure steam piping is constructed on the complete ring system, and is so designed that the plant may be enlarged without interfering with continuous operation. There are two triple expansion poppet valve engines made by Ersten Brünner Maschinenbau Fabrik. These are both of the same size, each having two tandem horizontal high and intermediate pressure cylinders, seventeen inches and twenty-seven inches diameter on one end of the shaft, while a low pressure cylinder of forty-three inches diameter is connected to a crank at 120 degrees on the other end. The stroke is forty-three inches, and at eighty-three revolutions the engine delivers 750 horse-power net. Each engine is provided with its own surface condenser. The air pump and circulating pump constitute one machine, installed in the basement of the engine room.

A three-phase alternating-current generator is built on each engine shaft. Each one has a capacity of 700 kilowatts. The voltage is 6,500, at 100 cycles. These generators were manufactured by Allgemeine Elektricitäts-Gesellschaft, of Berlin. A twenty-ton traveling crane with sixty-four-foot span serves the machinery in the engine room. Each generator has its own switch-panel, carrying the necessary apparatus and switches. There are two other panels: one for the phase-indicator, for making parallel connections, and one for the exciter. The exciter is driven by a belt from the engine shaft, as shown in the illustration. The switch panels are of white marble, without iron frames, and are bolted direct over openings in the division wall. All instruments on the front of the switchboards handle low-tension current, while the high-tension levers are behind the division wall in the switching room. In the basement of the switching room are the bus-bar ring system, high-tension fuses, measuring transformers, etc.

Two separate high-tension wire systems are carried on wooden poles seven miles to Sabuntschi, where they enter a tower, and pass down underground. The overhead wiring is well protected with horn lightning arresters, and is provided with wire netting suspended under the wires from pole to pole. The three-core underground cable is lead covered, and has a



INTERIOR OF POWER-HOUSE AND A FOREST OF OIL DERRICKS IN A RUSSIAN PETROLEUM FIELD.

Digitized by Google

cross-section of thirty-five square millimetres for each wire. There are three transformer stations, so arranged that any one of them may be switched from the tower onto either wiring system. In each transformer station there is a group of three transformers, stepping down from 6,000 to 1,100 volts. The secondary current is distributed over the oil fields by lines strung on wooden poles.

When electric motors were first introduced they were generally set up on the old engine foundations, and belted to the rigging, the same as the engine; but it was soon found that owing to great danger from fire it was better to build a separate stone house to contain the motor some ten feet distant from the wooden derrick house. These motors are thirty to fifty horse-power at 1,000 volts, and are specially built for this service. They have two separate field windings; one for starting up and running without load, and the other for normal working. When the motor is started and reaches the proper speed the normal field is automatically switched in. For protection against fire, from gases, the contact terminals are enclosed in air-tight cases.

The power plant was designed and built by the Allgemeine Elektricitäts-Gesellschaft, of Berlin, which also furnished and installed the entire electric equipment.

Three-phase high-tension distribution and motors have proved to be the best adapted for this kind of service. The motors are durable, the most simple, stand variable load, and require the least attention, all of which are most important factors on account of the unskilled labor common in petroleum fields.

Electrical Mining Machinery in South Africa.

In a recent consular report concerning the demand for mining machinery in South Africa, it is stated that a prominent feature in mining gold, tin, etc., in South Africa has been the remarkable increase in the demand for electrically-driven machinery. Hauling, lifting, pumping and lighting are being accomplished by electrical apparatus.

PROGRESS IN THE ELECTROLYTIC ALKALI AND BLEACH INDUSTRY.

BY JOHN B. C. KERSHAW.

INTRODUCTION.

There is no very striking progress to record in the electrolytic alkali and bleach industry during 1904, and the directors of many of the factories in Europe, where these products are made, have found some difficulty in maintaining their plants in full operation. This difficulty has been chiefly due to overproduction in the bleaching powder (hypochlorite of lime) industry, and to the very low prices which can be obtained consequently for this chemical in the open market.

The failure in 1902 to renew the existing sales price agreement between the Le Blanc and electrolytic manufacturers led to a fall of over $9.50 per ton in the price of bleach in Europe in 1903, and although the agreement has been revived during 1904 in a modified form, the price of bleach has not returned to its former level and is still only about twenty-one dollars per ton in Liverpool. The margin for profit on this chemical is therefore small.

Since 2.2 tons of bleach are produced for every one ton of seventy per cent caustic soda by either the Le Blanc or electrolytic processes, the influence exerted by the ruling low price of this chemical upon the economic success of the heavy chemical industry is apparent; and attempts are now being made in many works in Europe to utilize the chlorine evolved from the electrolytic alkali cells in some more profitable manufacture.

Tin crystals, carbon tetra-chloride, pure hydrochloric acid, and a bleaching solution for wood pulp are some of the new chloride products to which those in charge of these works are directing attention; and in addition to these electrolytic chloride is being employed on a very large scale in the manufacture of artificial indigo. The necessity for turning all the by-products of the electrolytic alkali and chloride industry to account has also led to renewed attempts to make some use of the hydrogen escaping from the cathode compartment of the cells; and in Italy this is being employed to produce pure hydrochloric acid, while in Germany it is collected, purified, dried and sold compressed in cylinders for balloon and other purposes. As regards the position of the industry in the various countries, the following notes will be of interest.

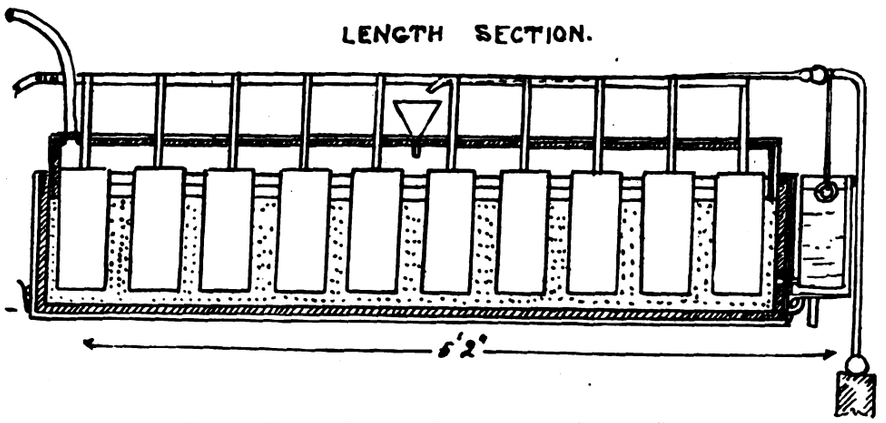


FIG. 1.—THE MCDONALD ELECTROLYTIC ALKALI CELL.

UNITED STATES.

The Castner-Kellner, Acker and Roberts cells are being extensively worked at Niagara Falls, but there is nothing new to report concerning these processes. Caustic potash and pure hydrochloric acid are made by the Roberts process, while caustic soda and bleach are the chief products of the other two companies, which together utilize from 7,000 to 8,000 horse-power. The Acker Process Company, however, has added carbon tetrachloride and tin crystals to its manufactured chlorine products.

The Bell Brothers cell is operated by the Pennsylvania Salt Company at Wyandotte, Mich. This is a mercury process, and the movement of the latter is effected by the pressure of the chlorine in the anode compartment of the cell. According to recent reports, the process is not yet working very successfully.

The Dow cell is of the diaphragm type and is operated by the Dow Chemical Company at Midland, Mich., with a plant having an annual capacity of 20,000 tons bleach. The Moore cell is another diaphragm type of cell, and is in use at the new works of the American Electrolytic Company at Rock Glen, Buffalo, N. Y.

The American Alkali Company, which was formed to work the Rhodin cell and process at Sault St. Marie, shut down its plant toward the end of 1902 owing to the fall in the price of bleach—and litigation followed a call upon the preferred shareholders for further capital. The case was won by the defendants who resisted the call on the ground that misleading statements had been published by the promoters of the company. So far, as the writer is aware, the works of Sault Ste. Marie are still closed.

A new type of diaphragm cell patented by McDonald has been introduced in America, and an installation of eighty cells of this type is in actual operation at the Clarion Paper Mills, Johnsonburg, Pa., and has been described by Ulke. Carbon anodes and iron cathodes are em-

Digitized by Google

ployed, and fifty-seven horse-power is said to yield one ton of bleach. The Standard & Colorado City Chlorination Company is reported to be about to install a large plant of these cells for production of the chloride required in opening up its ores. Figs. 1 and 2 are sectional drawings of the McDonald cell.

UNITED KINGDOM.

The Castner-Kellner Alkali Company and the Electrolytic Alkali Company continue to operate the Castner and the Hargreaves processes at Weston Point and Middlewich respectively, and the two works utilize about 7,000 horse-power in the manufacture of caustic soda and bleach.

The low prices obtained for the latter product during 1903 and 1904, however, have reduced the profits of each company seriously, and dividends have been cut down by the Castner-Kellner Company and passed altogether by the Electrolytic

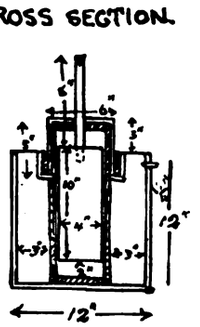


FIG. 2.—MCDONALD ELECTROLYTIC ALKALI CELL.

Alkali Company. The first-named company is now taking up other manufactures, and is devoting some portion of its chlorine to the production of zinc-chloride by the Swinburne-Ashcroft process, while the Middlewich company is devoting some portion of its capital and plant to the manufacture of fine salt; the brine being obtained from its own sources of supply on the property at Middlewich in Cheshire.

FRANCE.

Only two companies are producing alkali and bleach in France by electrolytic processes—namely, the Société Industrelle des Produits Chimiques at La Motte, and the Société la Volta at Montiers. The first employs the Griesheim cell and process, the second the Outhenin-Chalandre cell and process. Owing to the fall in the value of bleach neither company is making much headway, and at Montiers portion of the chlorine is being devoted to the production of carbon tetrachloride.

GERMANY.

There is little that is new to report concerning the progress of the industry in Germany. The Aussig bell (gravity) cell is stated to be in successful operation at Bitterfeld, at Grappin, and at Salbe-Westerhüsen. The Bitterfeld and Rheinfelden companies have amalgamated, and the capital of the former company has been increased in order to take over the shares of the Rheinfelden company. The dividend of the Chemische Fabrik Griesheim (the parent Electrolytic Alkali Company in Europe), which patented and exploited the "elektron" cell and process, estimated to be eleven per cent for the year 1903, but as this firm manufactures many chemicals other than caustic alkalies and bleach, it would be a mistake to assume that this profit had been earned solely by the manufacture and sale of the heavy chemicals. A considerable revenue is no doubt derived from royalties on the "elektron" cell and process, which is used in a very large number of subsidiary works in Germany, France and Russia. The great German dye works of the Baden Anilin and Soda Fabrik are reported to have a 3,500-horse-power plant in operation, using the Griesheim cell; the soda and chlorine produced being utilized on the spot in the manufacture of organic chemicals and dyes. The German Electrolytic Alkali Works is estimated to produce 50,000 tons bleach per annum, and to waste 500 tons of hydrogen.

RUSSIA.

The progress of the electrolytic alkali industry in Russia, as in the case of all skilled industries, has been hampered during 1904 by the war, and no information has been published relating to its present position and prospects. Two works were in operation at the commencement of the year at Zombkowice and at Slaviansk the former using the "elektron" cell and process, and the latter that patented and exploited by the Bitterfeld Company. Probably both of the works have been shut down, owing to the calling out of the reserves.

AUSTRIA.

Some modification of the Kellner mercury cell and process is operated at Hallein, but no reliable information concerning this plant, which has over 3,000 horse-power available, has been published. The chlorine is probably used on the spot in the manufacture of wood pulp. At Aussig 1,400 horse-power is utilized by the bell (gravity) type of cell, and early in 1904 another 800-horse-power unit of plant was reported to be in course of erection at these works.

ITALY.

A modified form of the Outhenin-Chalandre cell and process is worked at Piano by the Sociéta Elettrochimica Italiana and 6,000 horse-power is reported to be utilized by this company in the manufacture of alkali and bleach, chlorates, carbon tetrachloride and pure hydrochloric acid. The same company has another works at Bussi where only the heavy chemicals—caustic soda and bleach—are produced, the capacity of this plant being 3,000 tons caustic soda and 6,000 tons bleach per annum. Elter in a recent report upon electrochemical industry in Italy states that the financial results of these works have been disappointing, owing to the unfavorable position of the factories, and the high price of salt. This non-success has reacted upon the development of other schemes for utilizing the enormous water power of Italy in the alkali and chlorine industry.

SPAIN.

An electrolytic alkali works using the Griesheim "elektron" cell and process has been in operation at Flix on the Ebro since 1899. The output of caustic soda is estimated to be 2,500 tons per year, and since Spain imports 30,000 tons annually of this chemical, there should be ample room and opportunity for expansion of the industry.

Important contributions to the theory of the alkali chloride cell have been published during 1904 by Steiner, Guye and Adolp and will be found in the issues of the *Zeitschrift für Elektrochemie* for May and July, 1904, and abstracted in the *Elektrochemische Technik*. Steiner's investigation related to the bell (gravity) type of cell. This chemist found as the result of his laboratory investigations that a current efficiency of between eighty-five and ninety-four per cent could be maintained with an electromotive force of 3.7 to 4.2 volts, and a current density of two to four amperes per square diameter centimetre. Under these conditions a concentration of 130 grammes per litre of potassium-hydrate could be attained. The vertical distance of the lower anode surface from the edge of the bell was found by Steiner of great importance in its bearing on the results obtained with this type of cell.

A German medical commission has also reported during 1904 upon the curious skin disease known as "chlorine-ache," to which men engaged in electrolytic alkali works in Germany are subject. Frequent lime-washing of the walls, and of the floors of the room containing the electrolytic cells, is recommended as the best preventative of this troublesome disease; the moist calcium hydrate absorbing the gaseous chlorine compounds which appear to give rise to it.

Digitized by Google

TEST OF A 5,000-KILOWATT ALTERNATOR.[1]

BY L. L. GAILLARD.

The following paper is intended to give a general description of the series of tests made on each of the alternators installed in the Seventy-fourth street (Manhattan) power station of the Inter-

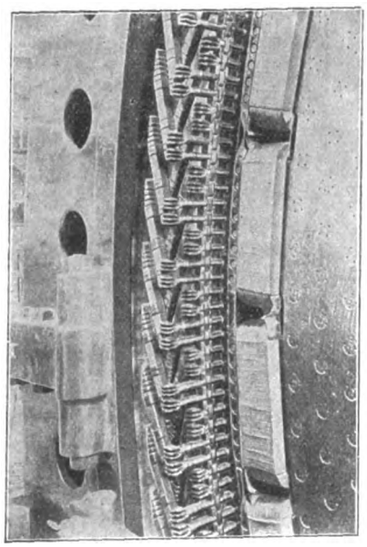


FIG. 1.—ARMATURE AND CONNECTIONS, SHOWING WOODEN BLOCK BRACING BETWEEN COILS.

borough Rapid Transit Company, of New York city. The object of the tests was to obtain characteristic curves of the machines and to determine how nearly they conformed to the contract requirements and the manufacturer's guarantee.

Each machine is a 5,000-kilowatt, 11,000-volt, twenty-five-cycle, seventy-five revolutions per minute Westinghouse alternator, direct-connected to a double horizontal-vertical Allis compound engine.

It may be well to preface the account of the tests with the following extracts

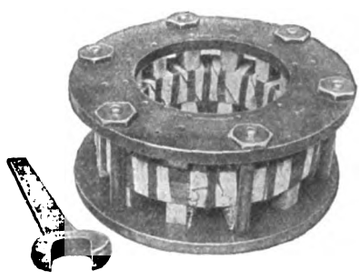


FIG. 2.—LAMINATED RING AND CLAMPING DEVICE FOR DETERMINING QUALITY OF IRON USED IN THE MANHATTAN ALTERNATORS.

from the contract specifications giving certain data obtained from the calculations of the manufacturer, and certain guarantees upon which was based the acceptance or rejection of the machine by the purchaser.

A guaranteed full-load efficiency of 96.5 per cent, to meet which guarantee the total permissible losses in the alternator are therefore 181,300 watts.

The full-load field current equals	202.0	amps.
The full-load armature current equals	263.0	amps.
The armature copper loss equals: $263^2 \times 0.4 =$	27667.0	watts.
The field resistance equals	0.85	ohm.
The resistance of the armature equals	0.4	ohm.
The field copper loss equals: $202^2 \times 0.85 =$	34683.0	watts.
Total copper losses =	62350.0	watts.
Total allowable iron losses, based on 96.5 per cent full-load efficiency, =	118950.0	watts.

The efficiency on non-inductive load will be:

	Per Cent.
At one-quarter load = not less than	90.00
At one-half load = not less than	94.50
At three-quarters load = not less than	95.50
At full-load = not less than	96.50
At 25 per cent overload = not less than	97.00

The efficiencies are based on I^2R loss in the armature and field coils and on the armature iron loss. Friction is not included.

The current in the armature when short-circuited with normal no-load field current, will equal three times full-load current.

The regulation at 100 per cent power-factor will equal 6 per cent.

After running for twenty-four hours at full load at 100 per cent power-factor, the rise in temperature in no part will exceed thirty-five degrees centigrade; and at twenty-five per cent greater load, with the same power-factor, for twenty-four hours, the rise in temperature will not exceed forty-five degrees centigrade.

The following measurements and tests were made on the alternator:

Measurement of armature iron loss. Resistance of armature winding. Resistance of field winding. I^2R loss in armature. I^2R loss in field. Efficiency at various loads. No-load saturation curve. Short-circuit characteristic. Regulation (calculated). Insulation puncture test. Temperature rise under load.

Armature Iron Loss—It being entirely impracticable to measure this loss in the usual manner, the following interesting method was adopted:

The alternator armature is built up of the following amounts of sheet steel worked at magnetic inductions given below:

234,000 cubic inches, 90 per cent solid,	@ 65,500	centimetre-gramme-second lines per square inch.
16,500 " " "	@ 91,100	" " "
20,300 " " "	@ 76,500	" " "

The iron losses were determined from a measurement of the losses in sample rings made from the material of which the armature was built up. These samples were annealed in the ovens with the armature laminations, were painted the same as these laminations, and then built up into test rings and compressed until their volume contained ninety per cent solid metal. The rings were then wound for test purposes and the losses at the different inductions mentioned above, were measured with a sensitive wattmeter.

The dimensions of the test samples were: outside diameter, twelve inches; inside diameter, eight inches; thickness (compressed to ninety per cent solid), two inches; cross-section, two inches by two inches, four square inches; mean circumference, 31.416 inches; volume, 125.66 cubic inches.

The calculations of ninety per cent solid material in samples were based upon specific gravity tests made on samples cut from the steel bars from which the sheets were rolled. The average specific gravity of several samples was 7.847, which gives 3.91 cubic inches per pound

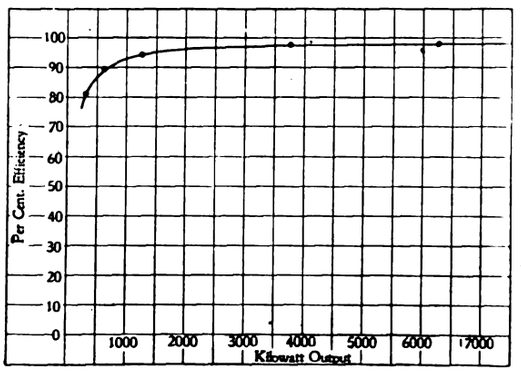


FIG. 3.—EFFICIENCY CURVE OF A 5,000-KILOWATT, 11,000-VOLT ALTERNATOR.

for ninety per cent solid material. The weight of the sample, on the basis of these calculations, should therefore be 32.13 pounds.

About twenty sample rings were built up and each sample was wound with seventy-two turns of No. 18 B. & S. annunciator wire, wound in twelve groups of one layer, and six turns each, with the groups symmetrically disposed around the circumference of the ring.

The iron loss in each sample was measured at each of the three inductions mentioned above, *viz.*:

	C.-G.-S. lines per sq. in.		C.-G.-S. lines per sq. cm.
(*a*)	65,500	=	10,155
(*b*)	91,100	=	14,124
(*c*)	76,500	=	11,860

The voltages required for each of the three inductions at 3,000 alternations were obtained from the following calculations:

B = maximum induction per square centimetre.
E = effective volts.
n = periods per second.
t = number of turns.
a = sectional area in square centimetres.

$$E = \pi\sqrt{2}\, a\, n\, t\, B\, 10^{-8}.$$

Reducing this formula to area in square inches and alternations per minute, we have:

$$E = .2388\, a'\, n'\, t'\, B\, 10^{-8}.$$

Where a' = sectional area in square inches = 4
n' = alternations per minute = 3000

The voltage at the various inductions is then as follows:

(*a*) $E = 0.2388 \times 4 \times 3{,}000 \times 72 \times 10{,}155 \times 10^{-8} =$ 20.96
(*b*) $E = 0.2388 \times 4 \times 3{,}000 \times 72 \times 14{,}124 \times 10^{-8} =$ 29.15
(*c*) $E = 0.2388 \times 4 \times 3{,}000 \times 72 \times 11{,}860 \times 10^{-8} =$ 24.48

[1] The Electric Club Journal, May, 1905.

Digitized by Google

The losses in the samples were measured by carefully calibrated instruments, and the alternator used for supplying current for the purposes of the test gave a wave of almost exactly sine form.

The average results of measurements on the twenty samples were as follows:

(*a*) 0.1340 watt loss per cubic inch.
(*b*) 0.2220 watt loss per cubic inch.
(*c*) 0.1724 watt loss per cubic inch.

The total watt loss in the armature was, therefore, as follows:

	Watts.
(*a*) 234,000 × 0.1340 =	31,380
(*b*) 16,500 × 0.2320 =	3,821
(*c*) 20,300 × 0.1724 =	3,492
Total	38,693

The impracticability of making an accurate determination of the iron losses after the machine had been assembled is to be regretted, as the method adopted and just described contains probabilities of error which can not be predetermined or eliminated. The armature casting is made in six sections and the sheet-steel laminations are each no greater than six feet in length, thus making in the magnetic circuit six butt and numerous lap-joints. The losses due to these breaks in the magnetic circuit are, of course, neglected when the determination of the iron losses is made in the manner just described, but it is probably that they are of so small a value when compared with the total losses as to be negligible.

Resistance Measurements of Armature and Field—These measurements were made by the usual drop-of-potential method, the temperature of the winding and of the room being observed. The resistances as mentioned were then calculated for a room temperature of twenty-five degrees centigrade and the I^2R losses calculated on this basis.

Resistance of armature:

Phase 1—2 R = 0.2325 ohm at 25 degrees C.
" 2—3 R = 0.2332 " 25 "
" 1—3 R = 0.2329 " 25 "

2 times combined resistance of three phases = 0.2325 + 0.2332 + 0.2329 = 0.6986.

Total armature resistance therefore equals $\frac{0.6986}{2} = 0.3493$ ohm.

Resistance of field at 25 deg. C. = 0.8206 ohm.

Efficiency—As noted above the efficiency is based on the armature iron losses and the field and armature I^2R losses. The iron losses were determined as described above, and from the resistance values as obtained by measurement, the I^2R losses in field and armature have been calculated for various loads from twenty-five per cent to 125 per cent of full rated load. These appear in tabulated form below, and following in a curve plotted from the calculated efficiencies.

In calculating the field I^2R loss, 208.1 amperes was used as full-load field current, this value being obtained in the following manner:

	Amps.
Field current corresponding to terminal voltage on open circuit plus armature resistance drop =	198.5
Field current necessary to give full load armature current or short-circuit, =	62.5
Full-load field current is the vector sum of above, or	208.1

	¼ Load.	½ Load.	¾ Load.	Full Load.	1¼ Load.
Iron loss.....kw.	38.69	38.69	38.69	38.69	38.69
Armature I^2R loss..... "	1.51	6.04	13.59	24.16	37.75
Field I^2R loss..... "	35.54	35.54	35.54	35.54	35.54
Total losses..... "	75.74	80.27	87.82	98.39	111.98
Output..... "	1250.00	2500.00	3750.00	5000.00	6250.00
Input..... "	1325.74	2580.27	3837.82	5098.39	6361.98
Efficiency.....per cent	94.29	96.50	97.71	98.06	98.24

No-Load Saturation—The no-load saturation curve was obtained in the following manner:

The alternator field was excited from a 250-volt steam-driven generator running at constant speed. The alternator, with its armature circuit open, was brought to full speed with the engine on the throttle, and held at this speed while the measurements were made. Simultaneous readings of volts field, amperes field, volts armature and speed were taken. The instantaneous reading of speed were made by means of a frequency indicator which had been previously carefully calibrated. Below is given in tabulated form the instrument readings from which the saturation curve has been plotted. As some of the readings were taken at a frequency higher than twenty-five cycles (due to the engine speeding up), the armature volts at these points were corrected for this difference in speed by decreasing them in proportion to the increase in speed.

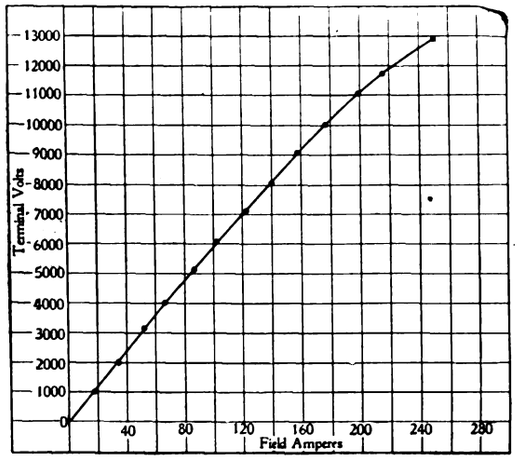


FIG. 4.—RUNNING SATURATION OF A 5,000-KILOWATT, 11,000-VOLT MANHATTAN ALTERNATOR.

Frequency.	Amperes Field.	Volts Field.	Volts Armature. Observed.	Volts Armature. Corrected.
25.0	17.5	15.3	1,000	1,000
25.0	33.5	29.4	1,963	1,963
25.0	51.4	44.8	3,140	3,140
25.0	66.0	57.3	4,010	4,010
25.0	86.0	74.5	5,150	5,150
25.0	101.8	87.3	6,100	6,100
25.2	121.8	103.5	7,190	7,133
25.2	139.0	117.8	8,120	8,055
25.2	157.2	134.8	9,150	9,077
25.2	176.2	150.0	10,100	10,019
25.2	198.0	168.5	11,160	11,070
25.5	214.0	183.0	11,970	11,640
25.2	249.2	218.0	13,020	12,916

Short-Circuit Characteristic—For this test the armature terminals were short-circuited, the alternator run at full speed and the armature current measured at different values of field current. The tabulated readings and the curve plotted from them are given below:

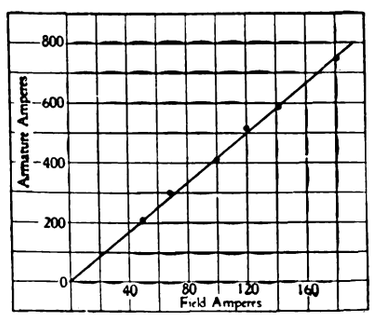


FIG. 5.—SHORT-CIRCUIT CHARACTERISTICS OF A 5,000-KILOWATT, 11,000-VOLT MANHATTAN ALTERNATOR.

Speed R. P. M.	Field Amperes.	Field Volts.	Armature Amperes.
75	50.0	36.0	210.0
75	68.0	50.0	300.0
75	100.0	74.5	411.6
75	120.2	89.5	516.0
75	141.2	105.5	588.0
75	181.0	140.5	744.0
75	193.3	158.0	798.0

Insulation Test—The contract specifications required that after the machine had been assembled the insulation of the field winding from the frame should be subjected to a puncture test of 2,500 volts alternating electromotive force for a period of one minute, and that the insulation of the armature winding from the frame should be tested at a potential of 25,000 volts for thirty minutes.

As the armature coils had been exposed to moisture for some time before being

Digitized by Google

assembled, it was thought advisable to give them a drying out before subjecting them to the puncture test. For this purpose the armature was short-circuited and the machine run at about two-thirds full speed with sufficient field current to give about 500 amperes in the armature. This heat run was kept on for about sixty hours, then the machine was shut down and the windings carefully wiped off and allowed to cool to the temperature of the room before the insulation test was made.

The insulation tests were made by using a 250-kilowatt, 40,000 : 360-volt twenty-five-cycle oil-cooled transformer, the low-tension winding of which was connected in series with a water rheostat to the 400-volt, twenty-five-cycle station bus-bars. The potential on the high-tension side of the transformer was measured with a 50,000-volt electrostatic voltmeter which had been previously calibrated.

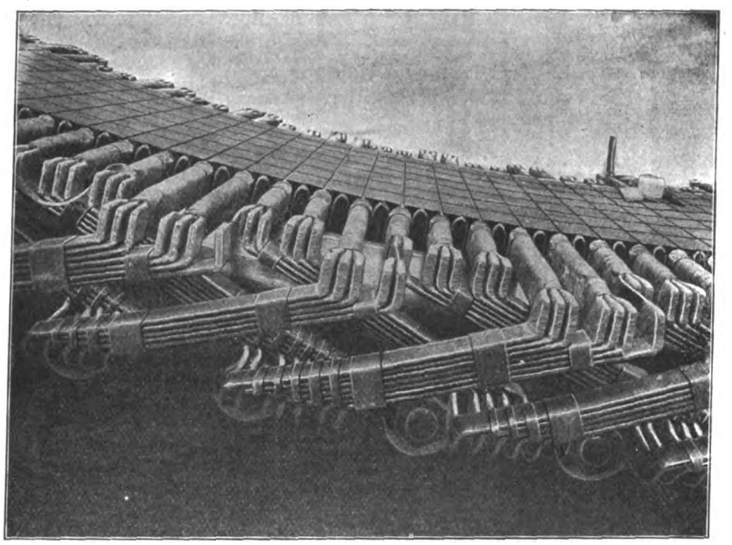


FIG. 6.—END CONNECTIONS OF ARMATURE WINDING.

It may be of interest to note that when the test potential was first raised to 25,000 volts, and for some minutes thereafter, a considerable static discharge was noticed taking place over the surface of the windings. As the test was prolonged, this static discharge gradually decreased in intensity until after the lapse of about twenty minutes it almost entirely disappeared.

Regulation—The specifications for this machine provide that "a load of 263 amperes per terminal at 11,000 volts electromotive force and at 100 per cent power-factor may be thrown off, and the electromotive force will rise six per cent with constant speed and constant excitation."

It has not been found convenient to make an actual measurement of the regulation of the machine, but from the data and characteristic curves it has been calculated. This calculation was made by the usual magnetomotive-force method and the regulation was found to be 4.5 per cent. This figure is undoubtedly too small as this method of calculation invariably gives results more favorable to the machine than those obtained from actual test.

Temperature Measurements—A number of determinations of the temperature rise in field and armature conductors and in armature laminations were made after the machine had been running under load for a sufficient length of time to have reached a constant temperature.

The following results represent the average rise in temperature above the surrounding air of the various parts of the machine after a run of seventeen hours at an average load of 5,000 kilowatts.

Temperature rise above air:

Field winding	22.5 degrees centigrade.
Armature winding	22.6 " "
Armature laminations	25.5 " "

The performance of the eight alternators, of which this one is representative, has been so excellent and the temperature so greatly below the guarantee, that their rating has been increased from 5,000 to 6,000 kilowatts.

Testing Synchronizing Connections—After the first machine had been installed it became necessary to make sure of the correctness of the synchronizing connections of each of the others as it became ready for operation. For synchronizing, dark lamps and a dial synchronizer are used.

To make an absolutely certain test of the synchronizing connections, the following interesting method was adopted: when the second machine was ready for service, the main switches of both Nos. 1 and 2 were closed, tying the machines to the bus. Full-load field current was put on each alternator and both engines were started simultaneously and slowly brought to full speed together. If the lamps remained dark and the synchronizer indicated exact synchronism, no better check could be had on all connections. Had there been any wrong connections in the armature circuit of one machine, making a short-circuit when the two machines were tied together, this would have been indicated on the ammeter in the armature circuit immediately after the machines started. The relay would also have operated immediately to open the armature switch.

After the two machines had been brought to full speed (tied together) they were then cut apart and synchronized in the usual manner. This method was used with great success on all the machines, a separate bus-bar being used for the purpose.

World's Copper Production.

Under date of March 13, 1905, United States Consul R. M. Bartleman, of Seville, Spain, transmits the following statistics of the world's copper production for the last three years, being the translation of an article which appeared in the *Revista de Economia y Hacienda*, Madrid, of March 11. The figures for 1904, although not absolutely accurate, have been obtained through the most reliable source.

THE WORLD'S PRODUCTION OF COPPER IN 1902, 1903, AND 1904.

Country.	1902. Metric Tons.	1903. Metric Tons.	1904. Metric Tons.
United States	294,297	311,536	349,866
Mexico	35,785	45,315	52,500
Spain and Portugal	49,790	49,740	50,000
Chile	28,980	31,100	33,000
Japan	28,775	31,360	32,000
Australia	28,640	29,000	30,000
Germany	21,605	21,205	21,500
Canada	17,485	19,320	21,500
Russia	8,000	10,390	10,000
Cape Colony	4,450	5,230	7,250
Peru	7,580	7,800	7,000
Norway	4,565	5,915	6,000
Italy	3,370	3,100	3,250
Newfoundland	2,000	2,060	2,000
Bolivia	2,000	2,000	2,000
Austria-Hungary	1,500	1,385	1,500
Turkey	1,100	1,400	1,500
Miscellaneous	1,295	1,060	1,300
Total	542,167	578,876	632,166

Spain, which twenty-five years ago was first in the world's production of copper, now ranks third.

The development which has taken place in the world's production of copper since the beginning of the nineteenth century may be observed as follows:

WORLD'S PRODUCTION OF COPPER BY DECADES, FROM 1800, AND IN THE PERIOD 1901-1904.

Period.	Production. Metric Tons.	Increase. Per Cent.
1801-1810	91,000	....
1811-1820	96,000	5
1821-1830	135,000	41
1831-1840	218,400	60
1841-1850	291,000	28
1851-1860	506,999	80
1861-1870	900,000	77
1871-1880	1,189,000	32
1881-1890	2,273,398	86
1891-1900	3,708,901	63
1901-1904	2,369,199	58

Digitized by Google

New York State Independent Telephone Association.

The annual convention of the New York State Independent Telephone Association will be held at the common council chamber, City Hall, Albany, N. Y., June 16. A good programme has been prepared, and from the present indications the attendance will be large.

The officers of the association are as follows:

H. H. Persons, president, Buffalo, N. Y.

Howard Hendrickson, vice-president, Albany, N. Y.

Boyd McDowell, second vice-president, Elmira, N. Y.

T. Harvey Ferris, treasurer, Utica, N. Y.

T. S. Lane, secretary, Buffalo, N. Y.

The members of the executive committee are H. H. Persons, Buffalo, N. Y.; Geo. R. Fuller, Rochester, N. Y.; B. G. Hubbell, Buffalo, N. Y.; Edward Davis, Binghamton, N. Y.; S. B. Rawson, Albany, N. Y.; J. S. Brailey, Jr., Utica, N. Y.; C. H. Poole, Utica, N. Y.; T. B. Basselin, Croghan, N. Y.; F. M. Potter, Jr., Syracuse, N. Y.; J. F. Stockwell, Oswego, N. Y.

Some very effective work has been done throughout the state during the past year by the organization of district associations, which form a part of the state association. The following districts have been organized:

Buffalo, H. H. Persons, Buffalo, N. Y., chairman; T. S. Lane, Buffalo, N. Y., secretary.

Rochester, Geo. R. Fuller, Rochester, N. Y., chairman; F. S. Bronson, Geneva, N. Y., secretary.

Hornellsville, H. M. Bennet, Hornellsville, N. Y., chairman; C. M. Kelly, Hornellsville, N. Y., secretary.

Binghamton, J. B. Marquis, Jr., Norwich, N. Y., chairman; M. L. Sternberg, Lisle, N. Y., secretary.

Albany and Troy, W. L. Burke, Troy, N. Y., chairman; S. M. Strong, Schenectady, N. Y., secretary.

Jamestown, W. H. Homewood, Jamestown, N. Y., chairman; John H. Wright, Jamestown, N. Y., secretary.

Syracuse, F. M. Potter, Jr., Syracuse, N. Y., chairman; H. W. Fluhrer, Auburn, N. Y., secretary.

The Gas Turbine.

The gas turbine invented by Stolze has been described by Dr. Alfred Gradenwitz. The principle of this turbine is not new, as it was described by M. E. Redtenbacher in his treatise on the heat engine in 1853, and in 1872 Dr. Stolze showed how it might be applied in the fire turbine which he invented at that time. He was unable to obtain a patent covering his invention, and abandoned it temporarily; but when the steam turbine was brought forward so successfully, Dr. Stolze again presented his invention to the Prussian patent office, and a patent was granted. The principle employed is this: a certain quantity of air is drawn into a vessel and compressed to about one and one-half atmospheres above atmospheric pressure. It is then heated and allowed to expand at the same time, so as to maintain a constant pressure, until the volume has increased from two to two and one-half times. This air is then expanded further until it reaches atmospheric pressure, when it is discharged and the cycle repeated. To apply this cycle to a turbine, air is drawn in and compressed by means of a turbine driven as an air-compressor. This air is then passed through a reheater, which is heated by the exhaust gases. A small part of the air thus heated is used to maintain the combustion of the fuel employed, and the remainder is mixed with the heated products of combustion. This hot mixture is then allowed to expand through the turbine to atmospheric pressure. In the arrangement adopted there are ten discs in the air-compressor, and fifteen stages in the turbine. A calculation of the theoretical efficiency of the system shows that it may be as high as thirty per cent. By changing the cycle somewhat and allowing the gases to expand isothermally, an increase in efficiency is thought to be possible. The advantages of this turbine, as compared with a reciprocating gas engine, are the possibility of using any kind of fuel—coal, gas or oil; and the absence of water-jackets, which cause such great loss of heat in the reciprocating gas engine.—*L'Electricien (Paris), May* 6.

Telephone Apparatus for the War Department.

Brigadier-General A. W. Greely, chief signal officer of the United States Army, announces that on June 1, or as soon thereafter as possible, advertising for proposals for furnishing the signal corps of the army with telephone apparatus to the value of approximately $75,000 will be issued.

Models of practically all of this equipment may be seen in the signal corps model room, Washington, D. C., and drawings and specifications are under preparation. Representatives of manufacturers should call upon Major Edgar Russel, officer in charge of electrical division, Lemon Building, Washington, D. C., for permission to inspect the models.

American Institute of Electrical Engineers.

ASSOCIATES ELECTED APRIL 28, 1905.

Harry Louis Bachman, Columbus, Ohio.
Christopher G. S. Bagot, Worcester, Mass.
Edward Stuart Baker, Lynn, Mass.
Philippe F. Ballinger, Long Branch, N. J.
Edward Hugh Bangs, Indianapolis, Ind.
Magnus Beckman, Linköping, Sweden.
John T. Robb Bell, New York city.
James W. Brown, Connellsville, Pa.
J. S. St. George Cooper, Manchester, England.
Leonard P. Coulter, Milwaukee, Wis.
Isidor Deutsch, Cleveland, Ohio.
Horatio A. Dresbach, Jersey City, N. J.
E. W. Farley, Niagara Falls, N. Y.
Russell S. Feicht, Pittsburg, Pa.
Louis Friedmann, Chicago, Ill.
William R. Garton, Chicago, Ill.
George Gibbs, New York city.
Henry C. Harris, Columbus, Ohio.
Harvey Edgar Heller, Salamanca, N. Y.
Philip Edgar Henninger, New York city.
Henry A. Hildebrand, Brooklyn, N. Y.
Chester D. Hubbard, New London, Ct.
Fred L. Hunt, Schenectady, N. Y.
Herbert Chanock Jennison, Ansonia, Ct.
George Karl Kaiser, Wilkinsburg, Pa.
Matthew G. Kennedy, Philadelphia, Pa.
Walter E. Kern, Washington, D. C.
Frank Fairchild Kinney, Chicago, Ill.
Nathan Kohn, St. Louis, Mo.
J. A. Lauberstein, Great Barrington, Mass.
Alan C. Macdougall, Massena, N. Y.
Norman Malcolm, Chicago, Ill.
William B. Malloy, Great Barrington, Mass.
Louis J. Mathis, Newark, N. J.
Marshall Andrews Maxwell, Easton, Pa.
Charles Palmer Merrill, Washington, D. C.
Richard Gilbert Morle, Schenectady, N. Y.
Henry C. Meyer, Montclair, N. J.
Irving Heward Nevitt, Toronto, Ontario.
Coleman Evan Nutter, Topeka, Kan.
Hiroyoshi Oshima, Osaka, Japan.
Glover Fitzhugh Perin, Brooklyn, N. Y.
Thomas Steel Perkins, Wilkinsburg, Pa.
Frederick J. Pestell, New York city.
John M. Plaisted, Columbus, Ohio.
Frederick Hedge Poor, Schenectady, N. Y.
Thomas B. Reid, Great Barrington, Mass.
Charles Reutlinger, Baltimore, Md.
Harry Curtis Rice, Pittsfield, Mass.
W. Arthur Ruggles, Camden, N. J.
Fred William Schiller, Utica, N. Y.
William Arthur Scott, Pittsfield, Mass.
Paulding Foote Sellers, Buffalo, N. Y.
Thomas Gracen Seidell, Atlanta, Ga.
Joseph Emory Sirrine, Greenville, S. C.
Frank Whitney Smith, Brooklyn, N. Y.
Almon Beede Stetson, Malden, Mass.
Joseph Gordon Swain, Wilkinsburg, Pa.
Edward Taylor, Brooklyn, N. Y.
George La Rue Thompson, Philadelphia, Pa.
Wray Thompson Thorn, Chicago, Ill.
William Arthur Tower, Baltimore, Md.
Howard Mason Van Gelder, New York city.
Theodore Varney, Pittsburg, Pa.
William J. Walker, Brooklyn, N. Y.
Frederick C. Warman, Washington, D. C.
Karl William Waterson, Boston, Mass.
George Augustus Wells, New York city.
Frank Wenner, Ames, Iowa.
Gerard B. Werner, New York city.
Arthur S. Wheeler, Berkeley, Cal.
Leonard E. Wheeler, Great Barrington, Mass.
William A. Whittlesey, Jr., Pittsfield, Mass.
Brent Wiley, Cleveland, Ohio.
Joseph L. Woodbridge, Philadelphia, Pa.
H. W. Young, Boston, Mass.

Digitized by Google

Paxtang Power Plant Unharmed by Explosion.

On May 11, the day of the disastrous Harrisburg (Pa.) train wreck, the following telegrams were exchanged:

F. W. HAMBLIN, General Manager,
Paxtang Electric Company,
Harrisburg, Pa.

Papers report your plant badly damaged. Wire us if there is any way we can assist.
J. G. WHITE & COMPANY.

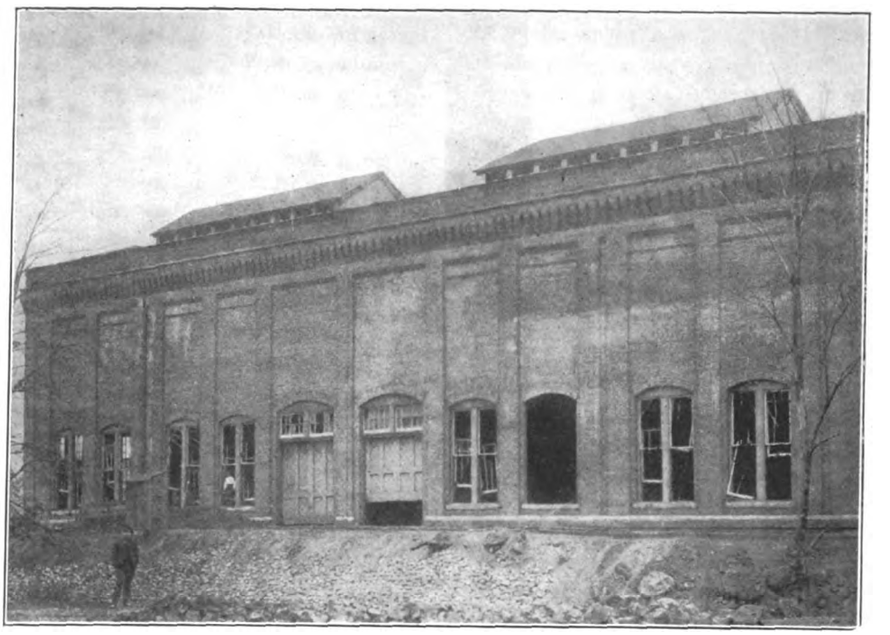
J. G. WHITE & COMPANY,
43 Exchange place. New York

Thanks to substantial construction only damage all windows blown out. No interruption in service.
F. W. HAMBLIN.

It seems truly remarkable that none of the electrical machinery was in any way deranged despite the fact that when the two trains collided 50,000 pounds of dynamite exploded not more than 150 feet away from the power-house. The accompanying photograph of the power-house gives evidence of the force of the explosion. Hardly a pane of glass was left intact and even the window frames were blown in. A count showed that over 1,000 panes of glass were shattered, covering the engines, generators and machinery with finely broken glass. Graphic testimony that the operation of the plant was in no way affected is afforded by the accompanying reproduction of the voltmeter card for the twenty-four-hour period during which the explosion occurred. A momentary deviation of the pen, caused by the concussion, is the only irregularity on the card not traceable to operating conditions.

A careful examination has been made of the foundations, but no trace of damage can be discovered. Even if slight cracks should develop here and there, the foundations would still be perfectly waterproof as they are protected by hydrex felt which, being tough and elastic, would permit of considerable cracking of the foundation without itself rupturing.

The Paxtang power-house was designed, built and equipped by J. G. White & Company, and commenced operation in September, 1903. It contains one 300-kilowatt and four 500-kilowatt, two-phase generators, the power being used for lighting purposes. A transmission line carries the current from the main station to a substation located in the centre of the town, from which part of the power is distributed by the Edison direct-current system and the balance by two-phase alternating-current distribution.



POWER-HOUSE OF PAXTANG ELECTRIC COMPANY AFTER DYNAMITE EXPLOSION NEARBY.

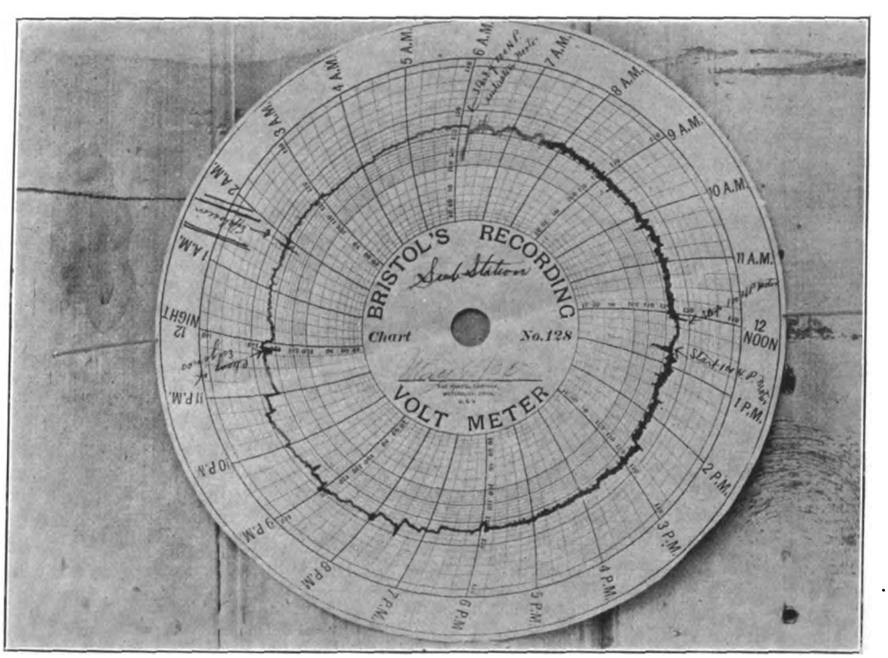
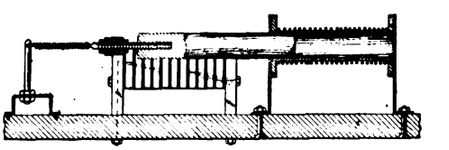


CHART SHOWING BEHAVIOR OF ELECTRICAL MACHINERY AT THE TIME OF DYNAMITE EXPLOSION OPPOSITE POWER STATION.

An Automatic Current Regulator.

A patent on an automatic electric current regulator has been recently granted to Thomas A. Swarts, of Columbus, Ohio (789,822, May 16, 1905). The object of the invention is to provide an improved current-regulating system adapted for use where the supply current is subject to variations. In the present invention, the system comprises a feed element and a potential regulating device having parallel series of contact points with the feed element connected to the contact point at one end of one of the series. A solenoid is connected to the corresponding contact of the other series. A core works in this solenoid and cooperates with the series of contact points. Means are provided for regulating changes in the load, this means having parallel series of contact points with a contact point of one series connected with the solenoid. A conductor leads away from a contact point of the opposite series. A solenoid is connected to the feed element and has a core working between and in cooperative relation with the second mentioned series of contact points.



AUTOMATIC ELECTRIC CURRENT REGULATOR.

Digitized by Google

PUBLICITY AS AN AID TO MANUFACTURERS.[1]

BY ARTHUR WARREN.

A department of publicity is a trade scout. It goes out in advance, a long way in advance, of the army of salesmen, and stirs up the possibilities of business.

* * *

When I talk of "publicity" let it be understood that I mean publicity in and for the industrial world, and that portion of the industrial world which concerns itself with engineering in many of the most important branches. Some kinds of business depend entirely upon publicity. They are businesses which cater for the populace. You can not compare their methods with the dissimilar and rather more scientific methods of an engineering company such as I have the honor to represent, a company which designs and produces both the great and the small in power engines, pumping engines, hoisting engines, blowing engines, steam turbines, hydraulic turbines, gas engines, air-compressors, electrical machinery, mining machinery, flour-mill machinery, sugar machinery, sawmill machinery, in brief a mechanical list which would measure a yard in length in nonpareil type.

* * *

Order is the first law of heaven and publicity. So we have to plan an effective system to get effective publicity. A good part of efficiency is promptness. And to be prompt you must plan ahead.

My notion of a department of publicity is that it is a sort of newspaper, and its management is not unlike that of a great newspaper. I had the good fortune to be brought up in a great newspaper establishment, under one of the ablest editors this country ever knew, and in publicity, my endeavor has been to combine the best newspaper methods with the best methods of the industrial world. How far short of this ideal the result falls no one knows so well as I, and, on the other hand, no one is more clearly aware of the difficulties in the path.

But difficulties exist in order that we may overcome them. When we have overcome them all we shall be ready to enter upon that state of perfect bliss where there is no more publicity.

* * *

Happily, those publishers who scorn publicity do not represent the most progressive element in the trade journal world. Happily, there are exceptions to the rule of mystery and dread: we know them, the men who have the courage to stand upon the merits of their journals. They are the men with whom we should do business; theirs are the papers we should seek. The stronger they are the better for our work. With such publishers a publicity department cooperates. We can help the live publishers and they can help us. They know it and we know it.

* * *

Publicity brings business. Manufacturers who do not buy publicity as liberally as they buy other selling facilities will some day have to take their places at the rear of the procession. The manufacturer who does not provide a publicity department of his own, small or large, and push it and develop it as he does any other branch of his business, is neglecting a great and profitable opportunity.

* * *

Everybody, once in a while, is curious regarding "follow-up-systems." I am trying to invent one. It is not perfect, but it has its good points. I have never known a perfect system, whether of "following-up" or of anything else. No system, whether it be of business, of government, or philosophy, is better than the men who work it. Most "follow-up-systems" are too complicated; they entail too much clerical labor. A "follow-up-system" that produces results without complexity is a good trade-getter. But it must be adapted to the special needs of a business. The reason so many systems break down is because they are imitations of what other people do. No system is effective without brains behind it. You must not only "follow up" your public, but you must follow up your system.

* * *

Don't take a narrow view of publicity. Don't swamp productive work with clerical work. A general in command can not fire the guns, can not count the ammunition used in battle, and can not tabulate the list of slain and of wounded—on the other side.

Advertising, whether direct or indirect, must be done generously if it is to bring results. The chief thing is to let the world know who you are, where you are, and what you are doing; and you can not do this on a large scale by stopping to take a census every time you fire a volley.

I am a believer in direct advertising, as well as in indirect; in the mailing list, as well as in the best trade journals. Each does what the other can not do. Each is essential.

* * *

A company's printed matter is a measure of the company's standing. It can not be too good. The best is the cheapest. Anything else puts you in a poor light. Tons of printed matter go out from all the advertisers in the country. Tons of it go straight to the waste basket. But the best of it finds its way to the customer's desk or bookshelf and is consulted when wanted. The best is not overdone and is never likely to be. The art of it all is to make your printed matter so good that the men you want to reach will always welcome it, and will always pick it out from the mass of matter that comes streaming in with each day's mail.

* * *

Publicity is an earning power. But the manifestations of this power have hardly yet begun. We have to make them so strong and fruitful that they will force themselves upon the attention of the manufacturing world in a way that even yet they have not done. There is so much more to do. We have to educate the manufacturing world to regard publicity as a revenue earner, not as a mere expense. Some manufacturers when hungry for business cut down their publicity expenses—cut down one of their means for making sales! When business is flourishing they say they do not need publicity; their shops are full of work. You remember the story of the Irishman's leaky roof. Pat couldn't mend the roof in rainy weather and on fine days it didn't need mending. Evidently we have some missionary work to do.

[1] Extracts from an address delivered before the Manufacturers' Advertising Club, Cleveland, Ohio, May 9.

Electrical Men Enjoy Planked Shad.

Mr. Charles E. Trump, president of the Novelty Electric Company, of Philadelphia, annually extends to several of his friends the compliments of a planked shad dinner during the season. The twelfth anniversary of this event was celebrated on Tuesday, May 16, at the Hon. W. H. Thompson's Park on the Delaware river near Philadelphia. The shad that were caught at 11 A. M. on that day were planked and served to the party at 1.30. Under these conditions, the king of fishes was at its best, and the shad this season are reported to be better than ever before and also scarcer.

Senator Thompson, the owner of the park and numerous electric railways connected with it, joined the dinner party before its adjournment and extended cordial welcome.

Among those present besides the host were Colonel Ezra De Forest, Captain W. L. Candee, George T. Manson, W. H. Hodgins, and Charles Cuttriss, of New York city; George P. Steel, of Williamsport, Pa., and E. B. Baker, of New Haven, Ct.

Before adjournment, it was unanimously voted to accept Mr. Trump's invitation for next year, the thirteenth, on which occasion proper cementing ceremonies will occur.

Digitized by Google

High-Speed Electric Railway Tests in Germany.

At the recent International Electrical Congress, held at Washington, Dr. Friedrich Schulz, president of the German Imperial Railway Commission, and president of the board of directors of the German High-Speed Electric Railway Society, presented an interesting paper giving the results of the noteworthy high-speed electric railway tests carried out at Berlin.

Dr. Schulz introduced his paper by referring to the early work of Dr. Werner von Siemens, who, it was said, in 1879 exhibited at the Berlin exposition the first practical electric locomotive. In the twenty-six years since that time the use of electric power has extended over the entire world, and the development in the United States has been extraordinarily great. As yet, however, electricity has not been applied for operating high-speed passenger railways. The question whether such an application could be carried out technically and profitably could be answered only through a practical test. To carry out this work, the High-Speed Electric Railway Society was founded in 1899, and in the four years following its work was completed. Financial support was given by the large industries and the banks; the German military department placed at the service of the society an experimental track, and the Prussian state railway supplied the material for constructing the way. During the many experiments made, velocities of 200 to 210 kilometres per hour (124 to 130.5 miles per hour) were reached—velocities which previously had only been approached.

For the experimental track the previous construction was maintained, but to prevent derailing and to strengthen the structure, light rails were laid between the others. The roadway was formed of rails twelve metres long, weighing forty-one kilogrammes per metre, each resting on eighteen wooden ties, the total weight being 224 kilogrammes per metre, including the guard rails. The sharpest curve had a radius of 2,000 metres, with an elevation of eighty millimetres of the outer rail. The grades were small. The experiments demonstrated that the present track construction is satisfactory for velocities up to 200 kilometres an hour.

Two motor cars were furnished, one by the Allgemeine Electricitäts-Gesellschaft, and the other by the Siemens & Halske Aktien Gesellschaft. They were of practically the same construction. Each car had room for fifty passengers. The cars were twenty-two metres long, with a distance between centres of the three-axle trucks of five metres. The weight was ninety tons. The cars ran smoothly at speeds of 200 kilometres per hour on the experimental track. The experiments demonstrated that the construction of the modern high-speed cars will be, in general, satisfactory for high velocities, if the wheel base be increased. By careful designing the weight might be decreased. In order to supply the large power required by the motors, a three-phase supply at 10,000 or 12,000 volts was adopted. The overhead conducting system consisted of three wires placed at the side of the track vertically, one over the other. The wires were of copper, 100 millimetres in diameter. They were supported on wooden poles by means of iron brackets. To the brackets was attached, for each wire, a safety device, which, in case of the breaking of a wire, disconnected the falling end from the supply, and the conductor automatically made contact with the grounded track. This apparatus gave good service in practice.

The Siemens & Halske collecting device, placed upon the roof of the car, was pressed, by means of light double springs, against the conductors. This apparatus also operated at the highest velocities safely and without pressing too heavily against the wires. It is thought that the experiments demonstrated how the large amount of energy required for high-speed cars may be supplied. At speeds of nearly sixty metres per second, with the car drawing almost 200 kilowatts, the conductors and the collecting device operated satisfactorily.

The transformer for lowering the high voltage to a lower voltage, for use in the motors, was placed under the car and worked well. The motors, which were designed for a normal output of 250 horse-power, could, when necessary, be called upon for 750 horse-power.

The air resistance increases much more quickly than the frictional resistance with increasing velocities, and the former therefore determines the limiting speed. The resistance of a trailing car is considerably less than that of a motor car; hence it follows that, for transportation of heavy traffic by means of quick and frequent single cars, a method ideal in some ways would require a much greater supply of power than the transportation in trains of several cars spaced at a greater distance apart.

The brake equipment consisted of the Westinghouse air brake and a hand brake.

The visual signals were not clear enough in foggy weather at velocities of over 120 kilometres an hour. For this reason an electromagnetic device was placed in the motor car, which, by means of a rubbing contact, showed a red disc if the distant signal were set at "stop." This arrangement performed its office at the highest speeds.

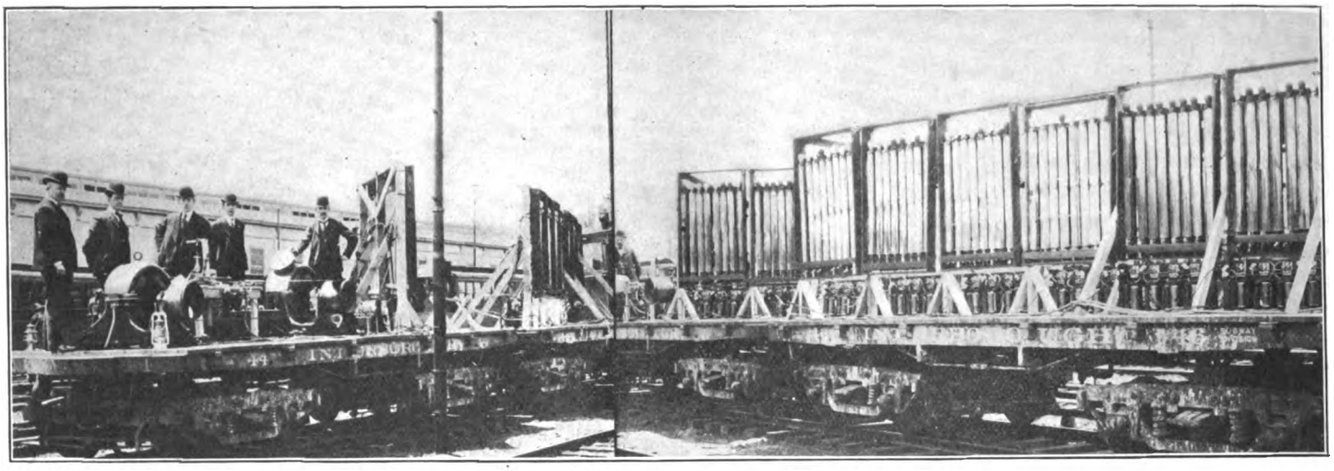
In conclusion, a few general remarks were made. As was true when the steam locomotive was first introduced, some anxiety was felt as to the effect of the high speeds on the health of the passengers. Bearing upon this question is the experience of the test crew, who felt no inconvenience at speeds of 200 kilometres per hour and more. Each engineer stood at his post and made the observations assigned to him. The only noise interrupting the quiet in the car was the clock signal, which was sounded every ten seconds, at which time the readings and measurements were taken. The greatest strain came upon the engineer running the car, who had to attend to the operation of his car and watch the signals with the greatest care. Although surrounded by apparatus and wires carrying currents at voltages of 14,000 volts, those who took part in the test felt perfectly safe. In spite of a few bad short-circuits, none of the passengers were injured. Although one could survey the road comfortably during the journey, it was hardly possible to recognize a person standing on the platforms of the stations passed. The air-brake never failed to work, allowing the car to run over on to the adjacent state railway. No accidents were caused to any persons on the road. In all, over 300 experimental runs were made without a single accident. Not a single person was killed or injured. Not infrequently bloody impressions of small birds were found on the front of the car. The poor little creatures thought they could cross the way in front of the approaching vehicle, but the electric car was quicker than the flight of the birds and killed them. These were the only accidents which occurred.

The society has thus accomplished its purpose. The conditions under which high-speed electric operation on main lines may be made are determined. Such operation brings no greater danger than operation by steam. Electrotechnics have thus opened a wide field for railway progress. The time may not be distant when a great operating high-speed electric railway will be called into life.

Digitized by Google

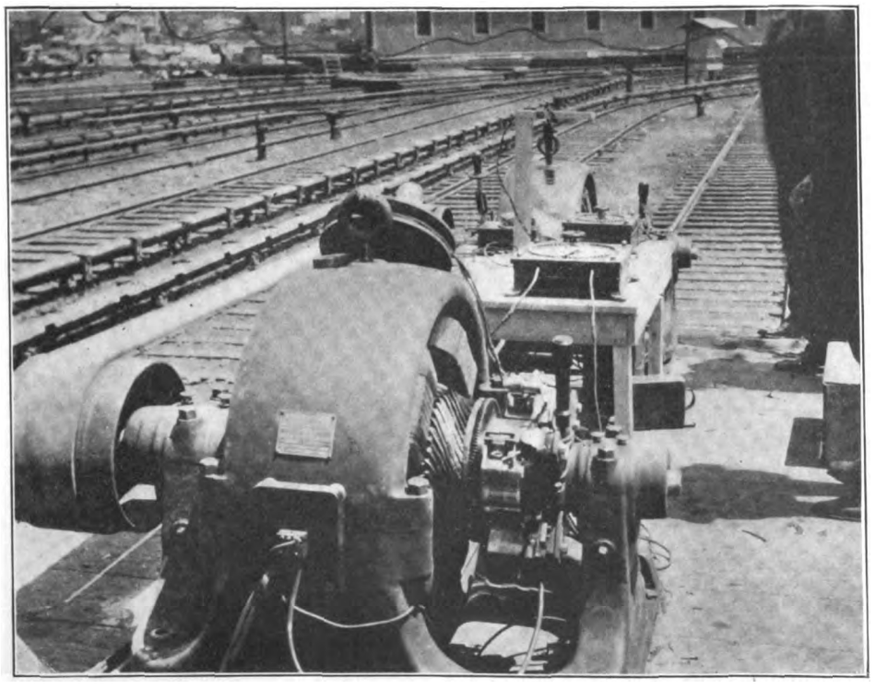
Taking Moving Pictures in the Subway.

On the morning of May 21 the American Mutoscope and Biograph Company, New York city, made elaborate preparations for taking a series of moving pictures of the subway of the Interborough Rapid Transit Company, from Fourteenth street to Forty-second street. This included scenes at the stations as the passengers left and boarded a local passenger train just ahead of the camera with which the pictures were made. The interesting feature of the expedition was the use to which Cooper Hewitt mercury vapor arc lamps were put. Upon two flat cars supplied by the Interborough Rapid Transit Company the American Mutoscope and Biograph Company had mounted, under the direction of Mr. F. A. Dobson, electrician, a complete generating outfit and nine banks of eight forty-five-inch type K mercury vapor lamps. The banks of lamps were staggered and arranged diagonally across the forward flat car, so that the light was thrown to one side and immediately ahead of the car upon which the camera was mounted. The car upon which the camera was mounted proceeded on the uptown local track. The flat cars containing the generating apparatus and the mercury vapor lamps proceeded at an even rate of speed on the uptown express tracks immediately to the left of the local. Each lamp was placed directly in front of a polished metal reflector. The lamps were started by means of the well-known kicking coil, the coils being arranged along the bottom of the frame. These may be seen clearly in the illustration.



TWO VIEWS OF THE FLAT CARS, SHOWING THE GENERATING PLANT, AND THE NINE BANKS OF EIGHT COOPER HEWITT MERCURY VAPOR LAMPS; A TOTAL OF 52,500 CANDLE-POWER.

The generating apparatus included a forty-horse-power, 600-volt Westinghouse motor, taking current from the third rail, and belted to a 110-volt, twenty-two and one-half-kilowatt, four-pole Westinghouse generator. Between the generator and motor there was set up a convenient switch table, upon which were mounted switches, voltmeter, ammeter, field control switch, and alongside of the table was arranged the field rheostat.



THE GENERATING PLANT FOR SUPPLYING CURRENT FOR THE MERCURY VAPOR LAMPS.

The banks of lamps are coupled together with fibre couplings. These are so arranged that the lamp banks may be thrown forward or backward, and connectors be put in between the various couplings. The whole arrangement was so adjusted that it could be dismantled within one hour.

The brilliant light made by the 52,500 candle-power of illumination could be seen far down the subway. During the entire trip but one lamp went out. It was announced that the work was entirely successful, the details of the subway construction being brought out with remarkable distinctness by the high actinic power of the lamps.

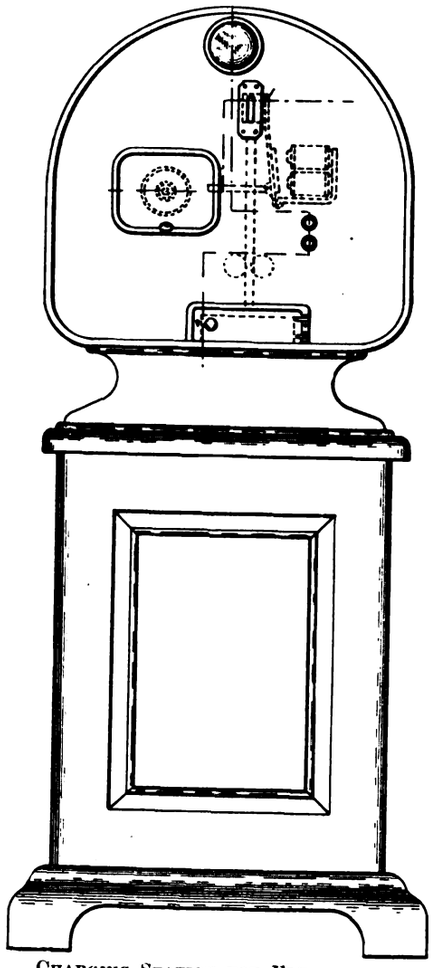
Mrs. McFarland's Death.

The friends of Mr. Walter M. McFarland, acting vice-president of the Westinghouse Electric and Manufacturing Company, have learned with regret of the death of his mother, Mrs. Sarah J. McFarland, in Pittsburg, May 11. Interment was at Washington, D. C., Mrs. McFarland's home for more than fifty years prior to her Pittsburg residence of the past six years. She was seventy-three years old.

Digitized by Google

Electrical Patents.

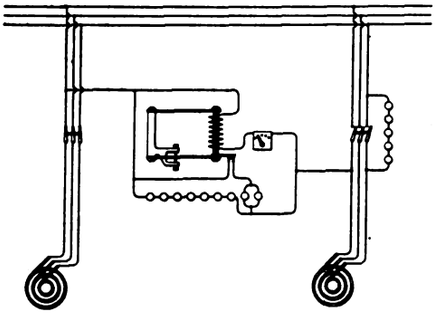
A charging station for electrically propelled vehicles has been patented by Frank P. Cox and Charles E. Holmes, of Lynn, Mass., and assigned by them to the General Electric Company, of New York (789,411, May 9, 1905). It is the object of the invention to provide a simple organization which will be cheap to in-



CHARGING STATION FOR ELECTRICALLY OPERATED VEHICLES.

stall, the current-measuring devices being located at the distributing station. Such a type of charging station may be employed in many cases where it is feasible to run a separate circuit or wire from a station to a convenient point which may be a rendezvous for cabs, as a theatre, hotel, or cab stand. Devices of this character are known in the art as "electrants" and are designed to permit the delivery of electric energy in determinating quantities upon the payment of a coin of defined value or by a deposit of a special token sold by the supply company. The invention comprises a type of electrant in which a storage battery vehicle in which there is a residual charge of current may gain access to a charging current and no other. The charging plug or station is provided with a coin-chute normally inaccessible, so as to prevent the insertion of strings, wires, twigs, or other fraudulent devices, but adapted to be rendered accessible by the charging plug of the automobile by means of an electromagnet controlled by the residual charge of the battery. The deposit of a coin then transmits a signal to central station indicating that a vehicle is present at charging station and the coin has been deposited. By the closure of a switch by the central station operator full potential is thrown on the supply wires to the charging station through a meter at the central station and after the value of the coin in current has been delivered the switch at the supply station is opened. An electric lamp is also provided in the charging post by which the cabman is apprised of the fact that his signal has been transmitted to the central station and which will indicate when the paid amount of energy has been put into his battery. Means are also provided for preventing the transmission of a signal to the central station except when a coin has been deposited in the chute. The invention, therefore, in brief, comprises a charging station for storage batteries provided with means under the control of the central station operator for delivering energy and fixing its quantity and means for indicating to the operator when the prepayment has been made.

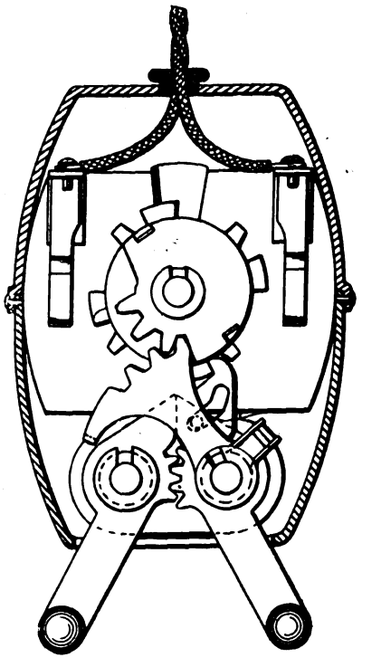
Paul L. Clark, of Chicago, Ill., is the inventor of a synchronism-indicator, which he has assigned to the General Electric Company, of New York (789,488, May 9, 1905). The invention relates to devices for indicating the proper instant for closing the line switch of an alternat-



SYNCHRONISM INDICATOR.

ing-current generator, synchronous motor, or rotary converter, which is to be connected in parallel with another similar machine already in operation. It is understood that this is to be done when the machines are in step, but under ordinary conditions it is uncertain when this instant occurs. The machines are never thrown together when the indicating lamps are fluctuating with short beats, and as the beats grow longer the interval of darkness or brightness extends over so long a period that it is difficult to guess just the right instant to close the switch. This invention aims to eliminate any possible doubt on this score, and it consists in a signaling device, such an an indicating lamp controlled by a switch, which is kept open so long as the phase displacement is at a maximum and is closed by a solenoid only when the beats become very long and at the middle portion only of each beat.

Hart & Hegeman Manufacturing Company, of Hartford, Ct., is the owner of a patent recently granted to Monroe Guett, of the same place, on an improvement in electric snap switches (789, May 9, 1905). The invention is particularly



ELECTRIC SNAP SWITCH.

adapted for use in pendent switches. The invention comprises an insulating base having stationary contacts mounted thereon. A spindle is supported by the base, and on this spindle is rotatably mounted a switch plate which is adapted for cooperation with the contacts. An oscillating member having spring detents which engage the switch plate for forward movement is employed. Stops are arranged on the switch plate, and are normally engaged by the finger of a pivoted plate, which plate is slotted to receive a pin carried by a lever, the lever and pin being adapted to disengage the plate from the stop. An arm is connected to the lever through a spring and to the oscillating member. The arm carries a pawl which is adapted to limit the movement of the switch plate.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Heat-Conducting Insulating Varnishes.

In this communication Mr. H. W. Turner describes briefly researches carried out by him for a German manufacturing company, in order to develop and improve a method of insulating armature and field windings. The work was done during the years 1900 and 1901, and the insulating compound known as "electro-enamel" was produced. It was found that this material greatly decreased the temperature rise of coils on which it was employed. It also preserved the copper covering from deterioration at high temperatures, and rendered the coils thoroughly moisture-proof. It was found that if two otherwise identical coils, one of which was impregnated with this compound, were connected in series, a current sufficient to heat the wire to a dull red failed to affect prejudicially the impregnated coil after an application of forty-five minutes, while the untreated coil was destroyed within ten minutes, the cotton covering being charred completely away. It was pointed out that the value of an insulating covering can not be determined by means of a thermometer applied to the exterior surface of the coil, for this test simply gives the temperature of the outside, which will be less if the insulating material be a poor conductor, although the temperature within will be higher. Some curves are given showing comparative results of coils mounted in the same way, except that the wire of one is drawn through a bath of "electro-enamel" during the winding process. After passing a heavy current through two coils for 200 minutes, the temperature calculated from resistance measurements of the unimpregnated coil was 300 degrees centigrade; that of the impregnated coil was 255 degrees centigrade. The temperature of the two coils continued to rise, though at a less rate for the latter coil.—*Abstracted from the Electrician (London), May 5.*

Thermit Rail Joints.

A discussion of various methods of making rail joints is here given by Mr. G. E. Pellisier, special attention being drawn to the use of thermit. The complete outfit for making such a joint consists of a crucible, a pair of moulds made to fit the section of the rail to be welded, a pair of clamps to hold the moulds in place, a wire brush to clean off the dirt from the ends of the rails, a small gasoline torch to dry off any moisture which may be present on the parts to be welded, and a portion of thermit weighing from fifteen to twenty-five pounds, depending on the section of rail to be welded. The whole outfit may be transported easily in an ordinary wheel-barrow. In making a weld, the ends of the rail are first cleaned with the wire brush, which is done simply to remove the dirt. Rust makes no difference. They are then heated with the torch to drive off moisture, and are brought into exact alignment. The moulds are put in place and fastened, care being taken that they fit closely where they join each other and around the rail. All joints are made tight with moist clay and the top of the rail is painted with a thin paste of clay and water, which, when dry, prevents the slag and iron from adhering to the top of the rail. When desired, clamps are adjusted for upsetting the rail, but this is not at all necessary. Sand is next packed around the moulds, and the crucible set on a tripod above. The charge is placed in the crucible, and a small quantity of ignition powder laid on top. The latter is ignited with an ordinary storm match, after which the reaction takes place rapidly and furiously. In about twenty seconds boiling has ceased, and the iron separates from the slag. The former is then allowed to flow into the mould, and in less than one minute from the time the match was lighted the joint is made. After cooling, two or three taps of a hammer separate the slag from the joint, and the work is completed, no chipping or grinding being necessary except when welding old rails where the joints are battered. A welding gang consists of four men, and they can make twenty joints in a day of ten hours. No skilled labor is necessary. A one-mile section of a single track on the main street in Holyoke, Mass., has been welded in this way by the author. The gang consisted of three men working under his supervision. From eight to fifteen joints were made per day, the smaller number being due to the slow laying of the rails. The cost of these joints is estimated at $6 each. While the author is not ready to say that joints made in this way are better than cast welds or electrically welded joints, he thinks that the thermit process is much superior because of the inexpensive apparatus required and the simplicity of the process. Chemical analyses of the joint showed it to be practically identical with the steel rail. Mechanical tests showed the joint to be stronger than the rest of the rail, while the electrical contact was perfect.—*Abstracted from the Journal of the Worcester Polytechnic Institute (Worcester), May.*

Considerations Relating to the Design of the Armature Slot Insulation in High-Voltage, Alternating-Current Generators.

An investigation was made recently by Mr. H. M. Hobart of a number of alternating-current dynamos of various sizes, manufactured by firms in different countries, and from the data collected a curve has been plotted showing the average thicknesses of slot insulation for different voltages. This curve gives thicknesses of insulation less than those recommended by Mr. H. F. Parshall in 1901. As a starting point in the further consideration of slot insulation, a curve is drawn from the mean values of the curve and Parshall's. Comparing this curve with one showing the disruptive strength of natural mica for different thicknesses, it is found that, while the specific disruptive strength of mica increases with decreasing thickness, in generators it is customary to permit an increasing specific stress with increasing thickness of insulation. One explanation of this is that, for mechanical reasons, it is not safe to go below one millimetre for the thickness of the slot insulation, and this has accustomed us to the use of a high factor of safety in low-voltage machines. For high-voltage machines a virtue is made of necessity, and while one would gladly have a factor of safety of five at least in high-tension alternators, the cost makes this prohibitive. In building a machine, high-tension tests should be made at every stage of construction, mitigating their severity as the machine approaches completion; but at no time should the insulation be harmfully strained, nor the stress carried beyond two-thirds of the ultimate disruptive strength of the insulating material. From recent researches made by Dr. B. Walter, the conclusion is reached that, for a homogeneous material, the true disruptive strength is directly proportional to the thickness—that is to say, the specific disruptive strength is a constant for a given quality of a given material. From this conclusion a curve is plotted showing the ultimate dielectric strength required per millimetre for slot

Digitized by Google

insulation, allowing a higher factor of safety for low-voltage machines than for high. The author then discusses the properties of "reconstructed mica," and concludes that it is not safe to assume that the disruptive strength is higher than 20,000 root mean square volts. Arnold has given results which show the values of the dielectric stress which for various thicknesses of reconstructed mica set up a perceptible heating if continuously applied. It must not be concluded, however, that heating exists at normal voltage, due to dielectric stress, nor is heating due to dielectric stress necessarily not permissible during normal operation. While such heating introduces a loss, and is objectionable from this standpoint, as long as the ultimate temperature rise in the insulation due to all losses in the machine does not injure the insulation or exceed the guarantee, the presence of such dielectric loss should not necessarily be grounds for condemning a design. The following rough rule is given: if, for a given thickness, a certain voltage is just sufficient to produce perceptible heating, there will be one-half degree centigrade rise for every one per cent increase in voltage. This rule gives a value of the temperature rise too low for considerable thicknesses, and too high for thin insulation. It is suggested that exhaustive investigations be made into the relative values of different insulating materials; and these tests should not be made with flat surfaces only, but with the insulation bent around a curved surface as well. Different curvatures should be used, and the results plotted so as to enable the effect of curvature on disruptive strength to be determined. The necessity of drying thoroughly all insulating material is emphasized. Vacuum-drying ovens should be regarded as indispensable accessories in a factory where electrical machinery is built. Mr. Hobart agrees with the recent suggestion of Mr. Highfield, that the whole of the space from copper to iron in electrical machinery should be filled with insulating material, so as entirely to exclude air. Tests should also be made to determine the influence of ozone and acid fumes when acting for a long time. Aging tests should be made under various temperature conditions, as well as under the influence of cyclic changes of temperature. It is useless to attempt to draw any final conclusions from other than the most exhaustive tests. A great many of these could be carried out satisfactorily by students.—*Abstracted from the Electrical Review (London), April 28 and May 5.*

Electricity in the "City of the Holy Cross," Cal.

Santa Cruz, Cal., is an interesting city of about 10,000 inhabitants—interesting for a number of reasons, but particularly so electrically because, although it is comparatively small, there are six companies furnishing its electrical supply: the street and municipal building lights are furnished by a steam-driven city plant; the Cooperative Electric Company maintains a steam-driven electric plant for isolated and general service at the Casino, a famous recreation pavilion; the Big Creek Power Company, from the electric power transmission service rendered from its water-power plant in the Santa Cruz mountains and its steam-driven plant in Watsonville, supplies current for operating the electric circuits of the Santa Cruz Gas and Electric Company; and there are two competing railway systems occupying the streets of the city. The latter three companies buy power from the Big Creek Power Company. This company derives its power from two streams. The original development was located on Big Creek, which was believed to be capable of delivering a minimum of 1,000 horse-power throughout the year. The normal flow of the creek, without storage, was such as to make it inadvisable to rely on a minimum in excess of 500 horse-power, so two years ago this development was reenforced by diverting into Big Creek the flow of Mill Creek, which, in conjunction with its storage system, was planned for a continuous delivery of 2,000 horse-power to the plant. In both cases water is impounded by means of crib dams. The topographic formation of the country is such that Big Creek flows down one side of a back-bone ridge, the other side of which forms a cañon through which Mill Creek flows. In these cañons are the ditches for the two systems, which unite at the junction of the creeks at the end of the ridge, shortly below which the power-house is located. These flumes are covered throughout their whole length, keeping out the leaves and other debris. The power-house is a comparatively small structure located at the foot of the pipe line on the westerly bank of Big Creek. Its equipment consists of two 1,500-kilowatt, two-phase, 1,100-volt, sixty-cycle generators driven by a 500-horse-power, forty-six-inch Pelton wheel. There is also a fifty-four-inch Pelton wheel driving one 400-kilowatt and one 180-kilowatt two-phase, 1,100-volt, sixty-cycle generators. The exciting equipment consists of a two-inch Pelton wheel driving one eleven and one-half-kilowatt and two six-kilowatt, 125-volt exciters, all direct-coupled. The pole line consists of redwood poles cut down in the neighborhood. There are two transmission lines from the power-house to Santa Cruz. One passes along the coast, and was the first to be erected. It gave considerable trouble, due to the fogs and salt spray from the ocean, so that it was supplemented by a second line which is carried through the country back of the coast. It was on the coast line that the fog boxes were first tried and found successful. The Watsonville plant receives power from the Big Creek Power Company. It has also a complete steam plant, which has been installed to supply the business of the company beyond the capacity of the water-power station. It serves also as a reserve in case of interruption to the transmission service. This plant uses oil fuel, which is stored in a 500-barrel cement tank set in the ground in the rear of the station. The oil is burned under Babcock & Wilcox boilers of the vertical header type. Steam is used in a horizontal engine, which is direct-connected to a 750-kilowatt, 11,000-volt, sixty-cycle, three-phase alternator of the revolving-field type. The Cooperative Electric Company's plant consists of two Babcock & Wilcox boilers supplying steam to a 300-horse-power Corliss engine, driving by means of a belt a 180-kilowatt, 3,300-volt, three-phase alternator. The municipal street lighting plant contains tubular boilers burning oil which furnish steam for the operation of a Corliss engine that, in turn, drives two sixty-five-light Brush arc dynamos and a centrifugal pump for handling sewage.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), May.*

Electrical Manufacturing in Lancashire, England.

During the first two months of this year the electrical engineering firms of Lancashire, England, had, according to the *British Trade Review*, scarcely work enough to keep their shops fully going. Now, however, orders are becoming more plentiful, and there is every prospect of a busy summer. Numerous enquiries are received, both from England and from foreign countries. There is thought to be hardly any limit to the possibilities of electrical engineering, especially with regard to the supplying of power for manufacturing purposes and locomotives. A great development in the industry is anticipated, not only in Lancashire, but throughout the north of England, particularly in the driving of cotton mills and the running of other works.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Single-Phase Alternating-Current Crane Motor.

Following the development of the single-phase, alternating-current railway motor and its successful adaptation to the conditions of modern traction service, the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has placed upon the market a complete line of motors of similar characteristics but smaller capacity for the operation of electric cranes, hoists, elevators and similar apparatus demanding a heavy starting torque and a wide range of speed variation under control of the operator.

Like the alternating-current railway motors, these motors, designated as type SC, are of the series-wound commutator type, with compensating field windings, laminated cores and inwardly projecting poles. The fields consist of laminated cores built up of sheet-steel punchings held between end-plates and mounted within cast-iron frames. The frames are of the box type and are closed at the end by substantial brackets which support the bearings. Feet are provided for the convenient mounting of the motors. The bolts which hold the end-plates to the frame are evenly spaced, so that the bearings may be turned ninety degrees and the motor mounted upright or with the feet bolted to a vertical surface. The large opening around the commutator is closed by a sheet-steel band fastened by thumb screws and so arranged that easy access may be obtained to commutator and brush-holders at all points. The bearings consist of solid shells lined with babbitt metal, and are of ample dimensions for the most severe service. Grease lubrication is used, drip cups being provided under the bearings.

There are four inwardly projecting poles made of laminated steel, punched solid with the core, and magnetized by field coils of the usual type. An auxiliary field winding is also provided, threaded through slots in the pole-faces.

The armature is of the usual slotted drum type with core built up of circular punchings of soft sheet steel mounted upon a cast-iron spider. In the larger sizes ventilating ducts are provided between the punchings through which air is forced out against the field coils and core. A uniform temperature is thus maintained at all parts. The commutator is mounted upon an extension of the armature spider. Wiper rings are provided to protect the armature from grease. The shafts are of great strength and are extended at both ends to accommodate pulleys, pinions and brake discs.

The carbon-holders are the same as the standard Westinghouse holders which have been so successful in direct-current practice, and consist of rectangular boxes machined to fit the brushes. An even pressure is maintained by the long, flat spiral spring, while the smaller vibrations are taken up by a short spring.

Type SC motors are wound for a nominal potential of 200 volts, at 3,000 alternations, or 100 volts, at 7,200 alternations per minute, but will operate successfully upon voltages ten per cent higher. For other potentials it is advisable to use transformers. These motors

NEW CRANE MOTOR.

are manufactured in sizes having nominal ratings from five to thirty-five horsepower and are wound for twenty-five cycles per second. For larger capacity, the standard single-phase, alternating-current railway motors are recommended.

The speed of motors of this type may be varied by any method which will vary the electromotive force impressed at the motor terminals. On account of its simplicity and effectiveness the rheostatic method of control, similar to that used with direct-current series-wound motors, has been adopted as standard. The controllers and resistances are similar to those used with direct-current motors of similar capacity and are of the well-known Westinghouse dial type or commutator type, according to the size of the motor with which they are to be used. Resistances are mounted in the controller frames. Contact fingers are carried on a moving part having four radial arms and can be operated by a single handle or a system of bell cranks and levers. The operating rod can be connected to either the right or left-hand side of the rocker arm, so that the controllers can be mounted face to face or back to back, as may be the most convenient. A single movement forward or back applies the current for the operation of the motor in either forward or reverse direction. Controllers of the dial type have twelve steps, those of the commutator type sixteen steps in either direction. The great number of steps reduces sparking at the contacts. Contact segments and fingers may be easily renewed. With the smaller controller the resistance is formed of wire wound with insulated bars which are supported in the frame by porcelain blocks. With the large controllers, resistances of the grid type are employed.

These controllers differ from those used with direct-current motors mainly in that blow-out magnets are not used. As the circuit is broken at four points, arcing is reduced to a minimum. At the first notch of the controller all contacts make connection simultaneously, with a maximum resistance in circuit. Succeeding steps are made by one set of fingers at a time. The large number of steps employed makes possible a very exact speed control, with a smooth start and a gradual acceleration, and reduces the starting current to a minimum.

All parts are easily accessible and the entire mechanism is simple and easily operated and maintained.

For use with type SC motors a complete line of automatic electric brakes, similar to those employed with direct-current series-wound motors and with induction motors in crane and hoisting service, has been developed. The device consists of a set of brake shoes, levers and magnet coils which are mounted upon the front end bracket of the motor, and a brake wheel which is mounted on the motor shaft. The shoes are lined with a special composition and are supplied to the wheel by the action of the armature of an electromagnet. A turnbuckle adjustment provides means for taking up wear. The electromagnet consists of a

Digitized by Google

U-shaped core and a U-shaped armature with two windings—one around each limb. Electrical connections are made across the line through a switch on the controller. The switch is automatically operated with the first step of the controller. When closed, the armature of the electromagnet is raised and the brake released. When movement of the controller to the off position opens the switch, the armature of the electromagnet falls under the action of gravity and the brake is set. The armature is connected with the brake shoe by means of links in such a way that it is practically impossible for the brake to fail when the controller is in the off position. Should the power fail while the motor is operating, the brake is immediately set and the load held. As both brake and controller are operated by the same mechanism, it is impossible to set the brake while the motor is connected to the line.

Electric Ventilating Fans.

The Crocker-Wheeler Company, Ampere, N. J., is applying electric motors to ventilating fans, as shown in the accompanying illustrations. Fig. 1 illustrates a Crocker-Wheeler motor connected to a twenty-four-inch Davidson fan. The smaller types of fans are operated by the bipolar form L motor. The larger sizes are equipped with the four-pole form I motor. The form L motors have cast-steel frames with two internally projecting poles, while the form I motors have cast-iron frames with steel poles cast welded to the frames. In both types the bearings are carried by end shields which are bolted to the frames, and are provided with oiling rings running in reservoirs. This feature enables the motors to be run a considerable length of time without attention. The frames and shields are so constructed that the motors are well protected from external injury. Ample provision is made, however, for ventilation.

The field coils are wound on forms heavily insulated and taped, and are made dust and moisture-proof. They are held in place on the poles by laminated shoes. The armature cores are built up of steel laminations slotted to receive the windings, and properly insulated from one another in order to reduce the eddy current loss to a minimum.

The commutator bars are of hard-drawn copper. They are of uniform section, and are insulated from one another by shell mica. The brush rigging is of simple and rigid construction, and requires no special attention.

Fig. 2 shows a Crocker-Wheeler type 51 motor direct-connected to a forty-two-inch Davidson propeller fan. The blades of the fan are of flanged steel, and are compound curved, being so designed as to pick up the air at a very low velocity and deliver it at a comparatively uniform pressure over the whole delivery surface of the fan. The blades are attached to a long cast-iron hub at two points This

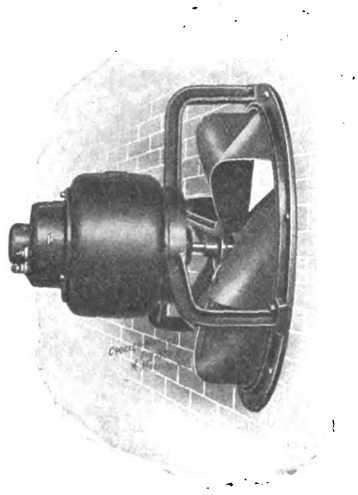


FIG. 1.—TWENTY-FOUR-INCH FAN WITH DIRECT-CONNECTED MOTOR.

serves to fix the pitch of the blades, which are set at an angle of forty-two degrees with the axis of the shaft. The outer rim of the blade is attached to a heavy wrought-iron running ring welded and made endless. This running ring is, in turn, connected to the outer end of the cast-iron hub by five steel braces, which

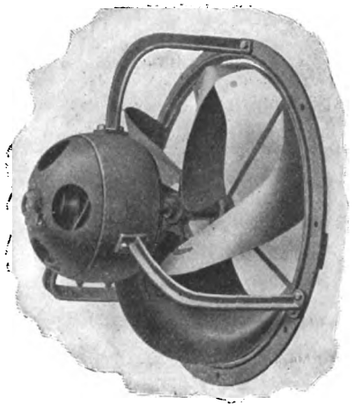


FIG. 2.—FORTY-TWO-INCH FAN WITH DIRECT-CONNECTED MOTOR.

are shouldered at their outer ends and riveted through the running ring. The inner ends are screwed into the hub. This construction ensures rigidity and safety to the fan at any speed, and enables it to be operated at very high peripheral speeds.

Fans which are used in drying-houses, bleacheries, sulphate mills, or in any other location where they are required to meet air or vapor containing gas which is likely to corrode steel blades, are furnished with blades of cold rolled copper or of composition.

The motors are furnished direct-connected to fans in all sizes from eighteen inches to sixty inches, inclusive. The motors may be open, gauze-enclosed, or fully enclosed, as the local conditions require. With the smaller sets the motors and fans are connected, a casting combining the wall ring and supporting arms being employed. With the larger sizes a separate wall ring is used, and this is fastened to the motor frame by means of iron arms. The former construction is illustrated in Fig. 1; the latter, in Fig. 2.

The motors are wound for either 115, 230 or 500 volts direct current, and are provided with a no-voltage release starter or a speed regulator capable of reducing the speed of the fan.

Bids Wanted—Water-Power Electric Plant.

Proposals will be received at the office of George W. Wagenseller, secretary, Middlecreek Electric Company, in Middleburg, Pa., up to noon of June 15, 1905, for the construction of a complete water-power electric plant of 700 horse-power, on Middlecreek and Pennscreek, two miles south of Selinsgrove, Pa. Bids can be made on part or all of the work.

The requirements are: a solid concrete dam, seventeen to twenty feet high and about 360 feet long; a tunnel and waterway 1,225 feet through a mountain; a power-house, two units with four wheels—direct-connected generators; auxiliary engine and boiler and complete equipment with twenty-five or thirty miles line construction, to furnish light, heat and power to Selinsgrove, Sunbury and Northumberland.

Plans and specifications can be seen at the office of the secretary in Middleburg, Pa., or at the office of E. F. Shatzer, hydraulic engineer, at the site, two miles south of Selinsgrove, where bidders can get the most satisfactory information. W. K. Darlington, Real Estate Trust Building, Philadelphia, is engineer.

Good Roads Convention.

The fifth annual National Good Roads Convention will be held in the auditorium at the Lewis and Clark Centennial Exposition, Portland, Ore., June 21-25. The proceedings of the convention will include addresses and discussions upon the scientific, eithic, and economic phases of the subject of good roads, and its relation to industrial progress and development.

Digitized by Google

New Type of Water-Tube Cleaner.

The General Specialty Company, Buffalo, N. Y., has brought out the "Demon" water-tube cleaner for removing the scale from the interior of the tubes of water-tube boilers. The machine consists essentially of two parts, namely, a new form of scale-cutting tool and a new and powerful form of motor to drive the cutter. The motor belongs to the general class of rotary engines, but differs from most of these in the essential feature that it has a central shaft, and is free from all valves. The maker states that it bears no resemblance to a turbine, either in design or in operation. The machine is operated by water power, and the exhaust water is used for washing away the loosened scale. The inlet and exhaust water is taken care of by properly arranged ports. The pistons of the motor, which are three in number, are attached to the shaft, and each, in turn, projects across the cylinder, forming a partition between the inlet and exhaust ports. The amount of water consumed is directly proportional to the speed at which the machine is revolving. When the machine is working on un-

"Demon" Tube-Cleaner.

usually heavy scale, the speed and the water consumption are both somewhat reduced.

The cutting tool is designed to cut the scale, in contradistinction to grinding it. Three cutters with tooth-shaped edges are attached to a heavy head, the latter being directly attached to the shaft of the cleaner. These cutters are journaled to the head at the front end, but slide in grooves at the rear end. They are not thrown out by centrifugal force, but are forced out by springs, so that they engage the scale in a positive manner. In order to prevent any possible injury to the tubes, and also to relieve the cutters of any friction and wear after the scale has been removed, the outward movement of the cutters is limited by a properly arranged stop. The cutters can be set so that their outside diameter is just equal to the inside diameter of the tube which is being cleaned. The motor or body of the cleaner is properly centered in the tube by six centering lugs, which ensure thorough and uniform work of the cutting tool on all sides of the tube.

Hubbell Pull Sockets.

Harvey Hubbell, Bridgeport, Ct., the well-known manufacturer of pull sockets, pull clusters and other electrical specialties, has moved the New York office to the new Barclay Building, 299 Broad-

Fig. 1.—Side-Wall Pull Socket.

way, where samples of goods manufactured by this firm will be carried. The office will be under the direct charge of H. W. Bliven, sales manager of the firm. The line of attachment plugs manufactured by this company embodies several unique features.

The Hubbell plugs are all made with separable caps—that is, the plug is in two parts, cap and base. The contact in the entire line of Hubbell plugs is on the knife-blade principle. There are no electrical contacts exposed. Each terminal is enclosed in a separate cell. The caps of the Hubbell plugs are made of porcelain, hard rubber, and porcelain with brass cover.

Two of the plugs are illustrated herewith. They are the side-wall plug, shown in Fig. 1, and the current-tap,

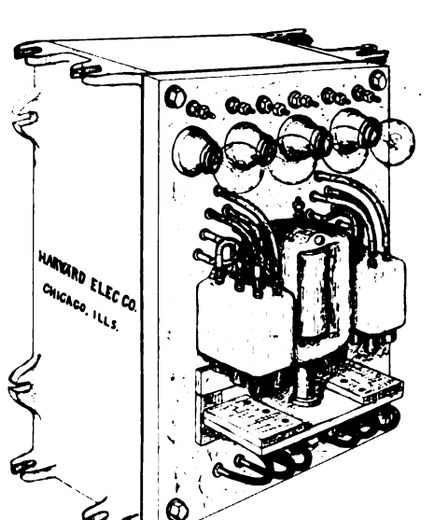
Fig. 2.—Current-Tap.

shown in Fig. 2. The side-wall plug can be used both with cleat and concealed wiring. It dispenses with socket and receptacle and can be used wherever it is desirable to use an extension cord. The current-tap is made on the same principle and is interchangeable with the entire line.

The new Trinity Building, at Thames street and Broadway, New York city, one of the most extensive and elaborate office buildings in the country to-day, has been equipped throughout with the Hubbell flush plugs.

An Automatic Electric Controller.

The Harvard Electric Company, Chicago, Ill., is placing on the market a line of automatic electric controllers. These controllers are simple in construction, durable, and of neat appearance. The illustration herewith shows the automatic motor-starter, which may be operated by a small snap switch or push-button placed at any distance from



Automatic Electric Controller.

the starter. These controllers automatically start the motor slowly with heavy loads, and more quickly with lighter loads, automatically returning to the starting position whenever there is an overload on the motor or when there is no voltage on the line. A feature of this device is that the contact surfaces increase as the motor is started, so that the motor runs with a large carbon contact.

The circuit is open on both sides, and the resistance is first cut in, and then the circuit is quickly broken between carbon and carbon. Besides these motor-starters the Harvard Electric Company is making a full line of automatic electric controllers, both single and reversing; single and reversing sign flashers; letter sign flashers; pressure regulators for electric pump service; electric controllers, and controllers for all forms of automatic electric service.

Digitized by Google

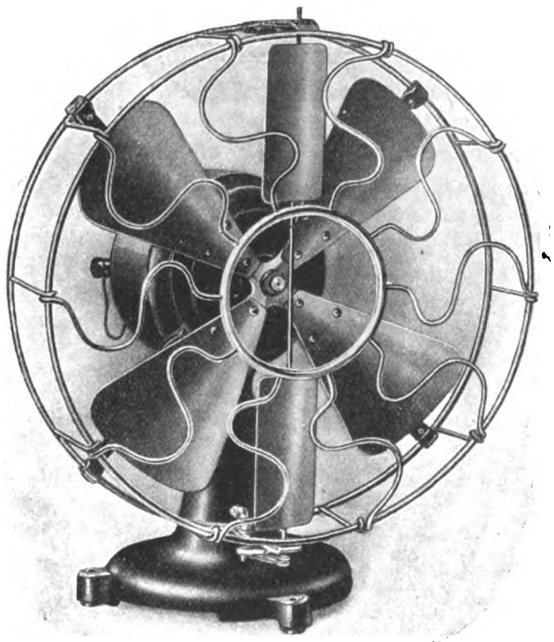
A New Oscillating Fan.

The accompanying illustration shows the new type "O. D." oscillating fan built by the Peerless Electric Company, Warren, Ohio. The Peerless oscillating fan represents a departure in this style of motor. The shifting vane which actuates the simple rotating mechanism is located inside the guard, removing any possibility of injury from external causes. The fan body rotates on double ball bearings, the balls, cones and races of which are made from high-grade steel, carefully hardened and ground.

The switch-plate, which is located in the base of the fan, is of steel, to withstand severe usage. On this plate is securely fastened the switch mechanism, mounted on heavy fibre board, all riveted together.

The brackets that support the actuating vane are rigidly fastened to the guard. These also carry the throwing lever.

Current is transmitted from the main circuit through the brush-holders to collector rings mounted on the hollow bearing spindle. Through this hollow spindle the leads to the motor are carried from the collector rings. By the use of collector rings there is no possibility of lead wires wearing off in consequence of the oscillating movement.



NEW OSCILLATING FAN.

The switch, brush-holder and collector rings are entirely contained within the base of the fan, protecting these parts from dirt and injury. The standard finish of the guard and blades is brass.

The Deutsch Electric Train-Lighting System.

The salient features of the Deutsch system of electric lighting for railway passenger cars are reliability of operation and low maintenance cost, the elimination of delicate moving parts, the simplification of electrical connections, and the provision of a direct-connected drive which allows the wheels to be easily changed. Inspection and repairs may be made without jacking up the car.

The Deutsch system consists of a dynamo hung in any convenient place in the car, a transmission gear, and the usual storage batteries. The storage battery is intended to supply current for the lights when the train is standing or running at less than a specified speed.

The drive consists of a steel bevel gear provided with a suitable hub extension forming a bearing immediately adjacent to the tooth face. The gear is attached to the axle and rotates with it. Encircling the bearing is a steel strap, to which a stud is electrically welded. This stud forms a bearing support for a raw-hide pinion which meshes with the steel gear, and to which is fastened the shaft for driving the dynamo. The shaft is telescopic, and provided with universal joints to allow for axle play and side motion of the truck on curves. Any tendency of the strap to revolve with the gear around the car axle is resisted by a rod projecting upward from the strap, and flexibly supported by the truck frame.

The steel gear casing is cast integral with the strap, thus making the gear casing, strap and pinion bearing in two pieces, which are bolted together and carried by the hub bearing of the gear. This arrangement ensures perfect alignment of the gear teeth under all conditions.

The advantages of this drive are stated by the maker to be as follows: it is not affected by snow, ice, sand, escaping steam or by tipping of the truck; the parts are simple, durable and of easy access; it has no sliding dust guards which may work loose and wear holes in the casing; there is no necessity for work to be done under the truck in changing wheels, as the whole transmission is supported by the car axle, and drops with it; no pivotal movements or springs are required, any inspection or repairs can be made without jacking up the car; there is practically no weight on the bearings of the transmission, and it is absolutely unaffected by shock from any cause, so long as the truck remains intact.

The dynamo is rigidly suspended under the car body. The bearings are self-aligning and ring-oiled. The wear on the bearings is insignificant, and the flexible nature of the shaft connection prevents any shock being transmitted to the dynamo. The armature can be removed and a new one substituted in about fifteen minutes. Both bearings are of the same size, and all screws holding removable parts are standard and of the same size. The casing can be removed, completely exposing the machine for inspection, in one minute by simply slacking two wing nuts, and the armature bushings can be removed without disturbing any electrical connections.

The regulator consists of an automatic switch, a controlling solenoid, an air valve, a cylinder, a piston working in the cylinder and carrying electrical contacts on the rod thereof, and a resistance located in the shunt-field circuit of the dynamo. The automatic switch cuts the dynamo in and out of the lamp circuit above and below a specified train speed—that is, when the train runs below a specified rate of speed, the lights are on the storage battery; above that speed they are on the dynamo. If the train speed is increased so that the dynamo is running faster than necessary for the maximum output, the controlling solenoid opens the air valve, thus raising the piston carrying the electrical contacts, and cuts resistance into the shunt-field circuit of the dynamo, thus reducing the output. When the train speed decreases, the air valve is closed by the controlling solenoid, and the piston drops by gravity, thus cutting resistance out of the field circuit until the dynamo output is again at its normal maximum. The regulator does not depend for its operation upon electrical means, being driven by compressed air from the brake mechanism. The working of the regulator is noiseless, and there is no motion except when the train speed materially changes. There are no rotating parts to cause trouble, and all electrical connections are simple and conveniently arranged.

The machines are furnished with all parts made to gauge and all corresponding parts interchangeable.

The Electric Controller and Supply Company, Cleveland, Ohio, is the licensee of the Deutsch patents for the United States, Canada and Mexico, and will supply any further information desired regarding the system.

Digitized by Google

Alternating-Current and Direct-Current Solenoids.

The accompanying illustrations show two new types of alternating-current and direct-current solenoids which have been

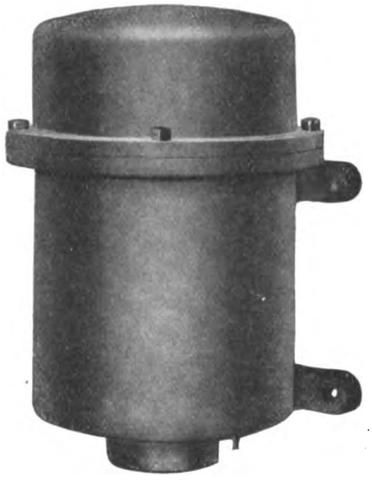


FIG. 1.—IRON-CLAD CLOSED-TYPE SOLENOID.

placed upon the market by the American Electric and Controller Company, 136 Liberty street, New York city. These solenoids may be used for the operation of switches at a distance, for the operation of motor starters, electric brakes as used on hoists, elevators and conveying machinery. The solenoids may also be used

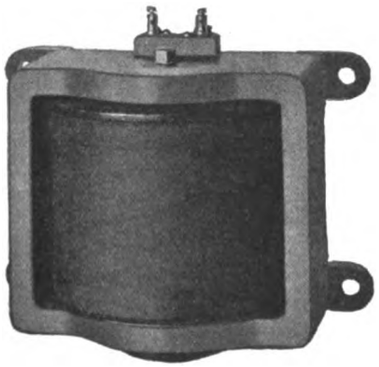


FIG. 2.—OPEN-TYPE SOLENOID

to operate valves from remote points by push-button control. Automatic control may be installed where desired. Fig. 1 shows the new type iron-clad solenoid, and Fig. 2 the open-type solenoid.

Automatic Release Starters and Motors for Heavy Duty.

Among the recent large orders received by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., is one covering two 1,500-horse-power, 250-volt automatic release starters for use in the Edgar Thompson steel works of the Carnegie Steel Company, Braddock, Pa. These starters are particularly interesting, not only for their size, but on account of the general arrangement of the starter, the unique type of resistance used, and the large overload capacity of the equipment.

The starter proper will be built in the form of a switchboard of white Italian marble, approximately seven feet eight inches high and eleven feet long. The starter parts will be of the well-known type used by the Cutler-Hammer Manufacturing Company, where the several sections of starting resistance are controlled by a number of independent levers. For the starter in question, the levers which will carry the motor current continuously are to have a continuous capacity of 10,000 amperes, and are guaranteed to carry this amount with a temperature rise not exceeding forty degrees centigrade. The intermediate starting levers, which as occasion demands, may also be used temporarily for regulating duty, will have 6,000 amperes capacity on the same basis.

The switchboard will consist of five panels, each panel containing two levers. The connection between the different panels will be made at the rear of the switchboard by bus-bars in the usual manner. At the front of the switchboard, such arrangements will be made that with very little trouble an entire panel may be removed from the board without disturbing the other panels, or the parts mounted on them. The levers on the several panels are mechanically interlocked in the manner adopted for the multiple-switch type of starters, so that the several levers composing the starter can not be operated except in a predetermined order.

The resistance for these starters will consist of standard steel rails, mounted in a steel rack, approximately twenty feet high, fourteen feet wide and twenty-seven feet long. There will be about 100 twenty-five-pound rails and 200 forty-pound rails used. This great capacity of resistance material is provided so that the resistance may be used to control the speed of the motor for short periods of time, even under comparatively heavy loads without permanent injury. The main connections to the starter will consist of six 1,000,000-circular-mil cables, while the intermediate resistance leads will consist of four 1,000,000-circular-mil cables.

The motors which these starters will be used to control are of Westinghouse make, and will be very heavily compounded. The motor armature shaft will carry a flywheel twenty feet in diameter, weighing approximately 125,000 pounds, and will be directly connected to the standard blooming mill rolls. The motors will be designed to stand very heavy overloads for short periods of time, and mechanically constructed so as to stand the strains encountered in this service. The normal speed of the motor will be 100 revolutions per minute, and allowances will be made so that this speed may be increased twenty-five per cent by weakening the shunt field of the motor. If the installation of these motors proves satisfactory, which result is confidently expected, the Carnegie Steel Company will equip the mills in its other plants with motors instead of the cumbersome steam engine now used.

For some time the Pittsburg Reduction Company has had a 1,500-horse-power, 500-volt motor driving a blooming mill in satisfactory operation at its plant at Massena, N. Y., which is controlled by a 500-volt starter, similar in construction to those to be installed at Braddock. Since installation, this particular equipment has given every satisfaction, and it would now seem as if the motor-drive was considered perfectly feasible for the largest mills.

New Arrangement in the Sales Organization of the Westinghouse Machine Company.

The Westinghouse Machine Company has recently announced substantial extensions in its sales organization. These extensions are the result of the rapidly increasing business, making necessary the more thorough covering of southern and western territories.

In addition to the original New York, Boston, Pittsburg and Chicago offices, new branches have been established at Cincinnati, Denver, San Francisco, Charlotte, N. C., and Atlanta, Ga. With these added facilities the extensive mining territory of the West and cotton industries of the South may receive more active attention.

The steam turbine and gas engine business of the company has increased rapidly during the last few years, and the prevailing activity in this branch of power development augurs well for the future.

The representative offices of the company are now as follows: New York, 10 Bridge street, L. L. Brinsmade; Boston, 131 State street, E. L. Clarke; Pittsburg, Westinghouse Building, William Bradford; Chicago, 171 La Salle street, John B. Allan; Cincinnati, 1111 Traction Building, A. A. Brown; Denver, 512 McPhee Building, C. C. Chappelle; Charlotte, N. C., South Tryon street, Stuart W. Cramer; Atlanta, Ga., Equitable Building, Stuart W. Cramer; Philadelphia, Stephen Girard Building, R. Muckle, Jr. & Company; San Francisco, 614 Mission street, Hunt, Mirk & Company.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

PORTLAND STREET RAILWAYS SOLD—The Portland Consolidated Street Railway Company, which operates all the street railways in Portland, Ore., has been purchased by a syndicate composed of Pennsylvania capitalists. The price was $5,000,000.

PROPOSED POWER PLANT IN OREGON—A town site is being developed near the falls of Hood river by W. Ross Winans. He proposes to construct a series of dams along the river, by which 50,000 horse-power may be developed. Power will be transmitted to points in the valley to supply the various towns with electric light.

CONSOLIDATION OF LIGHTING COMPANIES IN SOUTH DAKOTA—A merger of the Lead and the Deadwood electric light companies has been effected. The new company will install a power plant at Pluma, which will be one of the largest in the West. The plant will cost $10,000,000, including machinery and the transmission lines.

EXTENSION OF THE EDISON SAULT ELECTRIC COMPANY—The Edison Sault Electric Company, of Sault Ste. Marie, Mich., has filed a mortgage for $500,000, in favor of the Central Trust Company, of New York. The mortgage is to secure a bond issue. The proceeds of the bond issue are to be used for extensions of the electric plant and service in Sault Ste. Marie. The first section of the plant to be erected will develop from 2,500 to 3,000 horse-power.

TRANSFER OF COLUMBIA WATER-POWER COMPANY—The Columbia Electric Street Railway, Light and Power Company is negotiating for the purchase of the Columbia Water-Power Company. It is proposed to erect an auxiliary steam plant at a cost of $300,000. This plant is to be used in emergencies. The company will supply motive power to the factories, mills and other plants in Columbia, S. C. The merger involves an investment of $2,000,000.

INTERURBAN LINE TO BE BUILT IN CANADA—The London, Chatham & Western Electric Railway will build 113 miles of track connecting London and Windsor, Ont. The legislature has authorized the company to borrow $25,000 per mile of right of way, and has passed an act allowing the company to sell power with the consent of the municipalities interested, and to sell light and heat with the consent by by-law of the people. The road must be in operation within four years.

MERGER PLANNED OF INDEPENDENT TELEPHONE COMPANIES IN NEBRASKA—A company has been organized, and will issue bonds to the amount of more than $500,000, to control all the independent telephone lines in southeast Nebraska, northeast Kansas, northwest Missouri and southwest Iowa. Full details are not at present available, but the combination will include all the independent lines between Omaha and Kansas City as far west as Lincoln, Neb., and as far east as Red Oak, Iowa.

NEW ELECTRIC ROAD IN THE CAROLINAS—The Charleston, Virginia & Ohio Railway has been chartered to build from Charleston, S. C., to Newton, N. C., a distance of 250 miles. The authorized capital is $2,200,000, with $500,000 paid in. The incorporators are W. C. Ervin, H. L. Milner and E. P. Tate, of Morganton, N. C.; W. T. Hunter, Joseph F. Gowan and Robert Regney, of New York. The chief office of the company will be at Morganton, N. C. The road will open up the country from the seaboard to the mountain districts of North Carolina, and on the line are a number of the best-known summer resorts of North Carolina.

COMBINATION OF INDEPENDENT TELEPHONE INTERESTS IN CALIFORNIA—The California Independent Telephone Association has been formed. The combination consists of all the independent telephone companies of southern California. Officers have been elected as follows: president, John L. Van Liew, Los Angeles; first vice-president, D. S. Parker, Pomona; second vice-president, Roscoe Howard, San Diego; secretary, P. T. Spencer, Whittier; treasurer, William L. Frew, Compton. Executive committee: K. C. Wells, Redlands; W. J. Lambert, Riverside; A. L. Orton, Pasadena; P. Kerr Higgins, Los Angeles. Sixteen companies are interested, representing an investment of over $10,000,000. Thirty exchanges, 30,000 instruments, and toll lines extending to 110 towns and cities, are involved.

TELEPHONE AND TELEGRAPH.

READING, PA.—The Conestoga Telephone Company has completed arrangements to build a line from Douglassville to Bramcote.

DES MOINES, IOWA—The Black Hawk & Grant Township Telephone Company has been organized. Fred Schreiber is president.

GADSDEN, ALA.—The Southern Bell Telephone Company expects to complete its new line from Attalla to Altoona within the next two months.

TUNKHANNOCK, PA.—The Bell Telephone Company is extending its lines to Laceyville. The company has completed connection with West Nicholson.

PLAINFIELD, N. J.—The Lebanon Telephone Company is to extend its line from High Bridge to German Valley, taking in all the intervening towns.

ATLANTIC CITY, N. J.—It is said a new system of coast telephones will be installed from Cape May to Sandy Hook for the benefit of the life-saving patrol.

WOODSTOCK, ONTARIO—The Bell Telephone Company will erect a new building in Brantford at a cost of $40,000, and will install a central energy switchboard.

DULUTH, MINN.—The Mesaba Telephone Company will soon make extensive improvements to the service. Two new improved one-hundred drop-boards are to be installed at once in the exchange.

EDWARDSVILLE, ILL.—The Taylorville Home Telephone and Telegraph Company, of Taylorville, is getting ready to install a plant. The capital stock is $50,000, which is owned by local parties.

ADA, MINN.—The old Norman County Telephone Company has been reorganized with the following directors: A. L. Hanson, C. C. Allen, N. T. Moen, Sam Olson, M. A. Brattland, William Bosworth, C. H. Brown.

EMPORIA, KAN.—W. W. Finney, of Neosho Falls, has taken charge of the Emporia telephone exchange, having purchased the stock of the late Frank Brown, of Topeka, who owned the controlling interest.

SEATTLE, WASH.—E. E. Webster, manager of the Independent Telephone Company, has finished preliminary details for a long-distance telephone circuit that is to embrace all the principal points in the Pacific Northwest.

HANNIBAL, MO.—The directors of the Miller Township & Hannibal Telephone Company have elected the following officers: president, George W. Pine; vice-president, H. C. Whaley; secretary and treasurer, L. E. Frazier.

BALTIMORE, MD.—The Union Telephone Company, of Baltimore County, has filed for record a certificate of the increase of its capital stock from 120 shares of the par value of twenty-five dollars each to 400 shares of like value.

PORTLAND, ORE.—More than sixty men are engaged in placing underground conduits on the east side of Portland for the Pacific States Telephone Company. The work will cost about $25,000 and it is expected to have it completed by the latter part of August.

IDA GROVE, IOWA—Manager James E. Moorehead, of the Ida County Telephone Company, announces the early construction of six miles of rural telephone line, and the installation at the same time of about twenty more telephones, which will bring the total

Digitized by Google

number of instruments connected to the Ida Grove switchboard up to 495, and make a total mileage of lines owned by the local company of 110 miles.

WILKESBARRE, PA.—The Dietrick property on Northampton street has been purchased by the Pennsylvania Telephone Company. It is the intention of the company to erect a modern building. The present site on North Wyoming avenue will be abandoned. The exchange will be modern in all particulars.

UNIONTOWN, PA.—Judge Robert E. Umbel, John M. Core and Robert F. Hopwood, the executive committee of the Tri-State Telephone Company, have effected a deal whereby the Tri-State company becomes the owner of the Monongahela Valley Telephone Company, which is composed mostly of Brownsville capitalists.

SALT LAKE CITY, UTAH—The Bell Telephone Company is making a $20,000 addition to its central station, which will increase the capacity of the office one-third. The installation will be complete inside of thirty days. An exchange is also being installed at Twin Falls, Ida., with one hundred subscribers, and work has been begun in an exchange building at Ogden, where extensive underground improvements will be made.

COHOES, N. Y.—At a meeting of the Cohoes & Waterford Home Telephone Company the following officers were chosen: president, James H. Shine; vice-president, Irving H. Griswold; secretary, Sam Strong; treasurer, George R. Wilsdon; manager, Oliver J. Hawkins. The board of directors is as follows: James H. Shine, John Clute, Fred W. Kavanaugh, Irving H. Griswold, Frederick H. Sudro, Thomas Breslin, George H. Fitts, Paul H. Andrae, Sam B. Rawson, Theodore M. Brush, Howard Hendrickson.

ALBANY, N. Y.—The Home Telephone Company has elected the following officers: president, Howard Hendrickson; vice-president, Irving H. Griswold; treasurer, George C. Lee, Jr.; secretary, Henry J. Prince, Jr.; directors, James Moore, T. Henry Dumary, William H. Keeler, Albert Hessberg, E. B. Toedt, Howard Hendrickson, Eli M. Woodward, George C. Lee, Jr., Richard Stephens, Albany; Samuel B. Rawson, Irving H. Griswold, Theodore M. Brush, Frederick Sundro, W. E. Brooks, E. E. Williams, of Elyria, Ohio.

HARLAN, IOWA—At a meeting of representatives of the Bell and Farmers' Mutual Telephone companies an arrangement was effected, whereby the patrons of the Farmers' lines using the Harlan system may talk over the Bell lines. The Harlan Farmers' central office receives fifteen per cent of the toll charges coming into Harlan, and the Farmers' company at a nominal figure has the use of the Bell telephone poles in the city. The Harlan patrons of the Farmers' company will have Bell transmitters and receivers put in at an annual cost of one dollar.

LANCASTER, PA.—The annual meeting of the stockholders of the Southern Telephone Company was held at Kirkwood. The statements of the officers showed that the company had done a good business during the past year. The company now has direct connection with York County at McCall's Ferry, where messages can be transferred to a large part of that county. The following gentlemen were elected directors for the ensuing year: Cyrus G. Barr, P. C. Swisher and Frank Greenleaf, of Kirkwood; Irwin Cutler, of Furniss; Walter Kent, of Christiana, and T. C. Boyd, of Hensel. The board organized by choosing Irwin Cutler, president; Frank Greenleaf, vice-president; Cyrus G. Barr, secretary, and P. C. Swisher, treasurer.

WILLIAMSON, N. Y.—Announcement is made that the Wayne-Monroe Telephone Company has secured possession of the Kelly exchange at Newark. The Kelly system was established several years ago, and is now the largest system in any one town in the county. It was recently overhauled, and several thousand dollars spent in placing it in excellent condition. The annual election of officers for the ensuing year resulted as follows: directors, John A. Driscoll, of Rochester; J Seldon Brandt, of Ontario; Ledyard S. Cuyler, of Lyons; Albert Yeomans, of Lyons; George R Miles, of Wolcott; George F. Waters, of Pultneyville; James McCrea, of Walworth; William H. Kelly, of Newark, and Judson L. Transue, of Williamson. The board of directors elected John A. Driscoll, general manager and president; Judson L. Transue, secretary and treasurer; J. S. Brandt, Albert Yeomans and Judson L. Transue, executive committee.

ELECTRIC LIGHTING.

WISNER, N. H.—The town has voted to issue $9,000 bonds in order to erect a municipal electric light plant.

LIGONIER, IND.—The city council is asking for bids to light the city with electricity for a period of ten years.

McCOMB, OHIO—The town has purchased the electric light plant for $3,000. Bonds will be issued to pay for same.

OTTOWA, ONT.—The citizens of Ottowa have voted to authorize the city to spend $200,000 in order to purchase the Consumers' Electric Company.

HEMPSTEAD, N. Y.—The Queens Borough Gas and Electric Light Company has been granted a franchise to extend its poles and wires to all parts of the township.

ROCKFORD, ILL.—The Central Heat, Light and Power Company contemplates the erection of a new power-house and options are being secured on land for a site.

CATSKILL, N. Y.—The Catskill village board of trustees has granted the Catskill Illuminating and Power Company an extension of its franchise for thirty years.

ALEXANDRIA, IND.—The Alexandria Electric Light and Power Company will install a new system and add twenty-five arc lamps to the city lighting system, making eighty in all.

HAWLEY, PA.—The plant of the Hawley Electric Light and Power Company was totally destroyed by fire on May 18. The loss is $15,000, of which $10,000 is covered by insurance.

CENTRAL FALLS, R. I.—The city council has secured the option on a site on which to build a municipal electric light plant, when the present contract with the Pawtucket Electric Company expires.

YOUNGSTOWN, OHIO—Plans are being made for an extension of the power-house of the Youngstown Consolidated Gas and Electric Company. The extension is made necessary by reason of the electric company furnishing power for the street railway system.

MONTPELIER, VT.—The Consolidated Light and Power Company, of Montpelier, has been purchased by a syndicate composed of Wilbur F. Davison, A. D. Bennet, George Moore, of Port Huron, Mich., and others. The purchase price is said to have been $200,000.

THOMPSONVILLE, CT.—The Enfield Electric Light and Power Company will extend its lighting system to Hazardville and Scitico. It is estimated that from twenty to twenty-five miles of wire will be used in the work and that from 80 to 100 lamps will be needed.

HALESITE, N. Y.—The plant of the Huntington Light and Power Company is to be enlarged. The boiler capacity is to be doubled. A concrete building, 50 by 30 feet, is to take the place of the frame building now adjoining the power-house. It will contain offices, a laboratory for testing appliances, room for employés and storerooms.

SANDY HILL, N. Y.—The Glens Falls Electric Light Company has been given a fifty-year franchise to operate in Sandy Hill. Incandescent lights are to be supplied at ten cents per kilowatt-hour, and supply current for manufacturing purposes at five cents per kilowatt-hour. The arc lights are to cost $70 per lamp of 2,000 candle-power per year.

NORTH TONOWANDA, N. Y.—Sealed proposals for lighting the city from August 1, 1905, to August 1, 1906, or from August 1, 1905, to August 1, 1908, will be received until 8 P. M., on June 6, 1905. Proposals should be addressed to George J. Smith, city clerk of North Tonowanda, and should be accompanied by a bond to the city of North Tonowanda in the sum of $5,000 as a guarantee of good faith. Plans and specifications are on file in the office of the city clerk.

WILKESBARRE, PA.—The Wilkesbarre Gas and Electric Company will make improvements in its gas and electric plants at a cost of about $400,000. New machinery to be installed in the electric plant consists of an engine, condensing apparatus for all the engines, a new switchboard, and a coal and ash-handling plant. The increase in capacity of the station will be about 750 horse-power. The distribution system is to be changed from direct to alternating current.

Digitized by Google

ELECTRIC RAILWAYS.

NEENAH, WIS.—There is a report that the two lines, the Neenah-Oshkosh interurban and the Neenah-Appleton interurban, will consolidate their interests.

TRENTON, N. J.—Trenton now has direct trolley communication with Philadelphia, the Philadelphia, Bristol & Trenton Street Railway Company having commenced running its cars to Warren and Hanover streets.

JACKSON, MICH.—Shepherd, Mich., is to have an electric railway—the proposed line from Grand Rapids to Bay City. This line will tap a very rich farming district, most of which is entirely without rail facilities of any kind.

PHILADELPHIA, PA.—The franchise of the Delaware Interurban Railway Company, which purposes to build a line between Wilmington, Del., and Elkton, Md., has been extended one year. The company's work having been delayed.

SOMERSET, PA.—The property of the Meyersdale & Salisbury Street Railway Company, which was taken in execution some time ago at the suit of A. N. Slocum, has been sold to Harvey M. Berkley, cashier of the First National Bank, of Somerset.

CHATTANOOGA, TENN.—S. W. Divine has received official notice from Washington that a license has been granted him by the Secretary of War to build a line through the Chickamauga park and Fort Oglethorpe military reservations.

LEOMINSTER, MASS.—The contract for the building of the new electric street railway of the Worcester Consolidated, from Leominster to Worcester, by way of Sterling and Boylston, has been let and work begun. The contract has been awarded to J. G. White & Company, of New York.

ST. JOSEPH, MICH.—It is learned that Colonel W. W. Bean, former owner of the local street railway, and Charles A. Chapin, of Chicago, will construct the interurban system between Grand Rapids and Chicago, *via* St. Joseph, the proposed system to be the longest in the state of Michigan.

LEXINGTON, KY.—The contract for the construction of the interurban railroad to run between Lexington and Versailles has been awarded to Dolan Brothers. Under the terms of the contract the roadbed is to be completed, the rails laid and the wires stretched and ready for operation by September 15.

LAS VEGAS, N. M.—The Las Vegas electric line, which extends ten miles into the Gallinas cañon, has been sold to W. H. Buddecke, of St. Louis, who represents St. Louis capital. A. H. Duncan, of St. Louis, was the chief owner of the line. New cars have been ordered and the line will be extended and improved.

AKRON, OHIO—The Northern Ohio Traction and Light Company has signed a contract with the Barberton, Wadsworth & Western Railway Company to allow the latter to run its cars into Barberton and Akron over the tracks of the former road. The proposed line is intended to connect with Ashland, and actual work has already been commenced.

ALEXANDRIA, LA.—The Alexandria board of aldermen has granted a franchise for twenty-five years to T. G. Bush, of Mobile, Ala., to construct and operate an electric street car line in the city. The ordinance provides that work shall be commenced within four months, and that not less than three miles of track shall be completed in twelve months.

BLUFFTON, IND.—The Bluffton city council has voted to grant a franchise to the Ft. Wayne, Bluffton & Marion Traction Company for the use of Main and South streets. The interurban company has sixty days in which to accept the franchise and file a bond of $5,000. The company is to have the line from Ft. Wayne into Bluffton in operation by July, 1906.

MOUNT CARMEL, PA.—A charter has been granted to the Catawissa & Numidia Electric Railroad, the proposed line of which will extend from Catawissa to Numidia, where it is proposed to have it connect with another line that will extend from Numidia to Bear Gap. Surveys on the proposed road are to begin at once. It will have direct connection with Bloomsburg.

CHATHAM, ONT.—The formal organization of the Chatham, Wallaceburg & Lake Erie Electric Railway Company has been completed by the election of the following: president, Geo. W. Kipp, Towanda; vice-president, N. H. Stevens, Chatham; secretary, Edwin Bell, Chatham; general manager, W. N. Warburton. Directors: George W. Kipp, N. H. Stevens, D. A. Gordon, J. T. O'Keefe, R. E. Kizer, M. E. Lilley and S. F. Robinson.

YOUNGSTOWN, OHIO—The control of the Youngstown & Southern Railroad Company has passed into the hands of local capitalists, stock to the amount of $900,000 being purchased. The stock of the company represents $1,800,000, and twelve men of Youngstown now control the majority. The work of building the line to East Liverpool will be pushed at once. It will be a third-rail electric system, and contracts have been entered into for the equipment.

MEXICO, MO.—Only about forty miles of the right of way for the Missouri Central Electric Railroad from St. Louis to Kansas City are unsecured, it is said. The part lacking is in the counties of St. Charles, Lafayette and Saline. When the remainder of the right of way is obtained the financing of the authorized $4,000,000 capitalization will be completed and bids asked for the construction work. Bridge engineers have nearly completed plans and specifications for the two Missouri river bridges at St. Charles and Glasgow.

GRAND FORKS, N. D.—S. W. Wheeler, of the Wheeler Land Company, Moorhead, is at work interesting eastern capital in an electric line to run from Crookston to Fargo and Grand Forks. The proposed line would run due west from Crookston, on the south side of the Red Lake river, to a point opposite Fisher. It would there branch, one line running to Fargo and the other to Grand Forks. The line would be ninety miles long—sixty miles from Crookston to Fargo and thirty miles from Crookston to Grand Forks—and would touch a number of prosperous towns in the valley.

LANCASTER, PA.—A meeting of the stockholders of the Lancaster & Eastern Street Railroad was held recently, and it was decided to build the road at once. It will start at Conestoga park and run east down the Williamstown turnpike through the villages of Greenland, Soudersburg, Paradise, Leaman Place, Kinzers, Gap and end at Christiana. The company elected the following directors: Charles B. Keller, J. W. B. Bausman, J. Fred Sener, P. B. Shaw, James P. Marsh, P. E. Slaymaker, John S. Graybill, Jr., H. P. Brackbill, Jonas Eby, E. Herr Esbenshade, Joseph S. Esbenshade, B. Maurice Herr and S. R. Slaymaker. Charles B. Keller was elected president of the company, S. R. Slaymaker, vice-president, and John S. Graybill, secretary and treasurer.

ASBURY PARK, N. J.—The Seacoast Traction Company, which operates a trolley road from Belmar to Spring Lake Beach, recently secured a ninety-nine-years' franchise for an extension of its route through Spring Lake to Sea Girt, passing through Villa Park, and with the terminal adjacent to the state encampment grounds at Sea Girt. Through cars are now run between Asbury Park and Spring Lake, passing along the westerly boundary of Ocean Grove and through Bradley Beach, Avon-by-the-Sea, Belmar and Como. It is planned to have the Sea Girt extension completed in time for use this summer. The Monmouth County Electric Company is also arranging for the extension of its tracks to Oceanic. This company now owns and operates the road between Red Bank and Long Branch, connecting at the latter place with the Asbury Park cars. Still another road contemplated will run from Point Pleasant to Trenton, by way of Lakewood and Freehold.

MUSKEGON, MICH.—The annual meeting of the stockholders of the Muskegon Traction and Lighting Company was held recently. Out of 6,600 shares of common and preferred stock 5,500 shares were represented in person or by proxy. The following officers were elected: president, F. A. Nims; vice-president, Liddon Flick; secretary, Theodore S. Barber; treasurer, D. D. Erwin; directors, John N. Conyngham, E. F. Payne, Liddon Flick and Theodore S. Barber, of Wilkesbarre; F. A. Nims, Louis Kanitz and Thomas Munroe, of Muskegon. The report of the president showed that the net earnings of the company for the year to March 1 were $60,716.78, an increase of $5,278.73 over the previous year. As the bond interest of the company is $30,000, the company has earned more than twice the interest charges. The earnings for the past two months show an increase of eight per cent, and the outlook for the present year's business is exceedingly bright. Twenty-five thousand dollars was spent during the past year on betterments.

Digitized by Google

NEW INCORPORATIONS.

PLEASANTVILLE, NEB.—Union Telephone Company. $5,000.

FREDERICTON, N. B.—Provincial Telephone Company. $9,000.

LINCOLN, NEB.—Falls City Telephone Company. Increased to $50,000.

WATERFORD, N. Y.—The Waterford Electric Light, Heat and Power Company. Increased to $500,000.

SPRINGFIELD, ILL.—Mount Pleasant Telephone Company. $10,000. Incorporators: S. O. Stout, U. G. Ragsdale, James F. Dick.

PORTLAND, ORE.—St. Johns Water Works and Lighting Company. $50,000. Incorporators: J. L. Hartman, H. L. Powers and E. L. Thompson.

ALBANY, N. Y.—The Lower Niagara River Power and Water Supply Company, of Lewiston, Niagara County. Increased from $700 to $2,000,000.

ST. BERNICE, IND.—The Citizens' Mutual Telephone Company. $400. Directors: J. T. Newton, J. P. Hartsook, A. M. Reed, H. M. Nolan and V. P. Houston.

KEENE, N. H.—Citizens' Electric Company. $35,000. Incorporators: Robert E. Faulkner, G. Fred Little, L. M. Willard, Elisha F. Lane and Daniel R. Cole.

SALT LAKE CITY, UTAH—The Perry Electric Light and Power Company. $20,000. Officers: president, V. T. Davis; vice-president, John W. Francis; secretary and treasurer, James Young.

ST. PAUL, MINN.—The Walker Telephone Company. $50,000. Incorporators: E. I. P. Staede, Mankato; Charles Kinkele, C. E. Griffith, George E. Crow and Daniel De Lury, Walker.

OAKLAND, CAL.—Traction Transportation Company. $75,000. Directors: W. C. Reveal, of Berkeley; Jas. W. Blaine, W. S. Peters and W. H. Chickering, of Oakland, and H. C. Brougher, of Tonopah.

AUSTIN, TEX.—Gainesville Electric Railway and Light Company, of Gainesville. $50,000. Incorporators: E. J. O'Bierue, of Memphis, Tenn.; C. A. Zilker, of San Antonio; W. L. Greenhill, of Gainesville, and W. H. O'Bierue, of Gainesville.

ALBANY, N. Y.—The Niagara Power and Transmission Company, of Niagara County. To generate, sell and transmit electric power for all purposes. $5,000,000. Directors: Edward B. Bruce, Allan C. Rearick, Edward E. Stowell, Frank H. Cole, of New York, and John J. Daily, of Brooklyn.

INDIANAPOLIS, IND.—Laycock Power-House Company. $250,000. Officers and directors: president, T. B. Laycock; vice-president, Charles E. Coffin; second vice-president, I. N. Richie; treasurer, Charles E. Holloway; secretary, James F. Lindley; additional directors, W. H. Laycock, Clarence A. Kenyon, John H. Lytle and Irvin Conoway.

ALBANY, N. Y.—The Killawog Telephone Company. To construct a telephone line connecting the towns of Lisle and Triangle, Broome County, and Marathon, Willett, Lapeer, Harford, Virgil, Freetown, Cortlandville, Hoover, Preble, Cincinnatus and Solon, Cortland County. $18,000. Directors: Charles G. Tarble, Irving R. Hitt, Marvin Muckey, of Killawog; Albert C. Baker, A C. Adams and Charles A. Brooks, of Marathon, and W. S. Dickson, N. L. Shevalier and Joseph Shevalier, of Messengerville.

ALBANY, N. Y.—Oswego River Power Transmission Company, of Syracuse; to supply gas and electricity for power, light and heat in the counties of Onondaga and Oswego in particular, with the privilege of operating all through the state; $20,000; directors: Simon B. Storer, Louis W. Emerich and George W. Pulver, of Syracuse. Aqua Light and Power Company, of New York; $100,000; directors: Daniel H. Foley, of Brooklyn; Joseph M. Linden, of Wood Ridge, N. J.; James Simmons, of New York. Nassau & Suffolk Lighting Company, of Hempstead, Nassau County; to operate in Nassau and Suffolk counties; $200,000; directors: Samuel M. Havens, Dana T. Ackerly, George J. Corbett and F. C. Hauser, of New York, and James G. Stevenson, of Brooklyn. Over and Power Company; $20,000; directors: Simon B. Storer and George W. Pulver, of Syracuse, and Louis W. Emerich, of Fulton.

EDUCATIONAL NOTES.

UNIVERSITY OF MISSOURI—The University of Missouri, Columbia, Mo., has issued a bulletin describing the courses offered during the summer session, which will last from June 10 to August 10.

PURDUE UNIVERSITY—The following programme has been announced for commencement week at Purdue University, Lafayette, Ind.: Sunday, June 4, in Fowler Hall, baccalaureate address by Herbert Lockwood Willett, Ph. D., University of Chicago, 3 P. M.; vesper song service, 5 P. M. Monday, June 5, annual exhibit of the art department in the art studios, continuing throughout Tuesday; all departments and buildings open for inspection by visitors; ball games on Stuart field to be arranged between alumni, varsity, faculty and seniors; musical recitals in Fowler Hall by members of University, 4 P. M.; class and fraternity reunions and social functions in the evening. Tuesday, June 6, class-day exercises of the senior class during the morning, Fowler Hall and campus; ball game between Purdue and Indiana University, Stuart field, 3 P. M.; official reception in honor of alumni, graduates and guests, Agricultural Building, 8 to 11 P. M. Wednesday, June 7, graduation exercises, Fowler Hall, 9.30 A. M.; abstracts from these by members of the graduating class; address by Henry Churchill King, D. D., president of Oberlin College; conferring of degrees.

PERSONAL MENTION.

MR. D. H. ROBINSON has resigned as superintendent of the Indianapolis & Eastern Electric Railway, and has accepted a similar position with the Indianapolis & Western Electric Railway, which is now building a line between Indianapolis and Terre Haute, Ind.

MR. D. PERCY HARTZELL, of Frostburg, Md., has been elected secretary and treasurer of the Cumberland & Westernport Electric Railway. Mr. Hartzell held a position with the Cumberland & Pennsylvania Railroad, and succeeds Mr. W. H. Roberts, Jr., who has resigned.

MR. WARREN B. REED has recently returned from Nicaragua, where he installed and managed an electric light plant at the capital city of Managua. He has opened offices at 1011 Hibernia Bank Building, New Orleans, La., where he will carry on a consulting engineering practice.

MR. WILLIAM W. DONALDSON, electrical engineer of the Gould Storage Battery Company, has resigned and will spend the summer in the South resting. Mr. Donaldson has been a very hard worker, and his unremitting application has undermined his health. He has been ill for some time, and he will now reside at St. Denis, Baltimore, Md., where he will rest and recuperate.

MR. HOMER E. NIESZ, editor of the "Question Box" for the twenty-eighth convention of the National Electric Light Association, which will be held at Denver-Colorado Springs, Col., June 6-11, was a visitor to New York last week. Mr. Niesz is superintending the closing of the "Question Box," which will be bigger and better than ever. Few realize the great amount of work involved in making complete the most important department of the convention programme, and the association is to be congratulated upon having had the service of Mr. Niesz as editor.

MR. H. J. SLIFER has accepted a position with J. G. White & Company, Incorporated, 49 Exchange place, New York, as steam railway expert. Mr. Slifer was born in 1859, and graduated as a mining engineer from the Polytechnic College of Pennsylvania in 1880. From 1880 to 1882 he was with the Mexican National Railway and was engineer in charge of construction when he left the company. In 1882 he was made assistant engineer in charge of maintenance on the Philadelphia division of the Pennsylvania Railroad. His work included the replacing of a number of bridges and the moving of several bridges bodily to new locations. From 1891 to 1893 Mr. Slifer filled the position of assistant chief engineer of the Milwaukee, Lake Shore & Western Railroad, and upon its being merged with the Chicago & Northwestern he was made engineer of the Ashland division. He held this position until 1897, and during this time designed and constructed a large amount of dockage. From 1897 to 1899 Mr. Slifer was in charge of the construction of double track in Iowa for the Chicago & Northwestern Railroad. In 1899 he was made superintendent of the Iowa division of the Chicago & Northwestern Railroad, the operating, maintenance and motive power departments coming under his direction. In 1902 he

Digitized by Google

resigned to accept the position of general superintendent of the Chicago, Rock Island & Pacific Railroad in charge of operation, motive power and maintenance between Chicago and Denver. Mr. Slifer, as steam railway expert of J. G. White & Company, will be in responsible charge of matters relating to its steam railway undertakings.

ENGINEERING SOCIETIES.

PENNSYLVANIA STATE COLLEGE—The Electrical Society of the Pennsylvania State College met on Wednesday evening, May 17. The Institute papers on polyphase metering and the oscillograph were read and discussed. The final meeting for the school year was held on May 24.

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The twentieth regular meeting of the Toronto branch of the American Institute of Electrical Engineers was held on Friday evening, May 12. The subject for discussion was "Incandescent Lamps." Mr. A. B. Lambe introduced the discussion with an address entitled "Some Notes on Incandescent Lamps." The paper by J. D. Nies, entitled "Some Notes on Polyphase Metering," was also discussed.

LEGAL NOTES.

EXHAUSTING INCANDESCENT LAMPS—On May 17 District Judge Joseph Cross overruled the demurrer of the Germania Electric Lamp Company in the suit of the General Electric Company in the United States Circuit Court for the District of New Jersey. The patent involved in the suit was granted April 1, 1903, No. 726,293, upon the invention of John W. Howell, for a process of exhausting incandescent electric lamps, covering the method well known to incandescent lamp manufacturers as the "chemical exhaust," and owned by the General Electric Company. The justice held that a demurrer to a patent can be sustained only when the question of invention is free from doubt. There must be in the mind of the court an absolute conviction of the lack of invention; and if there is any doubt on this point, the case must be decided adversely to the demurrant. The court is not convinced that the patent does not disclose invention, and the demurrer is overruled.

IN A DECISION HANDED DOWN BY JUDGE RAY, in the Circuit Court of the United States, Southern District of New York, in the suit of Otis A. Mygatt *vs.* Edmund L. Zalinski and the Illuminating Engineering Company, for alleged infringement of a design patent on prismatic reflectors, manufactured by the Holophane Glass Company, the validity of the Mygatt patent was fully sustained, and the reflectors manufactured by the Illuminating Engineering Company held to be an infringement. A permanent injunction and accounting were ordered. The trial of this suit brought out some novel features in patent law, it being the first case on record where the peculiar appearance arising from the use of transparent glass has come into question. The patent on which suit was brought was design No. 32,685, and covered the well-known prismatic reflector which has been manufactured and sold by the Holophane Glass Company for the past five years. The infringing reflector was of the same general characteristics but with a slight modification, which had also been made the subject of a design patent. It was contended by Zalinski that the Mygatt patent was invalid, and also that his reflector was sufficiently different not to infringe. Both contentions, however, were denied by the court. In his decision, Judge Ray says, "in open court the complainant's reflectors, made according to the patent, were produced and placed in the position designated. It was clearly apparent to the court that the reflectors fill the bill, are all that is claimed. The evidence fully sustains the claim of the patent. The defendants are making and selling substantially what the complainant is making and selling or is authorized by his patent to make and sell. True, in some, if not all, the angle is changed; the edge is curved or beaded and in some there are other slight changes, but these changes are evidently made to be used in justifying the infringement if possible. The defendants' shades or reflectors are bald appropriations of the complainant's patent. Slight changes are made which add nothing to the ornamentation but rather detract therefrom. These, however, enable the defendants to say, 'our shade or reflector is different from yours; therefore we do not infringe.' . . . Clearly the patent is not void for want of invention. It is not claimed that 'the patent is generic as to form of configuration of the shade-body —embracing all frustums of cones.' They (the defendants) say, 'we may use the frustum of the cone shape, we may use a circular collar with an opening, we may use a smooth inside face, we may use the prismatic ribs; we may have them long or short as we elect; therefore we may use them in the combination indicated by the complainant's patent.' This can not be so if any design patent is to be held valid. . . . The court is of the opinion that the patent is valid and that defendants infringed. There will be a decree for an injunction and an accounting."

ELECTRICAL SECURITIES.

Professional sentiment regarding the present condition of the stock market is decidedly mixed. During the past week there was almost every conceivable variety of speculative agitation. Throughout one session there would be extreme buoyancy, followed by a decided reaction, and then again by considerable apathy. While it is held that the market is intrinsically sound, there are so many uncertainties in the situation that it is not presumed that there will be any early resumption of active speculation or any immediate advance in prices. It is quite unlikely, however, that there will be any further retrogression, as reports from almost every quarter indicate that there has been no abatement, and that there is no abatement in sight, of the prosperity which has been pretty general for the last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 20.

New York:	*Closing.*
Brooklyn Rapid Transit	60¼
Consolidated Gas	186
General Electric	170
Interborough Rapid Transit	201
Kings County Electric	200
Manhattan Elevated	162
Metropolitan Street Railway	115¼
New York & New Jersey Telephone	172
Westinghouse Manufacturing Company	188

Boston:	*Closing.*
American Telephone and Telegraph	139
Edison Electric Illuminating	246½
Massachusetts Electric	60
New England Telephone	137
Western Telephone and Telegraph preferred	98

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	79
Electric Storage Battery preferred	79
Philadelphia Electric	11⅝
Philadelphia Rapid Transit	32¼
United Gas Improvement	113½

The directors of the Philadelphia Electric Company have declared the regular semi-annual dividend of 2½ per cent, payable June 15 to stock of record May 24.

Chicago:	*Closing.*
Chicago Telephone	142
Chicago Edison Light	155
Metropolitan Elevated preferred	61½
National Carbon common	60
National Carbon preferred	116
Union Traction common	7¼
Union Traction preferred	37

The Chicago Union Traction report from March 1 to May 9 shows receipts and disbursements for each period equal. For March receipts and disbursements were equal at $1,239,642; for April at $1,247,021, and for nine days of May at $704,568. The company does not appear to be making any money. Cash on hand May 9 is set at $263,444 against $383,157 on March 1. The report shows that the receivers were each paid $1,500 per month.

Digitized by Google

INDUSTRIAL ITEMS.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., will be pleased to send its new index of publications. This is designated as bulletin No. 90, and is dated April, 1905.

THE WESTBURY LAMP COMPANY, 49 Hamilton street, Newark, N. J., is calling attention to its line of miniature lamps. These are of all forms and range in size from three-quarters to sixteen candle-power. They are made for voltages ranging from 2 to 130.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, manufacturer of the "Sterling Special" incandescent lamp, announces a reduction in price of frosted lamps from existing schedules, after May 19. The new schedule of prices may be secured upon application.

PARSELL & WEED, 129-131 West Thirty-first street, New York city, have issued bulletin No. 9051, describing Brocksmith dynamo castings and complete experimental outfits. The outfits comprise dynamos, motors, dynamotors, motor-generators, single-phase rectifiers, alternating-current generators, etc.

THE ASSOCIATION OF LICENSED MANUFACTURERS OF INCANDESCENT LAMPS, through its advertising committee, has issued a folder describing the advertising of licensed lamps which is now being done. The pamphlet consists of twenty pages, and contains a large number of advertising devices and labels.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued bulletins Nos. 4408 and 4409, describing, respectively, 125, 250 and 600-volt continuous-current, two-wire switchboard panels, and electrically driven turbine house pumps. The company has also issued publication No. 9138, entitled "Automatic Railway Block Signals."

THE GENERAL STORAGE BATTERY COMPANY, 42 Broadway, New York city, has issued catalogue A, descriptive of "Bijur" storage batteries of the "high-duty" type for stationary service. This catalogue is elaborately illustrated, and the text is sufficient to give a very good understanding of the electrical and mechanical features of the apparatus

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has broken ground for a two-story addition to its plant, which will have an area of 50 by 150 feet. The company is also erecting two very large porcelain kilns, in addition to its present equipment. Enlargements such as these have been made annually practically since the erection of the pottery, and they are becoming more extensive every year.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, was prominently represented at the recent International Railway Congress. The company's representatives were T. F. Manville, president; J. E. Meek, in charge of the company's exhibit; L. B. Melville, and James Younglove, manager of the company's Chicago branch. The company had an interesting display of asbestos and magnesia products and electrical supplies.

THE HOLOPHANE GLASS COMPANY, New York city, has recently secured an important decision in a suit for alleged infringement of a design patent on prismatic reflectors. The company owns numerous design patents covering all the forms and shapes of reflectors which are constructed on the prismatic principle. It is its intention to bring other suits immediately against all manufacturers and dealers who are making or selling prismatic shades or reflectors that infringe these patents.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39-41 Cortlandt street, New York city, states that it is supplying a large portion of the Bell telephone interests, the tunnels under the North and East rivers, New York, the underground rapid transit system of New York, the New York Central and Pennsylvania improvements, the Philadelphia Electric Company, the city of Baltimore, Norfolk, Va., and the forts of New York harbor with orders of vitrified conduit aggregating upward of 10,000,000 feet.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Ct., is calling attention to a very simple form of battery switch which it is placing on the market with great success. The end clips are made with spring fingers which press firmly against the blade, and, when changing from battery to magneto, a single slight movement throws the blade from one clip to the other, the change being made instantly. The base is of slate, two by four inches. All metal parts are heavy gauge copper.

FRANK B. COOK, Chicago, Ill., is advertising his protective devices of various types in a pamphlet in the form of an insurance policy. The instruments described on the interior pages of the policy are the type L protector, the Cook No. 8 self-soldering protector, the type SW pole cable terminal, the type JB junction box, and the pole terminals of the following types: A, SM, TM, H, W and M-2. Other articles described are the type 12-A subscribers' station protector, Cook's universal guy clamps, Cook's U-bolt clip, and the type 00 multiple-contact test connector.

DODGE & DAY, Philadelphia, Pa., as engineers and architects, have been commissioned by William Knabe & Company, Baltimore, Md., to take entire charge of extensive improvements to their plant. The operation includes a new five-story building 225 feet by 50 feet; new dry kiln and wood mill, as well as numerous changes to the present buildings. There will also be a new power plant, which will involve the purchase of a new engine and generator. Motors will be installed, and considerable electrical work done, as it is the intention to operate the plant electrically throughout.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, Chicago, Ill., will be pleased to mail its new bulletin No. 16, descriptive of "Union" enclosed fuses and blocks. This system of fuses has been perfected after several years of experimental work, and now includes the styles known as the "National Code Standard" and, in addition, fuses in sizes to fit other styles of blocks in common use, as well as a large variety of switchboard fuses of all sizes. "Union" code blocks are made from the highest grade of electrical porcelain with mountings of heavy brass and with phosphor-bronze springs. Extra fittings suitable for panel and switchboard work are also furnished for the fuses.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has issued a Brownie bulletin descriptive of common battery desk telephones. This bulletin is unique in its get-up, and will doubtless attract considerable attention. In addition to the allegorical pictures shown, there is a good technical description of the apparatus. A feature of the new desk-stand set is a metal desk-set box. The box is shallow, so that it may be mounted in any convenient place about a desk without being in the way. Standard parts are mounted in an iron case finished in black enamel. There are enclosing leads front and back which, when removed, expose the ringer, condenser and connecting racks. The new desk-stand set is furnished complete with cords and one of these metal desk-set boxes. Full information will be furnished upon application.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing considerable literature on fan motors, both direct and alternating current. The company, as general western agent for Diehl direct-current fan motors, carries in Chicago a large assortment of both desk and ceiling fans. In addition to this the company states that it is prepared to furnish Central Electric and Westinghouse fan motors, and that on all three lines the prices are attractive. The company will furnish catalogues and quotations, and will appreciate all enquiries on this subject. It has recovered a number of catalogues from the ruins of its building which was burned in February. These have been rebound and are doing service until new ones can be prepared. In the front of the book are photographs of the ruins of the old building, and of the company's new place of business 207-211 East Jackson Boulevard

THE WESCO SUPPLY COMPANY, St. Louis, Mo., is distributing a catalogue of electric railway and mining appliances. The company states that this is the most comprehensive catalogue on the subject which has ever been printed. The book contains about 500 pages, and is carefully compiled, edited and thoroughly indexed as to subjects, code words and catalogue numbers. The various sections treat of track equipment, rail bonds, bonding sleeves, pole brackets and fittings, trolley wire, anchors, guard wire insulators, trolley clamps, section insulators, cross-overs and switches, construction materials and supplies, motor and car supplies, station and mine devices and construction, linemen's and bonding tools. The last section contains a collection of data and information which the purchasing agent and engineer will find convenient. It consists of tables of sizes and weights of materials, and other information of a similar nature.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 22. NEW YORK, SATURDAY, JUNE 3, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Electrical Absorption Brakes 871
Practical Wireless Telegraphy 871
Insulators for Electrical Work 872
Telephone Infection 873
The National Electric Light Convention 873
A Large Electric Locomotive 873
The Properties of the Denver Gas and Electric Company, by C. W. Humphrey 874
Schenectady Visit of the Delegates to the International Railway Congress on the Long Tour 880
The Arkansas Valley Electric Company, by J. E. Johnston 881
Grand Junction Electric and Gas Company, by J. E. Johnston 881
A New Tool Steel 882
New Club-House and Garage for the Automobile Club of America 882
Annual Convention of the American Institute of Electrical Engineers 882
Meeting of the Railway Signal Association 882
National Electric Light Association 883
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 884
Combined Single-Phase and Continuous-Current Traction 885
Motor Buses in Malta 885
ELECTRICAL PATENTS 886
High-Tension Insulators 887
Raising Steam in Boilers 891
The Eddy Current Brake for Testing Motors, by D. K. Morris and G. A. Lister 892
A Large Single-Phase Locomotive for Heavy Railroad Service 895
Central Station Protection 897
Electric Lighting at the Lewis and Clark Exposition 901
Notes on the Application of Electric Power at Mines in Germany, by E. O. F. Brown 901
The First Woman Telephone Operator 903
INDUSTRIAL SECTION:
High-Tension Oil Switches 904
Water-Power Plant for Lighting the City of Chicago 904
A New Iron-Clad Entrance Switch 905
The Weber Key Socket 905
New Form of Incandescent Lamp 906
Prizes for Inventors 906
The New Home of the Electric Appliance Company, Chicago, Ill 906
New Line of Direct-Current Motors and Dynamos 909
Group Photograph of the Members Present at the Dinner of the Technical Publicity Association 910
New Wisconsin Power Company 910
CURRENT ELECTRICAL NEWS 911

ELECTRICAL ABSORPTION BRAKES.

The absorption brake for testing motors and prime movers still furnishes a standard test, in spite of a number of minor inconveniences and difficulties. Where possible, it is desirable to use the Hopkinson test, in which power is circulated, and only the losses of the machines are expended. But the Hopkinson test is not entirely free from objections, for it is not easy to separate exactly and apportion the losses to the different machines taking part in the test. Absorption brakes have been devised on a number of principles, some employing mechanical friction to dissipate the mechanical energy developed by the motor, others using electrical friction for the same purpose. Each type has some advantages of its own. The electrical type is, in general, easier to control. An example of this class was constructed and tested recently by Messrs. D. K. Morris and G. A. Lister, and is described briefly in this issue. This brake is interesting not only on account of its performance, but because of the theoretical investigations which have been carried out upon it.

PRACTICAL WIRELESS TELEGRAPHY.

Occasionally reports are made of an unusual distance of transmission of a wireless telegraph message, but of the daily working of the wireless system little or nothing is heard. Not long since mention was made of a determination to use this means of communicating with vessels near the coast, in order to increase the weather bureau service; and during the transatlantic race just finished, frequent mention was made of wireless messages transmitted from ship to shore or from ship to ship, giving the location of certain of the competing vessels. These instances call to mind the fact that wireless telegraphy is being used freely on shipboard, but it is probable that few except those who cross the ocean on some one of the liners equipped with wireless apparatus appreciate what this service means to the sea-going vessel.

In June of last year it was announced that one of the steamers of the Cunard system had kept in touch with one or the other shore during the trip across the Atlantic, and since that time it is said that overlapping of the messages when in mid-ocean has been the rule rather than the exception, the vessels of this line almost invariably getting in touch with the shore ahead before losing touch with that they were leaving. While, under ordinary conditions, it would be quite satisfactory if the vessel were in touch with one shore or the other throughout the entire voyage, if a greater range were secured the system would be so much the better and more reliable; and that this can be done satisfactorily was demonstrated by the recent trip of the Cunarder Campania, which arrived in New York early on the morning of Saturday, May 27. After leaving Liverpool on the preceding Saturday, the Campania began to receive messages when 300 miles out from Poldhu, and daily after that many messages were received relating to current events of most interest to the passengers. On Tuesday morning the Cunard bulletin announced that during the night the Campania had been in direct communication both with England and America; wireless messages were received from the Marconi stations at Poldhu, England, and at Cape Cod, Mass. The messages from England were sent out by Reuter's agency, and those from America by the Associated Press. The signals were strong and clear. The first message from this side was received about three o'clock in the morning, when the Campania was about 1,800 miles distant from Cape Cod, and 1,000 miles distant from Poldhu. On Wednesday, when the Campania was almost in mid-ocean—being 1,640 miles from Liverpool and 1,616 miles from New York—messages were received from both shores; and again on Thursday, signals from both stations were recorded. The Cunarder bulletin published on Thursday on the Campania contained news received from Poldhu when the vessel was 2,080 miles from that station. These messages were

Digitized by Google

among the longest ever received over so great a distance. They were strong and clear, and it was evident that communication could have been kept up from Poldhu longer had not the approach of the vessel to the Cape Cod station made it advisable for the Poldhu station to stop sending. Thus, it will be seen that the Campania was not only in constant communication throughout the entire trip, but that for three days she remained in communication with both shores.

These messages, it will be noted, are sent in one direction only: from the shore to the vessel. Messages are sent in the reverse direction normally about 150 miles, and, when conditions are favorable, about 260 miles. The limiting factor here is the equipment and the amount of power available on the vessel for wireless communication. If vessels could put more power at the disposal of the wireless system, much longer distances could be covered. It is noteworthy that this service was performed under actual working conditions. There was no special preparation for making a record, the messages being sent and received as routine work. Now that the ability to keep in touch with the world during an ocean voyage has been demonstrated, much of the dread which many feel regarding sea voyages should be removed. It only remains to provide the requisite power in order to make communication from the vessel to the shore continuous throughout the voyage. When this becomes possible, a great safeguard will be added to ocean travel, and the triumph of wireless telegraphy will be complete.

INSULATORS FOR ELECTRICAL WORK.

Nearly every great art depends for its progress upon the progress made in other arts. The engineer, in his work of controlling the natural forces, not infrequently is confronted by new conditions which require the use of a new material, or that the materials used previously be further improved. He then makes known his needs, and if a suitable article is not already available, some one generally undertakes to supply it. The need thus made known leads, then, to an improvement in an old art or the development of a new one.

An excellent example of the development of a great art to provide for the needs of another is the manufacture of insulators for electrical work. The first work in developing insulators was naturally done to supply the needs of the telegraph, that being the father of all electrical applications. For supporting the telegraph wires many materials were used, glass and porcelain being finally adopted almost to the exclusion of other materials. Glass, because of the ease with which it could be worked, became the common insulator material.

When other applications of electricity were made which required that wires be supported out of contact with the ground, the experience of the telegraph man was called upon, and the material which he used was employed where it would be satisfactory. The telephone requirements did not differ essentially from those of the telegraph, but, with the introduction of the electric light and the spread of the electric railway, and finally with the advent of power transmission, it was soon found that the telegraph insulator was inadequate to the work thrown upon it. Larger and stronger insulators become necessary, and as voltages rose step after step, the dielectric property—that is to say, the ability of the insulator to resist puncture by the electric pressure—became important. Up to this point many materials proved satisfactory. Fair insulating property and good mechanical strength, with the ability to manufacture the article cheaply, were the governing factors. When power transmission began to be taken up in earnest, however, voltages rose from 2,000 to 4,000, and then to 10,000. The electrical engineer demanded a better insulator, and began to lay stress upon its dielectric strength. Glass and porcelain still formed the materials of which they were made, but radical changes in the shape of the insulators were made, and the sizes were much increased. The insulator manufacturer was still able to supply the demands upon him. Now, not satisfied with 10,000 volts, we have gone to 20,000, 40,000 and to 60,000 volts, and, in some instances, even higher; and we still demand of the insulator manufacturer an insulator which will be reliable under these tremendous strains, and can not say that he has disappointed us. He has followed the progress of high-voltage transmission; he has studied the insulator problem in every phase; he has found the best method and the best materials of which to make it; he knows the shape which will give the greatest dielectric strength combined with the greatest mechanical strength, and still the insulator will be of such a shape that it meets other conditions such as being cleaned easily and not put out of service by a rain-storm. This progress in insulator manufacture has, of course, been the result of careful work. To turn out a reliable article requires that no step in its manufacture be neglected. One can not take a lump of clay, mould it into the desired form, bake it, and expect to have a perfect insulator. He must begin his work on the clay, and first prepare a suitable material. He must then shape his insulator, and must shape it so that it will not be punctured by a high voltage, so that it will have sufficient surface to prevent leakage over it. It must be sufficiently strong mechanically to hold the wire, and it must not be spoiled in the firing. The method by which this is done is recounted in an interesting article which appears on another page of this issue, in which the factory at which the famous Locke insulators are made is described. It will be seen from this article how every step in a long process is watched keenly, and how the progress of the material through the factory is checked at every stage; how the material is frequently tested so as to avoid loss, and how finally each insulator is subjected to a severe test before leaving the factory. It will be seen that the work is conducted in a most scientific manner, and that what one might be apt to look upon as merely a piece of shaped clay has really an interesting history; that there is a reason for every feature of it, and that its performance under any specified conditions can in general be predicted as accurately as that of any other material used by the engineer. The high-tension insulator of to-day is a noteworthy instance in which one art—in this case, ceramics—has met the needs of another.

Digitized by Google

TELEPHONE INFECTION.

This seems to be the age of germ diseases. Every human ailment is attributed to some minute organism which, for the moment, has assumed an unusual activity, with detrimental consequences. Many diseases are believed to be spread by these germs, which are supposed to attach themselves to every object used by the afflicted person, and there wait for an opportunity to seize upon a new victim. One of these objects sometimes held in suspicion is the telephone, particularly the public instruments which are used by every one. To see whether there is any truth in this matter, a recent examination was made in London, England, of a number of telephone instruments taken from public booths. These were carefully washed, and the water examined bacteriologically. Though the instruments were very dirty, no germs were found. The washings were then used to inoculate four-footed pigs, the two-legged variety not offering itself for the experiment. We are happy to say that the guinea pigs suffered no ill from the test. As these instruments were taken at random, and had doubtless been used many times by affected persons, the result should allay somewhat the anxiety of those who feel uneasy when using a public telephone.

THE NATIONAL ELECTRIC LIGHT CONVENTION.

The outlook for the coming convention of the National Electric Light Association, which will begin at Denver on Tuesday of next week, and conclude at Colorado Springs the following week, is good. The programme laid out, both as regards business and the scarcely less important work of sight-seeing, is varied and interesting. Although Denver seems to us very far west, it is only about two-thirds of the way across the continent. Nevertheless, the greater part of the members in attendance will journey from the east. The scenery, however, will reward them for their tiring trip, and their weariness will soon be forgotten when they experience western hospitality. When Denver, surrounded as she is by magnificent mountains, takes them in with open arms, all thought of weariness will be banished by the expectation of pleasures to come.

The convention will practically be divided into two sessions: the business meeting at Denver, and a pleasure session at Colorado Springs. During the business session a number of papers will be presented, which promise to be of unusual importance, besides which there are the "question box" and "wrinkles," which are always most interesting. The report on "The Present Methods of Protecting from Lightning and Other Static Disturbances," by Mr. Alex Dow, will doubtless be a valuable contribution to this perplexing problem. We are not yet accustomed to the alternating-current commutating motor for purposes other than railway work, except when used incidentally, but Mr. Clarence Renshaw will speak of the possibilities of using this type of motor for other purposes. There are a goodly number of other papers on subjects not less important than these, some relating to the engineering branch of electric lighting, others to the business end.

Colorado Springs is a particularly desirable place for a pleasure meeting, and we have no doubt that the greater part of those who attend the business meeting will not slight the other. The railway accommodations will be unexcelled, which will do much toward making the trip easy. Unless all signs fail, this convention will go on record as one of the most successful held by the association.

A LARGE ELECTRIC LOCOMOTIVE.

During the visit made recently by members of the International Railway Congress to the magnificent shops of the Westinghouse Electric and Manufacturing Company at East Pittsburg, Pa., they had the exceptional opportunity of examining one of the largest electric locomotives that has ever been constructed. This new monster is noteworthy in several respects. Besides being the largest alternating-current electric locomotive, it is equipped with six of the largest single-phase motors ever made. The locomotive is made up of two units normally operated together, but they can be separated and each used independently if desired. The complete locomotive weighs 135 tons. It has a normal drawbar pull of 50,000 pounds at a speed of ten miles per hour. Each unit has three 225-horse-power single-phase motors, one driving each of its three axles through single-reduction gears. The total nominal rating of the locomotive is therefore 1,350 horse-power, but, as with all electric motors, this rating is merely nominal, as it can be called upon to perform much greater work for a short time. Other distinctive features of this electric giant are forced ventilation of the motors and the method of control. Forced ventilation—by which is meant that the cooling air is forced through the motor in place of being allowed to circulate naturally—enables a much greater amount of heat to be got rid of than could be dissipated without it. Forced draught has already been used successfully in transformer practice, and its employment here to cool the motors of a locomotive will be watched closely. One of the difficulties in the construction of powerful electric locomotives is the necessity of compacting the motors and crowding them into small spaces. As the output of a motor is limited, not by its mechanical strength, but by the amount of heat which it can dissipate, an increase in size in addition to other changes must be accompanied either by increasing the radiating surface or improving the ventilation. The size of a railway motor is limited by railway conditions, and it remains to be seen how great an increase in output can be secured by improved ventilation.

The method adopted for controlling this locomotive will also be watched closely. The variations in speed are secured by voltage variations, themselves produced by means of a variable-voltage transformer. As this method does not make use of a rheostat, rheostatic losses are eliminated, and the locomotive is enabled to run at any speed at practically the same efficiency.

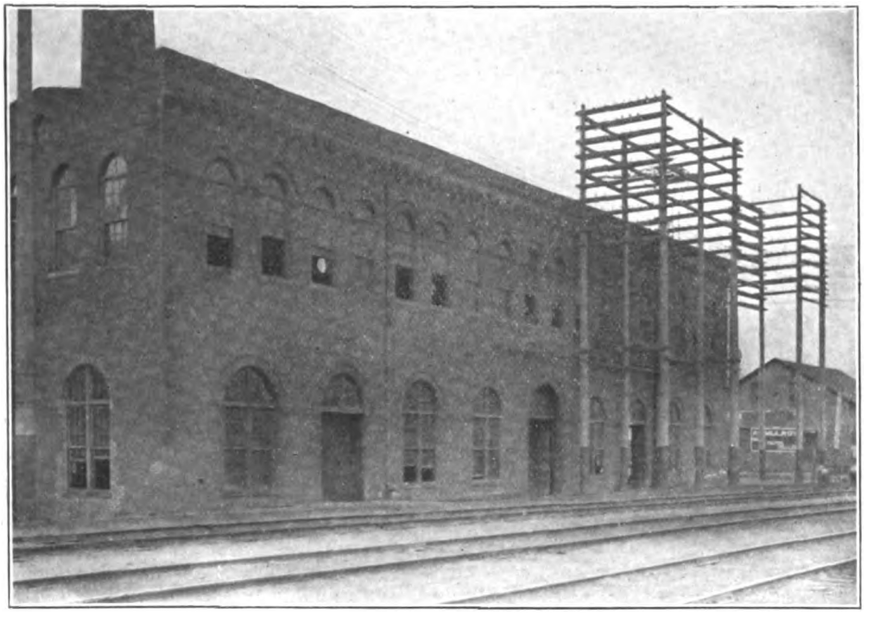
In spite of the enormous power which can be exerted by this single-phase locomotive, its energy is drawn from a single overhead trolley wire less than half an inch in diameter—a remarkable result which is accomplished by using a line voltage of only 6,000. This great tractor has been built for experimental work, and will be tested thoroughly in every respect. Its performance will no doubt draw attention again to the possibility of substituting the electric for the steam locomotive.

Digitized by Google

The Electrical Properties of the Denver Gas and Electric Company.

By C. W. Humphrey.

MEMBERS of the National Electric Light Association attending the annual convention to be held in Denver and Colorado Springs June 6 to 11 inclusive, will be much interested in the developments made by the Denver Gas and Electric Company during the past few years, and also the methods now in vogue which have nearly tripled the station output in the past three years. It seems even more phenomenal, however, when you stop to consider that Denver was one of the first cities in the United States to boast of electric lights, and since that time there have been many changes and consolidations, so that the Denver plant has experienced almost one continual round of remodeling and modernizing.

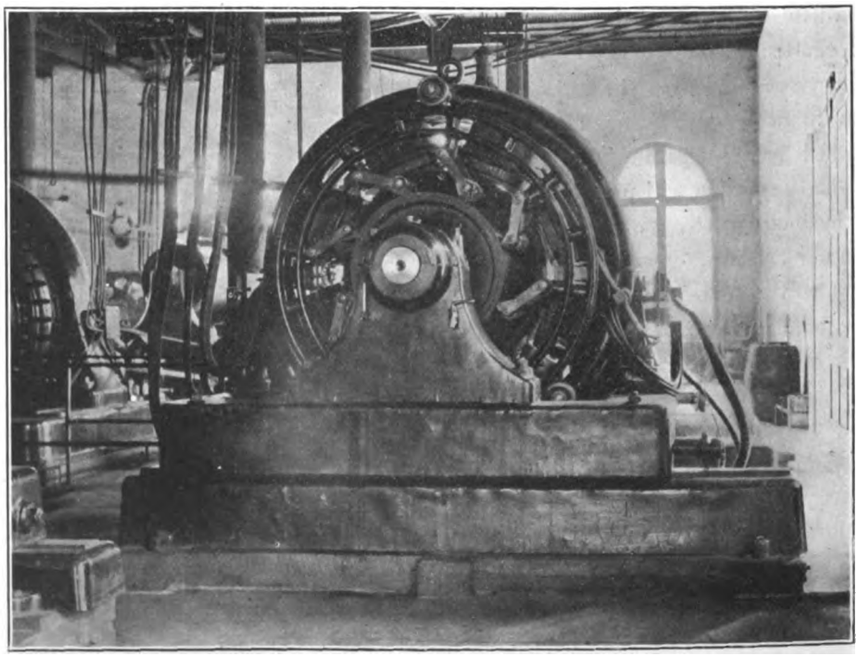


DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.—WEST STATION

In the year 1901, Mr. Henry L. Doherty took charge of the Denver electrical properties and since that time the Denver properties have developed at a remarkable rate. New methods were inaugurated, involving revolutionary changes in office management and station operation. New and modern machinery was purchased to replace old and obsolete types. The entire system of electrical distribution was gradually changed over to a more efficient system of three-wire secondaries and banked transformers.

The offices of the Denver Gas and Electric Company are situated in a two-story building 60 by 125 feet, located in the central portion of the business district, and are always conspicuous in the daytime for the business activity, and at night for the electrical display. From these offices the 700 employés of the company are controlled, and bills rendered to over 12,500 electrical consumers and 21,000 gas consumers monthly. Free lamp renewals are supplied for a connected load of over 250,000 sixteen-candle-power incandescent lamps. There are 1,600 arc lamps connected for commercial business alone, and the power supplied to drive machinery in and about Denver amounts to over 9,500 horse-power ranging in sizes from one-tenth horse-power to 200-horse-power motors. Only the most modern and up-to-date office systems are employed, twenty-eight loose-leaf consumers' ledgers are employed, two tabulating machines are kept in constant operation, and a complete city index card system is kept up to date, showing all orders issued or executed for every house-number in the city.

Of the office departments, the "New Business" department will probably create the greatest interest, and it is well worth any central station man's time and expense to travel half way across the continent to study and investigate the methods here used. Here it has been proved and demonstrated that an almost unlimited demand may be created in supposedly barren fields. The "New Business" department is divided into two main branches, the advertising or publicity department and the soliciting department. The main features of the work to be done by these two departments are laid out in committee meetings composed of the heads of all the departments.



400-KILOWATT, BULLOCK DIRECT-CURRENT GENERATOR, WEST STATION, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

The advertising department has charge

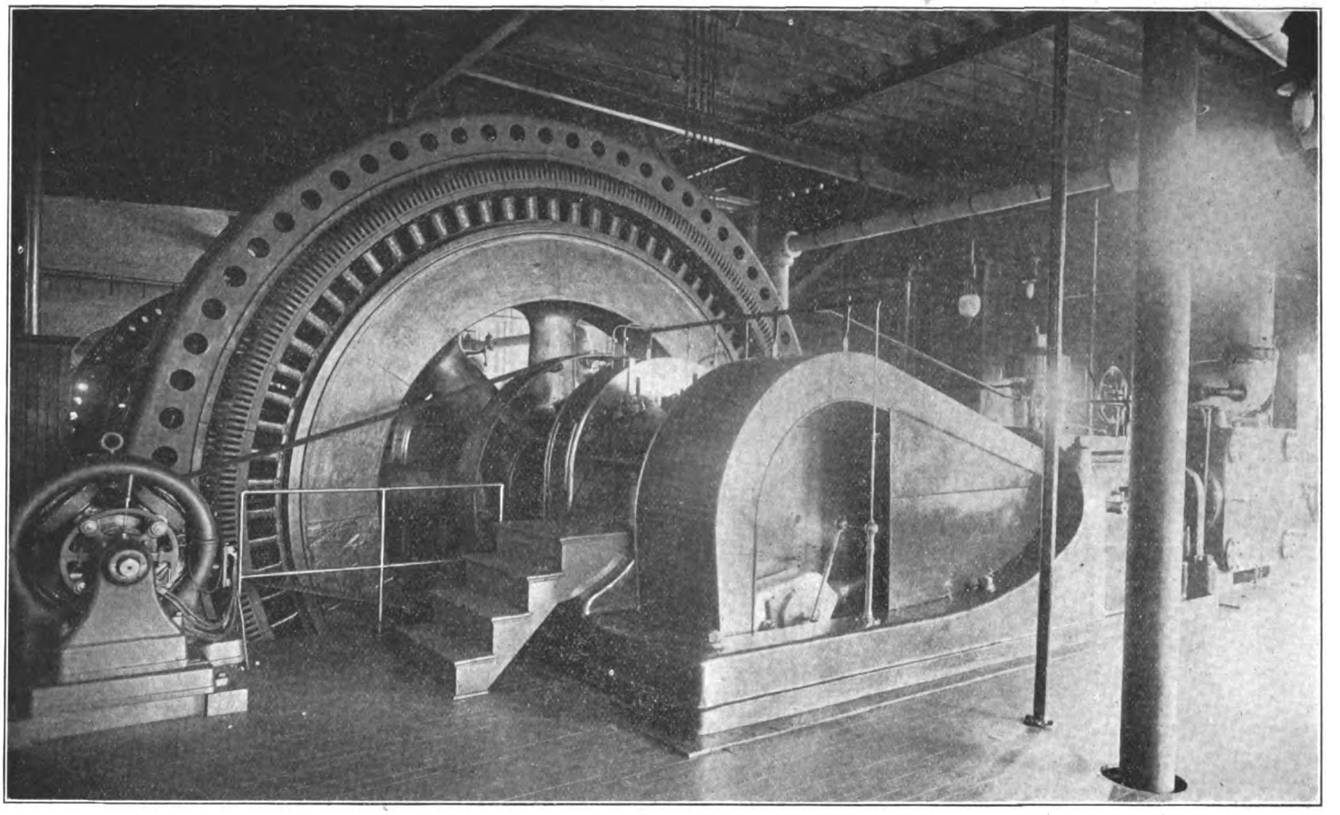
Digitized by Google

of all mail, newspaper, sign and other special forms of advertising. Some form of mail advertising goes out daily, all of which is followed up by the soliciting department.

The soliciting department is made up of over fifty active representatives, including special representatives, or specialists in sign and window lighting, power and fuel gas propositions. The city is divided up into fourteen territories, each territory being in charge of a representative and two or more assistants. A tabulated card index list is kept of all prospects, good or bad, in each particular line, and each representative is required to hand in daily reports of progress made. Each morning a meeting is held, comprising all representatives; at these meetings new ideas are discussed and the general campaign for the day laid out. Every man in this department is paid on a basis of increased revenue from each representative's respective territory, increase being based on that over and above the same month the previous year. In this way it is to the representative's interests, as well as the company's, to strive to sign up the best paying business to the company, neglecting such other business as would prove unremunerative.

The scope and effectiveness of the "New Business" department may readily be judged when it is known that over 400 electric signs have been hung during the past two years, and that some of these signs will compare very favorably with the best in any of the large cities. The electric signs of Denver, together with the regular street illumination, window and outline lighting, make the city one of the best lighted in the country, and have earned for it the title of "The City of Lights."

It was in Denver that the Doherty rate was first tried and universally adopted, and was one of the main items which has forestalled and knocked out competition and ensured the success of the Denver company. This rate is now being applied to the selling of gas.



1,500-KILOWATT BULLOCK ALTERNATOR, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

Denver is a city which covers a great area, but there is no place inside of the city limits which can not be lighted by electricity; the lighting lines cover extreme distances of about fifteen miles from one end of the city to the other. Not being content with its local field, the company has reached out and constructed transmission lines to all tributary cities and towns within a radius of twenty miles from Denver. Among the cities supplied in this way are Littleton, Golden, Globeville, Elyria, Englewood and Montclair.

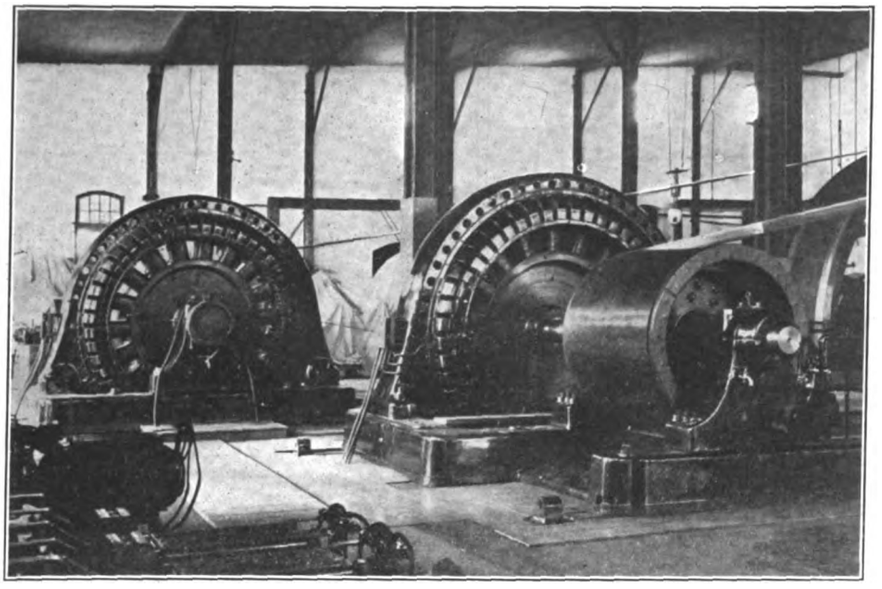
One transmission line, three-phase, 12,000 volts, sixty cycles, extends due west of the city for about twelve miles to supply power to two enormous gold dredges which are operating along the bed of Clear Creek. The current is stepped up at the Denver station from 2,400 volts in three delta-connected Westinghouse transformers of 125 kilowatts capacity each. At the step-down substations, one located at each dredge, the current is stepped down by three fifty-kilowatt Westinghouse transformers to 380 volts for use in a rotary converter. These small substations containing step-down transformers, are of wood construction mounted on wooden sledges to permit of being drawn about, as the dredges are constantly moving, and are connected to substations by only 600 feet of three-conductor, No. 000 flexible rubber-covered cable. When the dredge has worked out the limit of this cable, the substation has to be moved. This secondary cable lies on the ground with no protection until within three hundred feet of the dredge, when it is covered with a rubber fire hose to protect that portion which is constantly submerged in water. This cable transmits about 150 kilowatts at 380 volts, three-phase, to be used partially in three-phase induction motors and rotary converter. Lightning arresters are placed on each end of this line and thus far there has been no trouble experienced due to lightning.

There are four different classes of elec-

Digitized by Google

tric service in Denver, incandescent lighting, series arc lighting, direct-current power and alternating power.

The incandescent lighting is supplied to the city of Denver by means of twenty-six single-phase, 2,400-volt feeders, of



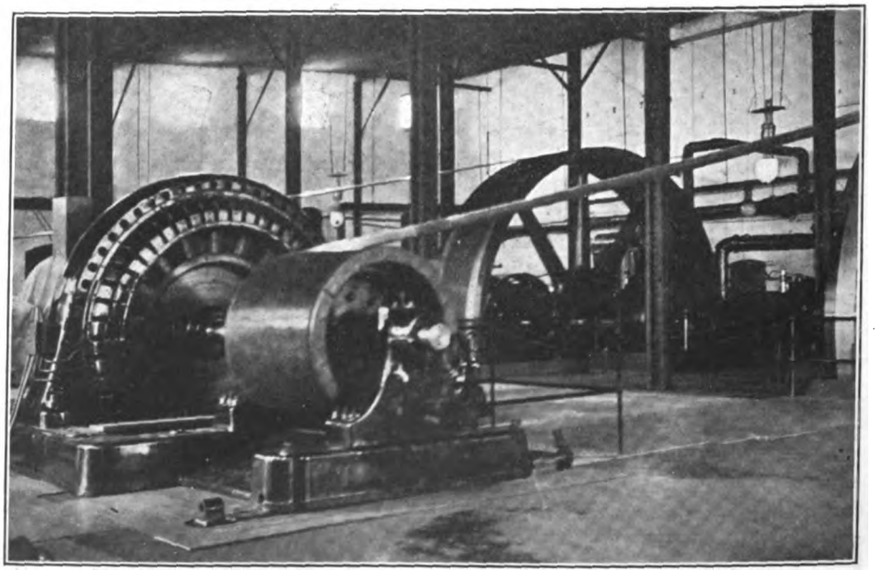
600-KILOWATT, THREE-PHASE ALTERNATOR, EAST STATION, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

from 150 to 300 kilowatts capacity. The secondaries are all three-wire network of 108 and 216 volts. The centre of distribution of some of these feeders is as high as six miles from the station, and as only six out of the twenty-six feeders are equipped with feeder regulators, great care had to be exercised in the design of each feeder in order to furnish good regulation. Some of these feeders cover a large area and in such cases the primaries had to be run to the centre of distribution and then feed back to the different sections of the feeder. The standard sizes of transformers used are five, ten, and twenty-kilowatt sizes. All secondaries in the residence feeders are made of three No. 4 wires and the downtown feeders of three No. 2 wires. Proper regulation is obtained by the spacing of the proper-sized transformers according to location of load. Junction fuses are used on the secondaries between all transformers and of such a size that, if for any reason the primary fuse of a transformer blew, these secondary junction fuses would blow, cutting a section out of service, which would be equivalent to the load on the transformer. Copper wire across ordinary break-arms are used for junction fuses.

The Denver company, to all probability, looks after the operation of its transformers in service more carefully than any other company in the country. During the fall when the peak load is rapidly increasing, periodic tests are made on each transformer in service to ascertain the load and as to whether that load is balanced or not. This test is made by means of a special instrument, by which the current flowing from a transformer may be ascertained without cutting of wires or interruption of service. This is accomplished by means of a special series transformer with a two-piece iron core hinged together so that it may be readily clasped about any wire. The transformer is connected to an ammeter by about forty feet of duplex flexible cable. The ammeter is calibrated directly with series transformer. Two men in this way are enabled to test a large number of transformers in one evening during the peak load. A record of these tests is kept so that if it is desired, the load on any transformer may be looked up with very little trouble. This instrument has proved very valuable to the Denver company in keeping transformers properly balanced and loaded.

As it is customary to overload the transformers from twenty to fifty per cent, according to location, a close watch must be maintained and with the above system in vogue a great saving is made, both in losses and original costs. A card index is also kept of all transformers in service, showing type, make, location, size and losses. A consumers' index is also kept up, showing consumers, meters and connected load arranged by feeders.

The Denver company keeps a careful record of lost and unaccounted-for current for each different feeder, keeping track of station output, kilowatt-hour sales, transformer losses, primary, secondary and meter shunt losses. In this way, the amount unaccounted for is ascertained and means instituted for its reduction where excessive. Through these analyses, systematic investigations were instituted by which a large amount of this lost and unaccounted-for current was found. The direct-current power service is a three-wire system with 220 volts on a side, 440 volts across the outside. This is a system which was started in the early days of the company. This system covers the entire business portion of the city, the outlying districts being supplied with three-phase, 2,400-volt, sixty-cycle current for power purposes. These feeders, two in number,



600-KILOWATT, THREE-PHASE, BULLOCK ALTERNATOR, EAST STATION, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

Digitized by Google

are run on the same bus-bars with lighting feeders.

The company's meter department is located at the downtown office, where all new meters are subjected to rigid tests and careful records kept of the same. All incandescent meters are changed at least every two years for test, and power meters once a year. Samples of all new meters made and placed upon the market are obtained and a rigid test is made upon them to determine their respective merits. The meter department is equipped with two very novel testing racks, one for direct-current meters and one for alternating. The alternating meter rack is equipped with a series transformer with an adjustable resistance in series with the primary, and placed across the 108-volt mains, the secondary is connected in series with the meter to be tested, then by varying the resistance, any desired current may be made to flow in the meter, with very little expenditure of energy, the potential coil being cut in ahead of the series transformer.

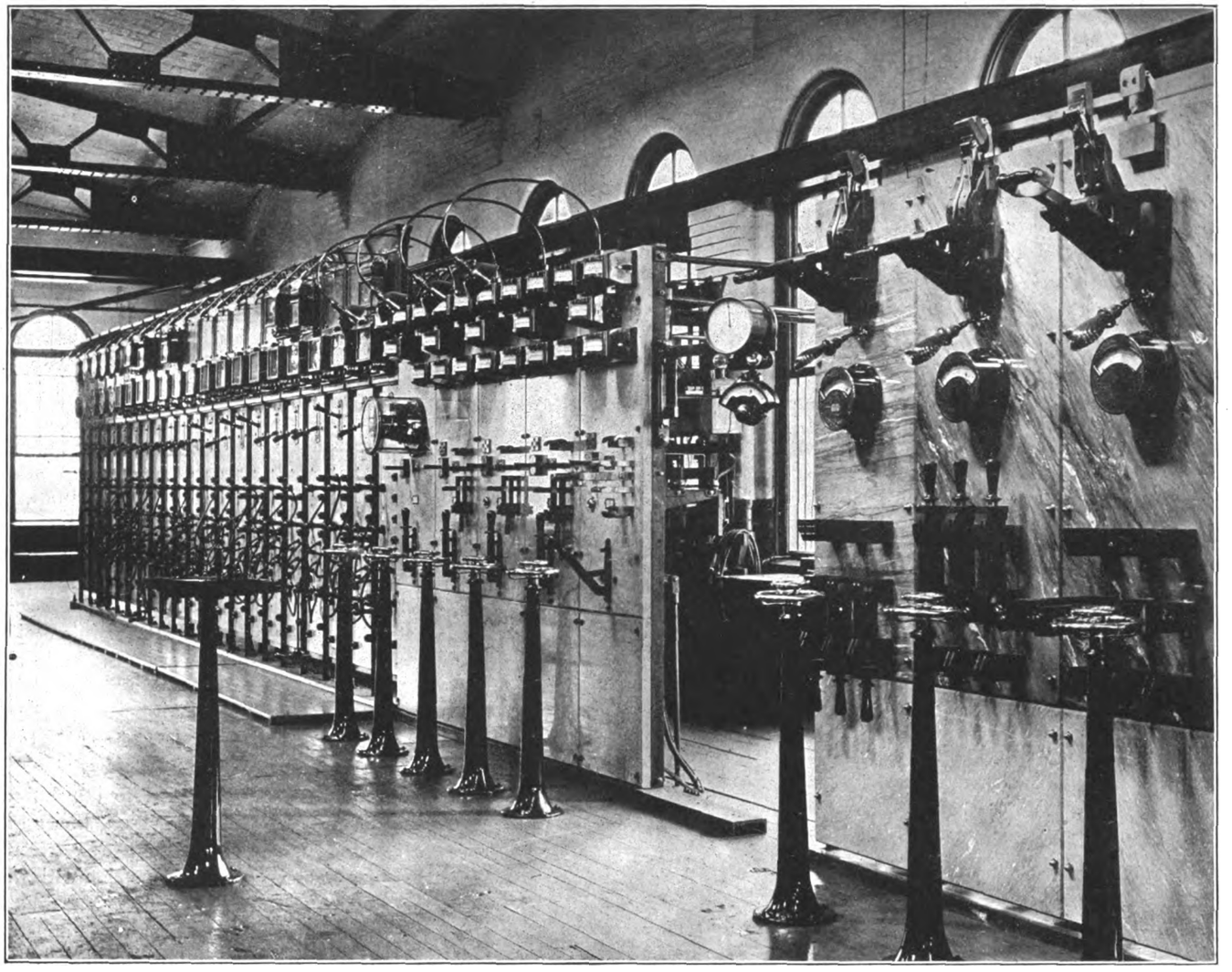
The direct-current meter testing set is very similar but the series transformer is replaced with a small motor-generating set of very low voltage and high-current capacity. The advantages claimed for this method of testing are the flexibility and economy of current.

The transformer department is located at the East Side station, and is rather a new departure from ordinary practice. It is the duty of this department to repair all burned-out transformers, not only those from the Denver lines, but from all of the McMillin properties. Each type of transformer to be repaired is redesigned and built up regardless of the previous manufacturer's design. In this way, it has been found that a better and more durable transformer can be built than would be possible, either by adhering to the original design or returning it to the factory for repairs. It is in this department that all new transformers and those repaired are subjected to rigid tests for insulation, copper losses, iron losses and regulation. All tests are made as is usual in commercial testing.

The arc lamp department is also located at the East Side station, and its function is the repair and maintenance of all direct and alternating arc lamps.

The Denver Gas and Electric Company operates two stations situated about one mile apart, and each of which is about one mile from the centre of distribution, where the main offices are located. The larger of the two stations, usually called the West station, situated at Sixth and Lawrence streets, has a capacity of approximately 6,000 kilowatts. It is gradually being modernized and equipped with the latest types of machinery, and at the present rate of progress it will not be long till Denver can boast of one of the best and most up-to-date electrical plants in the country.

At the present writing, the West station is equipped with two 1,500-kilowatt,



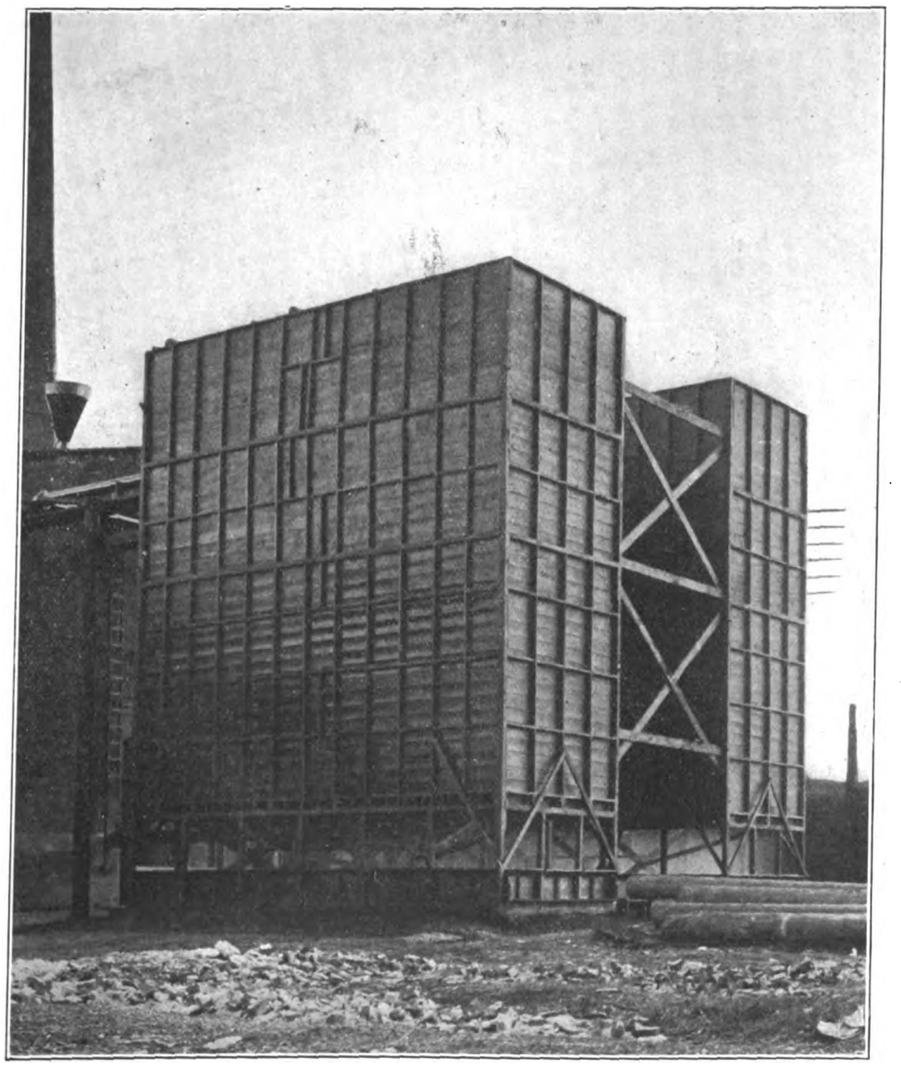
SWITCHBOARD, WEST STATION, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

Digitized by Google

three-phase, sixty-cycle, 2,400-volt Bullock alternators, direct-connected to a Filar-Stowell cross-compound Corliss condensing engine, running at 100 revolutions per minute. Four more Corliss cross-compound condensing engines are connected as follows: No. 1 is belted by tandem forty-two-inch three-ply belts to a 400-kilowatt, 275-volt General Electric, direct-current generator, and a 600-kilowatt, three-phase, sixty-cycle, 2,400-volt Bullock alternator and a 400-kilowatt, 274-volt power machine. No. 3 engine drives another 400-kilowatt Bullock power machine. No. 4 engine drives a short line shaft carrying two 100-kilowatt General Electric power machines and six 100-light Brush arc machines. This line shaft is gradually being cut out, and the time is not far distant when this shaft can be cut out entirely. In a big plant like that of Denver, where it is almost impossible to keep up with the rapidly increasing business, it is hard to get sufficient capacity ahead so that changes can be made without interfering with continuity of service.

A small De Laval 225-horse-power turbine has recently been installed to drive two 100-light Brush arc machines.

Each engine is equipped with a jet condenser and a closed feed-water heater. The condensing water is all obtained from a large mill ditch which flows by the station at about a block's distance. This water, however, is unfit for boiler-feed purposes, and is again returned to the ditch. All boiler-feed water is pumped from two artesian wells by means of compressed air. This water is heated to about 120 degrees Fahrenheit in the individual engine heaters, and is finally heated to 200 degrees Fahrenheit in an open heater just before entering the boilers. This heater receives its steam from all auxiliary steam apparatus, such as boiler-feed pumps and air compressor. At certain hours of the day this steam is insufficient to heat the water the required amount, so the receiver of each engine has been tapped and pipes run to the heater to supply this deficiency. A valve is placed in these pipes, handy to the heater, so that an attendant can keep the steam supply properly adjusted. It has been ascertained that there is a gain of about four per cent for every ten degrees the temperature of the feed water is raised in this manner.



Cooling Tower, East Station, Denver Gas and Electric Company, Denver, Col.

The boiler room is equipped with three 500-horse-power water-tube Heine boilers, one 400-horse-power Wickes vertical boiler, and the balance of the boiler room is equipped with 200-horse-power Heine water-tube boilers, which are gradually being replaced with 500-horse-power boilers, as additional capacity is required. Unusual methods have been instituted in the boiler room to obtain higher boiler efficiencies. A technical fuel engineer was given absolute charge of the boiler room, and thus far the work accomplished has been very gratifying. The principal innovations introduced were the testing of boilers, flue gas analysis, etc., and special tests to ascertain best methods of operating, great pains being particularly taken to enlighten the firemen as much as possible as to the best methods and to keep close tab on the different men so as to always keep everything at its maximum efficiency, regardless of load conditions.

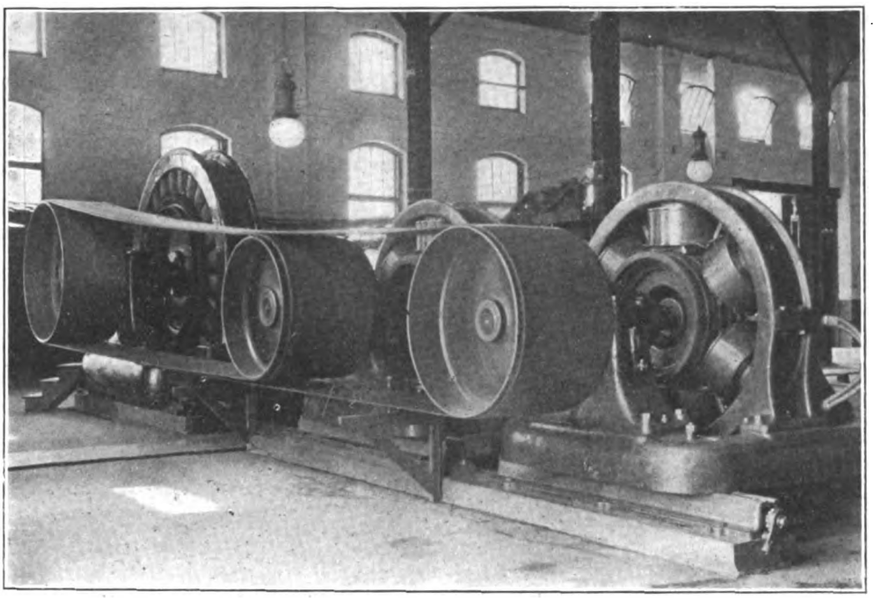
Lignite coal is used exclusively, a coal which is very high in volatile carbons and requires a very high temperature for perfect combustion, something that is hardly possible in ordinary forms of furnace design. Those who have used this coal will appreciate what users in and about Denver have to contend with in obtaining the highest possible efficiency. Mechanical stokers have been tried here, but with little or no success, as the coal here does not seem to be adapted to the design of mechanical stoker now on the market. All boilers are equipped with a secondary feed-water main, in connection with which there are weighing scales for the weighing of boiler-feed water. With this apparatus, it is possible to get any boiler in shape for the most complete boiler test in a very few minutes.

All generators are operated in parallel, additional machines being cut in and out to meet requirements of the load. The alternators are all operated without the use of any fuses, circuit-breakers or other protective devices. Each alternator is controlled from a separate switchboard panel and separate exciters. Each panel contains three ammeters, a voltmeter and an indicating wattmeter, also a single-throw, three-pole oil switch, remote control. There is one plug panel-board for

Digitized by Google

each feeder, which contains an ammeter, voltmeter, double-pole, double-throw oil switch and an integrating wattmeter. No protective devices are used, the switchboard attendant being instructed to pull the switch if he finds he is unable to burn off any short-circuit which might occur.

Very complete daily station reports are made out, which contain the different machine loads, total load for different hours of the day, engines and boilers in service, vacuums carried, feed-water temperatures, feeder demands and capacities, daily outputs and connected load data. In fact, everything which is of importance to successfully manage the operation of a large plant.



SYNCHRONOUS MOTOR SET, EAST STATION, DENVER GAS AND ELECTRIC COMPANY, DENVER, COL.

The East station, which is situated at Twenty-first and Wewatta streets, is now being used as a short-hour station, running only during the peak load. It has a capacity of about 2,000 kilowatts, its principal equipment being two 600-kilowatt, three-phase, sixty-cycle, 2,400-volt, Bullock alternators, belted to two Corliss cross-compound, condensing engines. These machines are run in parallel with the West station over a three-phase auxiliary of No. 000 wire connecting the two stations. The two stations may be run entirely separate if desired. The day load of this station being carried over this auxiliary, it is seldom necessary to switch a feeder, except for the purpose of balancing phases.

Condensing water used here is cooled in a cooling tower, the water being pumped to the top of the tower a distance of twenty-eight feet by the circulating pump of the jet condenser. These towers, two in number, were built to take care of 2,000-horse-power, and cool the water forty degrees. Tests made since installing these towers show that they will do even better. Feed water is obtained in the same way as at the West station, from two artesian wells.

In the daytime, the East station is operated much as a substation. A 450-kilowatt synchronous motor is installed here, which is belted by tandem belts to two 200-kilowatt, 275-volt General Electric power machines. The outfit is started from the direct-current end, and after it is running, the motor end receives its current over the same three-phase auxiliary. The direct current is pumped into the network at this point, serving to maintain good power regulation and saving a good deal in direct-current copper losses and initial expense for copper. As the average maximum demand on power is about 2,000 kilowatts, it would mean an immense amount of copper to furnish this amount of power at a distance of over a mile from the station, and at a voltage of 440 volts. The losses have been found to be much less transmitting at 2,400 volts, and then transforming into direct current by means of a motor-generator. This apparatus also serves another purpose, as by over or under-exciting the fields of the synchronous motor, the voltage on the feeders emanating from the East station may be varied. Advantage has been taken of this, and a Tirrill regulator has been installed on the exciter of the synchronous motor, so that very good day regulation is maintained on the day lighting feeders.

Several other smaller machines are installed at the East station, but they are old, obsolete types, which are only used in the most extreme emergencies. As it has been planned to do away with the East station entirely as a steam station, these old machines have been allowed to stand. All additional machinery is being installed at the West station as it is the most advantageously located. Architectural plans are already completed for the building of an extensive pressed-brick and steel addition to the West station, and work will be begun on this addition in the very near future.

There is one machine located at the East station which will prove of historic interest, and that is an old simple engine, which was originally purchased and installed for driving bipolar Edison machines twenty-four years ago. This was the third electric lighting station in the country, and attracted a great deal of attention at that time. That engine is still sitting on the same foundation and the same engineer, then in charge of it, is still on hand to run it, as it is still run if emergency requires it, belted to an old General Electric three-phase, 2,400-volt alternator of 300-kilowatt capacity.

The officers of the Denver Gas and Electric Company desire to extend a cordial invitation to all those attending the convention, to visit the offices and plants of the company.

Rome-to-Paris Telephone.

It is announced that the Paris-Rome telephone system has been successfully completed, and that within a few weeks the French and Italian capitals will have regular telephonic communication. Giuseppe Angelini, chief of the Italian telegraph, held the first conversation on May 25 over the line with Gaston Calmette, editor of the Paris *Figaro,* sending a fraternal message from the Italian press. After an interchange of compliments, Angelini adjusted a phonograph to the telephone and the music of the "Traviata," played in Rome, it is said, was heard with great distinctness in Paris.

A new development in electric welding is the automatic production of continuous rolls of wire fencing. A number of galvanized-iron wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these lengths of wire are cut off and fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect they are welded together by small transformers. The welded material then moves forward and the operation is continuously repeated.—*Engineering and Mining Journal.*

Digitized by Google

Schenectady Visit of the Delegates to the International Railway Congress on the Long Tour.

After spending the night at Saratoga, N. Y., the participants in the long tour of the International Railway Congress, 200 strong, arrived at Schenectady, N. Y., about 9.30 Friday morning, May 26, the train running in three sections. The visitors left their cars at the American Locomotive Company's works, where they were received by the officers and representatives of the company, the whole party then proceeded through the shops. An interesting feature at these works was a large number of completed locomotives together with several in different stages of construction. These were examined with interest by the visitors before making a visit to the different buildings where the various processes of manufacturing and assembling were in progress. After two hours' sight-seeing among the different departments, the party assembled for luncheon on the third floor of one of the new buildings. In the meantime the ladies of the party had been escorted by a local reception committee of Schenectady ladies on a drive through the city and about the grounds of the Mohawk Golf Club, after which they joined the gentlemen at luncheon. The room set aside for this purpose had been attractively decorated with flags of all nations and bunting, flowers and palms, and an orchestra provided music during the luncheon hour.

When luncheon was finished, A. J. Pitkin, president of the American Locomotive Company, briefly addressed the guests and then called upon W. J. Clark, general manager of the foreign department of the General Electric Company, who was a United States Government delegate to the congress. His remarks of welcome were responded to by R. Fane-de-Salis, director of the North Staffordshire Railway, England; Chas. Tenney, chief engineer, Southern Railway of Austria; Edouard Sauvage, engineer-in-chief, Western Railway of France, and E. H. Stieltjes, representative of the government of Holland. Mr. Pitkin then spoke of the remarkable results accomplished by Mr. Allen, secretary of the American Railway Association, in connection with the great undertaking which had been carried through so successfully, and called upon Mr. Allen to address the guests. His remarks were greeted with hearty applause.

From the luncheon room the party proceeded to a special train in waiting to carry them to the testing tracks just west of Schenectady, for an inspection of the electric locomotive, which is the first of a large number being built by the General Electric Company and the American Locomotive Company for use on the New York Central & Hudson River Railroad at its New York terminals and suburban lines at that point. This train was in charge of F. A. Harrington, general superintendent of the Mohawk Division. Through the courtesy of W. J. Wilgus, fifth vice-president, and E. B. Katte, electrical engineer, arrangements had been made for a full exhibition of the operation of the electric locomotive.

Arriving at the testing track, the electric locomotive was coupled on to the special train bearing the visitors and the steam locomotive was uncoupled. Under electric power the train then passed back and forth over the five and one-half miles of track equipped with the third rail, the delegates being given an opportunity to personally inspect the electric locomotive while operating at high speed. No attempt at phenomenal speed was made, although the instruments recorded over sixty miles an hour at different times during the run. This train was then stopped and the delegates were given an opportunity to further examine the locomotive. The delegates were particularly impressed with the smooth running of the electric locomotive as compared with the noise and vibration of a steam locomotive. Comparison of this feature was made easy by the fact that steam trains passed on adjacent tracks while the party stood watching the electric locomotive making an exhibition run at over sixty miles an hour.

The party was next carried to the works of the General Electric Company, reaching that place shortly after three o'clock. Until five o'clock was spent in visiting some of the principal shops of these works, the visitors being particularly interested in the large machine shops devoted exclusively to the manufacture of Curtis steam turbines. Light refreshments were served in the company's restaurant at the close of this tour and the entire party of delegates boarded their special train at five o'clock.

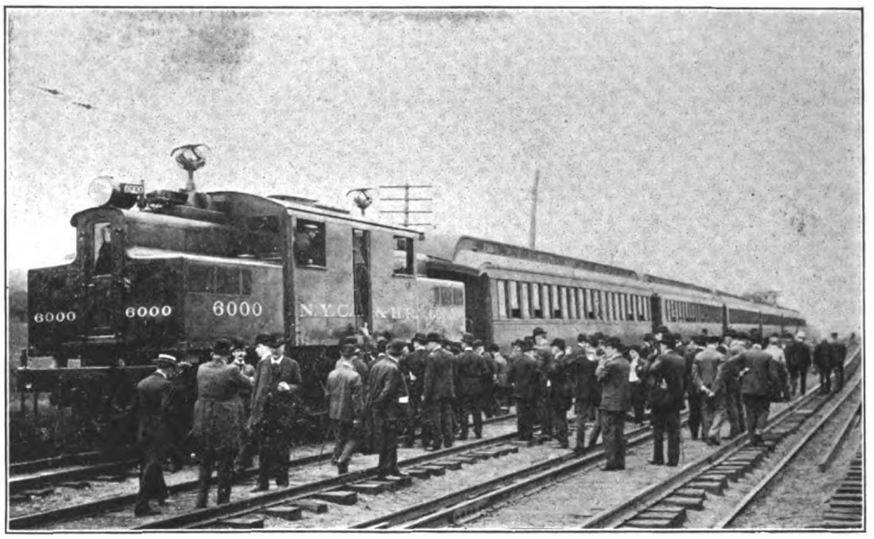
The local reception committee at Schenectady, under the auspices of the American Railway Association, included the following gentlemen:

From the American Locomotive Company: A. J. Pitkin, J. E. Sague and James McNaughton.

From the New York Central: George H. Daniels, general passenger agent.

From the General Electric Company: E. W. Rice, Jr., W. B. Potter, G. E. Emmons, A. W. Burchard, G. de B. Greene.

This committee was augmented by other officials of both companies, including R. J. Cross, J. D. Sawyer and F. J. Cole of the American Locomotive Company, and W. J. Clark, A. L. Rohrer, W. B. Schlicter and F. H. Gale of the General Electric Company, and F. A. Currie and F. A. Kingsbury of the New York Central.



THE DELEGATES TO THE INTERNATIONAL RAILWAY CONGRESS, INSPECTING THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD ELECTRIC LOCOMOTIVE AT SCHENECTADY, N. Y.

Steel Plate Combine in Germany.

Under date of April 7, 1905, United States Consul-General Richard Guenther, of Frankfort, reports that fifteen of the leading German manufacturers of steel plates for ships have combined to regulate prices and production.

Digitized by Google

The Arkansas Valley Electric Company.

By J. E. Johnston.

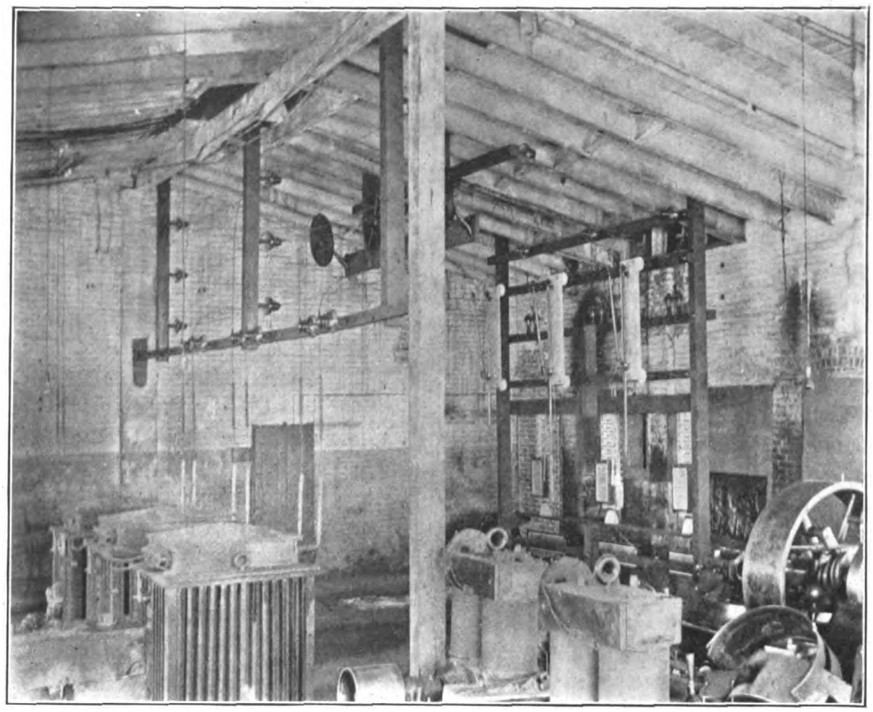
THE town of Florence, Col., is located on the main line of the Denver & Rio Grande railway and is in the fertile valley of the Arkansas river. It is also the centre of the only producing oil district of the state and is a prominent ore-milling point, the ores of Cripple Creek being shipped here for treatment.

The town is lighted by the Arkansas Valley Electric Company, and was originally done from a steam-driven station located within the town and supplying direct current to an Edison three-wire system at the usual voltage of 110-220. The peak of the load amounted to nearly two hundred kilowatts and three sets of generators, driven by high-speed engines, supplied the system. During the past winter, however, this system has been abandoned and the generating station converted into a substation, taking current from the lines of the Colorado Electric Power Company, of Canon City, the transmission distance being about eight miles and the voltage 20,000, which is the regular voltage of the transmission company's lines. The current supplied is three-phase.

On making the change the engines and direct-current dynamos were removed from a portion of the engine room, and the lowering transformers and lightning arrester equipment were installed in the space thus gained. As the town was already wired for the three-wire system, it was determined to leave this part unchanged in its main features and low-voltage transformers were installed, which supply the old three-wire mains. The outlying districts are served with 2,000-volt transformers, thus reducing the size of the old three-wire district and materially improving the distribution.

As current at thirty cycles is used, the question of a satisfactory light to replace the indoor arcs was solved by Nernst lamps, which are used principally in the four-glower size. The street lights are supplied by alternating, enclosed, six-ampere, constant-potential lamps, which were placed upon the old wiring system of the direct-current lamps. These have been giving satisfaction and seem to be in every way, for street lighting, equal to the direct-current lamps. Another important item in the change was the taking out of all commutator type meters and the installing in their stead of induction meters, which resulted in considerable gain, especially on light loads.

The result of these changes was a material reduction in the amount of attendance necessary to operate the system, and this is being still further reduced by the installation of automatic time switches, which will take care of the opening and closing of certain circuits which otherwise would require the running of additional lines as well as attendance. Some of these switches are in the substation and some are on poles in the outlying districts.



ARRESTER, CHOKE-COILS AND TRANSFORMER, ARKANSAS VALLEY ELECTRIC COMPANY.

In addition to the lighting load there is considerable business in the way of small motors and fans, most of which is a day load. The motors are, as a rule, single-phase, although a few are three-phase, being carried by the three-wire transformers, which are connected in three-phase relation.

The change from the old system has proven satisfactory and has resulted in simplifying the business and cutting down expenses.

Grand Junction Electric and Gas Company, Colorado.

By J. E. Johnston.

THE town of Grand Junction has had a remarkable growth in recent years. Fruit-raising, the principal industry of the surrounding country, together with the lumber trade, sugar manufacturing and railroad shops of the Denver & Rio Grande Railroad, has caused the town to become the principal business centre of western Colorado.

Grand Junction was among the first towns of its size in the state of Colorado to have an electric lighting plant. This was installed in 1899, the Heisler series system being used. This was operated until 1891 when the system was changed to a constant-potential system at 1,000 volts, 16,000 alternations, a National single-phase generator supplying the current. With various additions this system was maintained until the winter of 1903-4, when extensive improvements were undertaken. Additional boiler capacity was installed, a Corliss engine driving a 150-kilowatt, single-phase, 7,200-alternation generator was added to the engine-room equipment and the distributing system completely remodeled.

The boiler plant now consists of six tubular boilers, each rated at 100 horsepower. These are hand-fired, and slack

Digitized by Google

coal is used, a side track from the Denver & Rio Grande railway delivering the coal at the plant.

The generating equipment consists of two sixty-kilowatt and one 150-kilowatt generators, all of the Westinghouse make, single-phase and sixty cycles. The 150-kilowatt machine is belt-driven by the Corliss engine, no countershaft being used, and the smaller machines are each belt-driven from high-speed automatic engines. A marble switchboard, equipped with oil-break switches and a complete line of meters, adds very materially to the station appearance and to safety from fire and other risks.

As before stated, the recent changes in the distributing system were extensive. The voltage was changed from 1,100 to 2,200; house to house transformers were taken down and sold as junk and large transformers were put up, supplying sometimes one and sometimes two or more blocks according to the needs; the constant-potential street arcs were exchanged for constant-current apparatus, and all lines rebuilt and extended. The metering of the town was also improved by substituting induction meters for many of the commutator type and flat rate customers changed to meter rates.

The street lighting is done by a fifty-light regulator and another will be installed as soon as the present one is loaded beyond its capacity. Many motors of small size are being added to the day load, and the company is making every effort to extend this branch of its business. By next winter it will be necessary to install another generator of at least 150-kilowatt capacity to take care of the increasing load.

Meeting of the Railway Signal Association.

A regular meeting of the Railway Signal Association was held at the Grand Union Hotel, New York city, on May 23, 1905.

Mr. C. H. Morrison, signal engineer of the Erie Railroad, with headquarters at Jersey City, was elected vice-president to take the place of Mr. Lawrence Griffith, resigned.

The committee on definitions and nomenclature submitted a number of definitions for approval. The following papers were presented: "Discipline of Trainmen as Relating to Automatic Block Signals," by R. G. Kenley.

"Signaling in the Subway," by J. M. Waldron.

"Storage Batteries for Track Circuit," by C. C. Anthony.

"The Semaphore Spectacle," by W. H. Elliot.

The next meeting will be held in Chicago on September 5, 1905.

The Convention of the American Institute of Electrical Engineers.

The annual convention of the American Institute of Electrical Engineers will be held at Asheville, N. C., June 19 to June 23. Arrangements are being completed for the presentation of papers and the entertainment of the visitors.

The following list of papers has been announced:

"Appalachian Water Powers," by F. A. C. Perrine.

"Three-Phase Traction," by F. N. Waterman.

"Limits of Injurious Sparking in Direct-Current Commutation," by Thorburn Reid.

"A Study in the Design of Induction Motors," by C. A. Adams.

"Choice of Motors in Steam and Electric Practice," by William McClellan.

"High-Potential Oscillations of High Power in Large Power Distribution Systems," by Charles P. Steinmetz.

"The Constant-Current Mercury Arc Rectifier," by Charles P. Steinmetz.

"Heavy Electric Freight Traction," by C. De Muralt.

"A New Instrument for Measuring Alternating Currents," by E. F. Northrup.

"Motor-Generators and Rotary Converters," by W. L. Waters.

"Limits in Direct-Current Machine Design," by Sebastian Sonstius.

"Electrical Features of Block Signaling," by L. H. Thullen.

"The Development of the Ontario Power Company," by P. N. Nunn.

"A New Induction Generator," by William Stanley.

"An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Due to Switching, Grounding, Etc.," by Percy H. Thomas.

"Experimental Data Relating to Conductors and Underground Electric Cables," by Henry W. Fisher.

"Methods of High-Pressure Measurement," by S. M. Kintner.

"Weight Distribution on Electric Locomotives, as Affected by Motor Suspension and Draw-Bar Pull," by S. T. Dodd.

"Eddy Currents in Large Armature Conductors," by A. B. Field.

New Club-House and Garage for the Automobile Club of America.

The new club-house and garage of the Automobile Club of America, which is to be erected at Fifty-fourth street and Broadway, New York city, will be of light stone, marble or Indiana limestone, white brick and terra-cotta, the latter used in two other colors for decorations in the heads of the window arches on the second or main floor. The building will contain large and commodious clubrooms for the members, four storage floors for automobiles, and a machine and repair shop and power plant. The building will be seven stories high, including the basement, with the members' entrance at the Broadway end, and the attendants' entrance at the Eighth avenue end. The ground floor will have a large open space to accommodate fifty to seventy-five cars, and will contain seven stands for washing the cars, a large members' locker room, and an office for the superintendent of the garage.

In the basement will be an electric generating plant, with coal bunkers under the sidewalk. Underneath the coal vault will be a gasoline storage subdivided into numerous tanks, so that the contents of each will not exceed the amount prescribed by the fire department.

The elevators will be electrically driven, and of four tons capacity, the platforms being ten by eighteen feet.

The repair department and the machine shop are located on the top floor, and will be equipped with electrically driven tools. In this department there will be a dynamometer, which will be arranged to take measurements of efficiency, fuel consumption, power, etc., of all makes of cars.

A New Tool Steel.

The Sheffield Steel Makers, Limited, Sheffield, England, have placed on the market a new tool steel under the name of "Unor." This is a steel which is intermediate between the ordinary type of tool steel and the modern high-speed steel. It does not resemble any steel which has so far been made, and its characteristics mark it as an entirely new class of material. It is an air-hardening steel, and possesses qualities which fit it equally well for processes of finishing and of roughing. To harden, it is only necessary to heat the steel to a bright red and to allow it to cool naturally in the air, without the use of an air-blast. To anneal "Unor" steel for easy machining it is necessary to heat it to a cherry red and then to allow the heat to sink over the fire to a very dark red, plunging it into water. Experiments have demonstrated that it can be rehardened or softened any number of times, and that the wearing quality of the steel does not deteriorate in any way in the course of these processes. A number of tests have been made with the steel at the Sheffield testing works. Twist drills made of the steel drilled in a railroad tire made of 0.49 per cent carbon forty-nine fifteen-thirty-seconds-inch holes seventeen-eighths inches deep, at an average speed of twenty-five seconds each. A thirteen-sixteenths-inch drill made from this steel drilled twenty holes two inches deep in sixteen and one-half minutes.

Digitized by Google

National Electric Light Association.

The Twenty-eighth Convention, Denver and Colorado Springs, Col., June 6 to June 11.

FROM present indications the twenty-eighth convention of the National Electric Light Association, which will be held at Denver and Colorado Springs, June 6 to June 11, will be very successful in every way. The business sessions are assured a number of highly interesting papers and reports, and the entertainment committees have worked unremittingly to make certain that nothing will be overlooked in the way of making the event a most enjoyable one.

PROGRAMME DENVER, JUNE 6, 7, 8.

TUESDAY, JUNE 6.

First session, 10 A. M., convention hall, Brown Palace Hotel—Address of welcome, the mayor of Denver; president's address, Ernest H. Davis, Williamsport, Pa.

"Report, Progress," T. Commerford Martin, New York.

"The Paramount Importance of Choosing Standard in Preference to Special Machinery," David Hall, Cincinnati, Ohio.

"Insulation Testing—Apparatus and Methods," C. E. Skinner, Pittsburg, Pa.

Second session, 2 P. M.

"Automatic Synchronizing of Generators and Rotaries for Lighting and Power Systems," Paul MacGahan, Pittsburg, Pa.

"Notes on Rotary Converters and Motor-Generators for Lighting and Power Systems," Louis E. Bogen, Cincinnati, Ohio.

"The Organization of Working Forces in Large Power-Houses," W. P. Hancock, Boston, Mass.

"Report, Committee on Steam Turbines," W. C. L. Eglin, chairman, Philadelphia, Pa.

"Operating Features of the Curtis Steam Turbine," A. H. Kruesi, Schenectady, N. Y.

WEDNESDAY, JUNE 7.

Third session, 10 A. M.

"Series Alternating-Current Motors for Industrial Work," Clarence Renshaw, Pittsburg, Pa.

"A New Type of Single-Phase Motors for Elevator Work," S. Percy Cole, St. Louis, Mo.

"Long-Distance High-Tension Transmission in California," John A. Britton, San Francisco, Cal.

"Report, Present Methods of Protection from Lightning and Other Static Disturbances," Alex Dow, and Robert S. Stewart, Detroit, Mich.

"The Nernst Lamp—Its Present Performance and Commercial Status," E. R. Roberts, Pittsburg, Pa.

"The Choice of an Insulated Cable," Wallace S. Clark, Schenectady, N. Y.

Fourth session, 8 P. M.

"Some Investigations of Induction Losses," E. P. Dillon, Colorado Springs, Col.

"Mercury Arc Rectifiers," P. D. Wagoner, Schenectady, N. Y.

"Report, Advertising Methods," Percy Ingalls, Newark, N. J.

"Report, Sign and Decorative Lighting," La Rue Vredenburgh, Boston, Mass.

"Free Signs and Flat Rates," G. W. Lee, Newark, N. J.

THURSDAY, JUNE 8.

Fifth session, 10 A. M.

"Report, Progress of Electric Heating," James I. Ayer, Boston, Mass.

"Report, Purchased Electric Power in Factories," E. W. Lloyd, Chicago, Ill.

"Report, Committee on District Steam Heating," W. H. Blood, Jr., chairman, Seattle, Wash.

"Wrinkles," H. C. Abell, editor, New York city.

Sixth session, 2 P. M.

"Report, Committee on Relations with Kindred Organizations," James I. Ayer, chairman, Boston, Mass.

Executive session.

"Report, Committee on Rates and Costs," Charles L. Edgar, chairman, Boston, Mass.

"Report, Municipal Ownership," Arthur Williams, New York, N. Y.

"Question Box," Homer E. Niesz, editor, Chicago, Ill.

Seventh session, 3 P. M.

Executive session.

"Report of Secretary and Treasurer."

"Report of Executive Committee."

"Report of Committee on Relations between Manufacturers and Central Station Companies," Henry L. Doherty, chairman, New York.

Dr. Louis Bell will read a paper on the "Tantalum Lamp."

"Report of Committee on Standard Rules for Electrical Construction and Operation," Charles L. Edgar, chairman.

Election of officers.

For the accommodation of New England delegates arrangements have been completed to run a special car from Boston to Denver, leaving the Terminal station, Boston, on the Federal express at 7.45 P. M., Friday, June 2, which car will be attached to the special convention train from New York to Denver, leaving New York city, June 3, at 10.25 A. M., arriving at Chicago 8.25 A. M., June 4, and arriving at Denver 2.30 P. M., Monday, June 5.

Unusually low rates have been authorized by the respective railways to Denver-Colorado Springs meeting. From all points in the Western Passenger Association territory a rate of one fare plus fifty cents for the round trip has been granted; this to apply only where one-way rate is $12 or more.

The Trans-Continental Passenger Association has authorized a rate from California to Denver and return of one fare. The New England Passenger Association and Trunk Line Association have authorized a rate of a fare and one-third from the respective points in their territory to Chicago and St. Louis plus the rates authorized in Western Passenger Association, namely, $30, Chicago to Denver and return.

Arrangements have been completed to run a special train of Pullman sleeping, dining, combination, observation and stateroom cars, electrically lighted throughout, from New York to Denver without change, leaving New York *via* Pennsylvania Railroad at 10.25 A. M., Saturday, June 3, running as second section of the Limited, arriving at Chicago 8.25 A. M., June 4; leaving 11.15 A. M. *via* Burlington and arriving at Denver 2.30 P. M. Monday, June 5.

At Chicago the train will be consolidated with cars for the special party that is being made up at that point.

The fare from New York to Denver and return on this train will be $56.70; sleeping car berth New York to Denver, $11.

Applications for space on this train should be made to Mr. C. H. Hodskinson, 70 State street, Boston; Mr. Frank L. Perry, Marquette Building, Chicago, or to Mr. George F. Porter, 136 Liberty street, New York.

The entertainment of delegates will include a theatre party at the Elitch summer gardens, a luncheon at the Denver Country Club for the ladies, followed by a drive about the city. The ladies will also be entertained at the Orpheum Theatre during an evening session of the convention, and after this session the men will be entertained at a smoker.

One afternoon will be devoted to a broncho busting contest.

On Friday morning the entire party will be taken to Colorado Springs on special trains. During Friday afternoon there will be drives to points of interest about Colorado Springs, Glen Eyrie, Garden of the Gods, Cheyenne Cañons, over the Bear Creek Cañon road to Bruin's Inn; also visits to the power plants of the Colorado Springs Interurban Railway Company, the Colorado Springs Electric Company, the Curtis Company's lignite coal mines, the reduction mills at Colorado City, the Pike's Peak Hydroelectric Company's hydraulic plant at Manitou, from which point the delegates may take the "Cog Road" to Pike's Peak. In the evening there will be a concert at the Broadmoor Casino.

Saturday will be given to an all-day trip to Cripple Creek, through the most beautiful scenery in Colorado.

On Sunday such of the delegates as desire to do so will have an opportunity to take trips mentioned for Friday afternoon, as it will be impossible for all these trips to be taken in one day.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Tribelhorn Accumulators.

M. de Kermond describes here several types of Tribelhorn accumulator. The element used in stationary batteries is a lead basin, which acts not only as the positive and negative electrodes, but as the connection between plates and as the acid-containing vessel. These basins are piled one upon the other, each being filled with the acid solution. The lower surface forms the negative plate, and the upper surface the positive—an arrangement which is advantageous, since there is less tendency for the spongy lead to be detached from the basin than for the lead peroxide. For automobile use a type known as "Volcan" has been devised. In this the elements are of pyramidal shape, and are placed with the base downward, one fitting over the other. Alternate plates form the positive and negative electrodes, which are braced at the corners by lead posts. The upper part of each plate is pierced to allow the escape of gas bubbles. This shape is thought to give great solidity and mechanical strength. The connections are made by means of lead strips, which are carried upward through the central opening.—*Translated and abstracted from L'Electricien (Paris), May* 13.

Tantalum Lamp Measurements.

An interesting comparison has been made by Herr Egon Siedek of the performance of tantalum and carbon-filament lamps with variations in voltage. The lamps used were intended for a normal voltage of 110. The apparatus employed for the photometric measurements was a Lummer photometer. The measurements were begun at seventy-five volts, and extended to 200 volts. Up to 150 volts readings were taken every five volts. From here on readings were taken every ten volts only. Four lamps of each kind were tested, and the results, which are given in curves, are the mean values. Below seventy-five volts the intensity of the lamp was too low, and above 200 too great for satisfactory measurements. With increasing voltage, the light of the tantalum lamp becomes whiter, and thus adds to the difficulty of accurate measurements. At eighty-five volts its color is similar to that of a carbon-filament lamp burning at normal voltage. The curves show that the increase in the intensity of light is less with the tantalum lamp than with the carbon filament lamp. With the former the candle-power at seventy-five volts was 6.4, while the carbon filament gave scarcely 2.5 candles at the same voltage. At normal voltage both lamps gave twenty-five candles. At 160 volts the carbon lamp reached 209 candles, while the tantalum lamp reached only ninety-three candles, and the latter gave 206 candles only at 200 volts. There was no difficulty in obtaining readings for the tantalum lamps at 200 volts. On the other hand, the carbon lamp burned out in three and one-half minutes at this voltage, and it heated the glass globe so greatly that it partially collapsed. Plotting the consumption of energy with variations in voltage, the characteristics for both lamps are approximately straight lines. That for the carbon lamp rises much more rapidly than that for the tantalum lamp. This is due to the fact that the temperature coefficient of tantalum is positive, and that of carbon negative; hence the more rapid increase in the energy consumption of the carbon lamp and the corresponding rapid increase in illumination. The curves show that, at the normal voltage of 110, the tantalum lamp consumed forty watts, and the carbon lamp about ninety-six. At 200 volts the consumption of energy in the tantalum lamp was approximately that of the carbon lamp at 112 volts. A third set of curves shows the variations in economy of the two lamps with varying voltage. At seventy-five volts the volt-amperes per candle for the carbon lamp were 16.8, while at the same voltage the volt-amperes for the tantalum lamp were only 3.2. The economy of the carbon lamp sinks rapidly to 3.78 volt-amperes at 110, and to 1.1 at 160 volts. The curve for the tantalum lamp is considerably flatter. The average consumption for tantalum lamps at 110 volts was 1.6 volt-amperes per candle. The practical result of these readings is the following: the voltage variations in a distributing system have less influence on the economy and life of a tantalum lamp than is the case for the carbon lamp.—*Translated and abstracted from Zeitschrift für Elektrotechnik (Vienna), May* 7.

Electric Lighting of Railway Trains.

This is the second article by M. R. de Valbreuze describing various train-lighting systems. The following are taken up here: the Leitner-Lucas, Electric-Car Lighting, Gerdes, Allegemeine Elektricitäts Gesellschaft, Rosenberg and Brown-Boveri with field regulator. All of these systems except the Gerdes have been described in the ELECTRICAL REVIEW. In this system a constant speed of rotation of the generator is obtained by using a hydraulic transmission system. The car axle drives a centrifugal pump which maintains a liquid—in this case, glycerine—under pressure in a reservoir. This liquid is then employed in driving the dynamo which operates the lights and charges the battery. The pump is constructed in such a way that the liquid circulates throughout the system in the same direction, no matter what the direction of motion of the car. Between the pump and the driving motor is placed a valve controlled by a centrifugal governor. When the speed of the car and, in consequence, the speed of rotation of the pump increase, the governor acts so as to limit the quantity of liquid delivered to the motor to that necessary for driving the generator at the required speed. On the contrary, if the speed of the train diminishes, the valve is opened further and the speed of the generator maintained constant. The description of the Allgemeine Elektricitäts Gesellschaft system is interesting, as it dwells particularly upon the employment of electrolytic rectifiers for controlling the charging of the battery. The generator is a single-phase alternator which supplies current directly to a system of rectifiers arranged after the Graetz method. These rectifiers not only supply unidirectional current for charging the batteries, but prevent a discharge of the battery back through the generator when the voltage of the lattter falls below the battery voltage. The generator voltage is maintained fairly constant, independent of speed variation, by means of a differential series winding connected in the secondary or direct-current circuit. The principal difficulty in applying the electrolyte rectifier to this purpose was that of obtaining a suitable electrolyte. Many different solutions were tried. Some decomposed, some attacked the iron plates, and others acted upon the aluminum. The electrolyte giving the best rectifying action was ammonium carbonate, but this material decomposes, particularly in high temperatures. Phosphoric acid does not decom-

Digitized by Google

pose, but attacks the iron vigorously. Ammonium phosphate, after a time, behaves in the same way. The solution finally adopted was ammonium borate, which not only enables the rectifier to preserve its properties up to sixty degrees centigrade, but has the advantage that the solution is not impoverished, but remains unaltered. In forming this electrolyte it is not necessary that the boric acid and the ammonium hydrate should be used in quantities proportional to their electrochemical equivalents. An excess of either one causes no inconvenience.—*Translated and abstracted from L'Éclairage Électrique (Paris), May* 13.

The Electrically Driven Semet-Solvay Coke Plant of the Wigan Coal and Iron Company, Limited, near Wigan, England.

An interesting and detailed description is given here of an electrically equipped coke plant near Wigan, England. The greater part of this plant is electrically driven, the energy being furnished by two direct-coupled Belliss-Westinghouse steam generators. The generators are three-phase alternators, each rated at 175 kilowatts, 440 volts, fifty cycles. Each has a separate belt-driven exciter capable of supplying two machines. Under the present arrangement the washed slack or fine coal which is delivered by the railway is raised in elevators and fed through a hoppered regulating bin to a motor-driven Robins belt conveyer. This is an eighteen-inch belt, which carries the fuel to a disintegrator house, where it is dropped through the disintegrator or crusher. The latter consists of two reels running in opposite directions, one within the other. These reels are carefully balanced so as to avoid all vibration, and are driven at a peripheral speed of 7,000 feet per minute, each being independently belt-driven by a sixty-horse-power induction motor. This disintegrator has a capacity of thirty tons per hour. From the disintegrator the powdered coal is delivered through a chute to an elevator driven by a motor. The elevator delivers the coal to a ninety-ton steel bunker. From here it is drawn as required into the buckets of an aerial ropeway, which automatically empties it into a 200-ton steel storage bunker at the other end of the line. From the storage bunker the coal is drawn through two hoppers, only one of which works at a time, and is delivered to two revolving feed tables fitted with scraper arms. From this it drops on a second Robins belt, the tables and the belt being driven by motors through gearing. The belt spans the track on which the coke oven chargers and rammers run, and delivers the coal into the compression boxes of one or the other of the two charging machines, which are moved, in turn, into position under the distributor. On the same tracks which carry the distributing machine are two stamping machines, each driven by a motor. Each of these machines delivers fifty blows per minute on the powdered coal in the compression box, the stamps traveling backward and forward between successive blows, reversing at the extreme end of the box, and also at a varying point at or about the centre of the box. The charging machines are moved by means of a variable-speed induction motor. The bottom of the compression box consists of a charging "peel" or sliding slab built up of steel sections having a flat top for the charged compressed coke to rest on, and an inverted steel rack beneath. There is a raised back at one end which forces the charge through the sides of the compression box. The rack is operated through reduction gear by an independent variable-speed motor similar to the traveling motor. The machine, after receiving its charge of compressed coal, is moved up to the front of the particular oven to be charged. The door at the front end of the compression box and the hinged door of the oven are opened, and the charging "peel" or sliding bottom of the compression box, with its load of coal, is put in motion, the coal being pushed into the oven in the form of a compressed cake which fits the dimensions of the oven very closely. The "peel" is withdrawn after closing and fixing the oven door, there being a space below sufficient for it to be drawn through. After twenty-four hours of coking the charge is ready to be removed. The door on the discharge side of the oven is raised by means of an electrically operated driving hoist running along a track on the top of the ovens. One of the two ramming machines is brought up to the other side of the oven. The hinged door on that side is opened, and the charge of coke is forced out through an enclosed coke quencher suspended from the hoist onto an iron-plated sloping hearth at the back of the ovens. The rams are equipped with two motors, one for traveling, and the other for operating the ram. The latter motion is effected through reducing and clutch gear, and a pinion which engages in the long steel rack belted on the top of the ram girder. The traveling motor is a variable-speed machine, which enables the centering of the ram with regard to the oven to be facilitated. The gearing driving the ram allows a quick return at about five times the speed of the thrust. In the pump room there are two pumping sets, each consisting of a motor direct-coupled to a centrifugal pump.—*Abstracted from the Electrical Review (London), May* 12.

Combined Single-Phase and Continuous-Current Traction.

A test has been made by the Allgemeine Elektricitäts Gesellschaft, of Berlin, of an electric car which can operate over either a continuous-current or single-phase system. This car is fitted with two single-phase Winter-Eichburg motors. These motors have six poles, are rated at thirty horse-power, and take current at 550 volts, forty cycles per second. The fields and armatures of the two machines are in series at the start. The field coils are thrown in parallel after a certain speed has been reached, the armatures remaining in series with the pair of field windings. An additional winding is used when the car runs over the continuous-current section of the line. The speed of the motor is controlled by rheostats and the series parallel grouping mentioned above. A continuous-current controller has been adapted to suit the new equipment. The switches for changing over from direct-current work to alternating-current, and the reverse, are interlocked with the main controller. It is said that no harm will result if either alternating current or direct current is supplied to the motor when connected up for the other system. Braking is effected by short-circuiting the motors. During the tests the speed of the car ranged from nine to twelve and one-half miles per hour on the continuous-current section of the track, and reached fifteen and one-half miles per hour on the single-phase section.

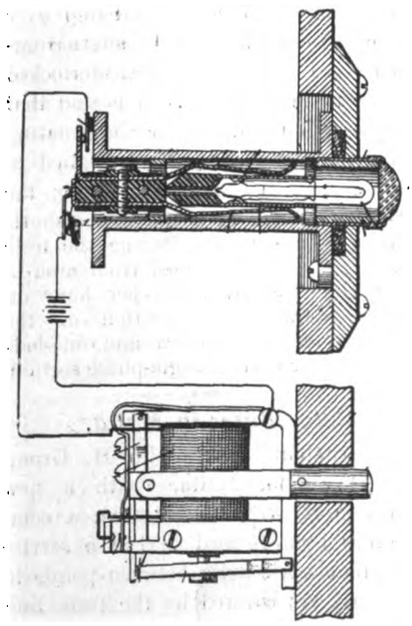
Motor Buses in Malta.

"Not content," says John H. Grout, consul, Valletta, Malta, "with a new tram line recently inaugurated, a company has been formed to run a service of public electric buses between points in Malta not yet covered by the tram line. The company is building a garage, which will be fitted for storage of its vehicles and for the repair of its own and other motor cars. A complete installation will be provided offering facilities for charging accumulators for electric carriages. For public service there will be a twenty-horse-power, seventeen-seat, single-deck bus; four twenty-four-horse-power, thirty-six-seat, double-deck buses, and one twenty-four-horse-power lorry. All of the vehicles will be fitted with electric lights. The new service was to be opened about June 1."

Digitized by Google

Electrical Patents.

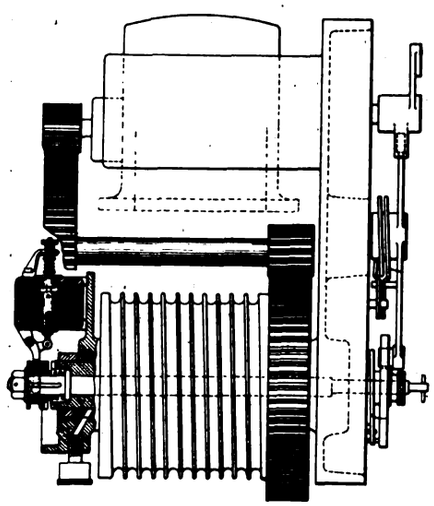
The Western Electric Company, of Illinois, controls a patent on an annunciator, devised by George F. Atwood, of New York, N. Y. (790,548, May 23, 1905). The invention has for its object to provide a device of neat appearance which will be simple, compact, and highly efficient in its operation. The aim has been to devise an annunciator arranged to display a signal and provided with mechanism forming a part of the annunciator itself adapted, when the signal is displayed, to be operated in such a manner as to efface the same. In accordance with the invention, a lens or bull's-eye provided with a lamp behind it to constitute an illuminated signal is arranged to serve also as a manual push-button for the actuation of contacts which control the electrical circuit of the lamp. In carrying out the invention a holder is arranged to slide longitudinally in a frame, this holder carrying a contact strip which has its rear end bent at an angle and resting against the end of the holder. A contact spring engages the angular portion of the contact strip and normally



ANNUNCIATOR.

maintains the holder at its forward limit of movement. A second contact strip is carried by the holder and has its rear end bent to project at an angle to the holder and normally resting against a contact anvil. An incandescent lamp is employed having terminals adapted to be engaged by the contact strips. A bull's-eye cap is carried by the holder in front of the lamp and is adapted to be pushed in to move the holder longitudinally and break the normal connection at the contact anvil.

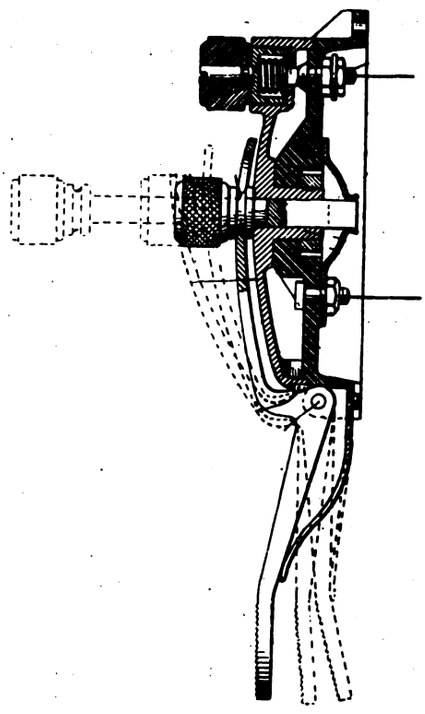
Philip J. Darlington, of Glen Ridge, N. J., has assigned to the Sprague Electric Company, of New Jersey, a patent recently granted to him on an overload cut-off for hoists (789,413, May 9, 1905). The invention relates to electrically operated hoists, and the object is to provide a novel and efficient cutout whereby overloads of the motor may be prevented.



OVERLOAD CUTOUT FOR HOISTS.

The invention consists in providing means responsive to an overload on the motor-controller adapted to connect such controller mechanically to a moving part of the hoist, whereby the controller is automatically and positively moved to its off-position, so as to break the motor circuit. More specifically considered, the invention consists in a magnet coil connected in a motor circuit and a clutch controlled thereby and arranged to establish a mechanical connection between the motor controller and a moving shaft. In the present invention a driving motor is employed having a controller. A hoisting drum is carried on a rotatable sleeve, within which a shaft is journaled. Suitable means are provided for holding the shaft normally stationary and loose, yet positive connections are located between the shaft and controller. A clutch is employed to lock the shaft to the sleeve. A magnet is arranged in the motor circuit and operative connections are provided between the magnet and clutch.

Gustave L. Herz, of New York, N. Y., has patented an electric switch, which is designed to provide improvements in the construction, form an arrangement of the several parts of an electric switch of that type in which a removable plug, included in the circuit, is employed for controlling the making and breaking of the current (789,975, May 16, 1905). The present improvement is particularly well adapted for use in connection with the electric ignition devices of explosive hydrocarbon engines employed in connection with motor vehicles and boats, wherein it is advisable to utilize a plug in the electric switch, which may be removed by the operator when he leaves the engine to prevent the same from being started. The present invention provides for a switch of this character, in which the plug may be slid into and out of operative position by a spring-actuated rocking lever, without removing the plug from its bearing, the connection between the lever and plug being such that when the lever is rocked to a predetermined point, the plug may be released therefrom and removed from the switch. In carrying out the invention, a suitable base is provided having a stationary contact on its outer face connected to a source of electrical energy. A rotary shell is mounted on the base and encloses its outer face. A movable contact is carried by the shell and is in position to be brought into and out of engagement with the stationary contact. A contact-plate is carried by the inner face of the base and connected to the source of electrical energy. A plug is carried by the shell and means are employed for sliding the plug into and out of engagement with the contact-plate.



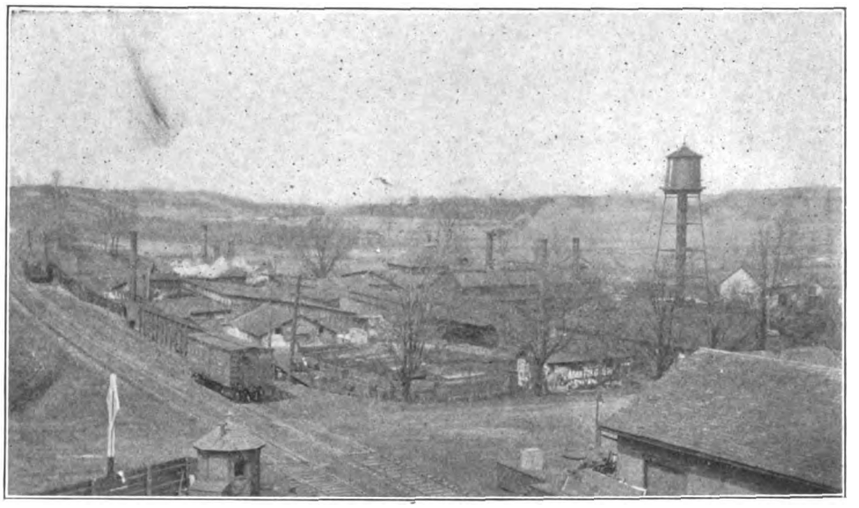
ELECTRIC SWITCH.

Digitized by Google

High-Tension Insulators.

The Manufacture and Electric Testing of an Important Element of Line Construction.

IN THE early days of the telegraph, when the first transmission of electrical energy was accomplished, the potentials used were so very low that any substance not actually a conductor served as a means of separating the lines from one another as well as from the earth, and so long as the transmission of energy was confined to this class of apparatus, where a short-circuit or leaky line meant nothing more than temporary interruption of service, no great demand was made upon the insulator manufacturer, but once any considerable power was transmitted at higher pressures a faulty insulator or a leaky one came to mean not only a serious interruption to service but ofttimes actual destruction of valuable apparatus and possibly loss of life. Thus has it come about that upon the insulator man falls the responsibility of maintaining uninterrupted service to a vast number of consumers as well as guaranteeing safety to the public and to the operators of the electrical apparatus with which the line is connected.



BIRD'S-EYE VIEW OF THE PLANT OF THE LOCKE INSULATOR MANUFACTURING COMPANY, VICTOR, N. Y.

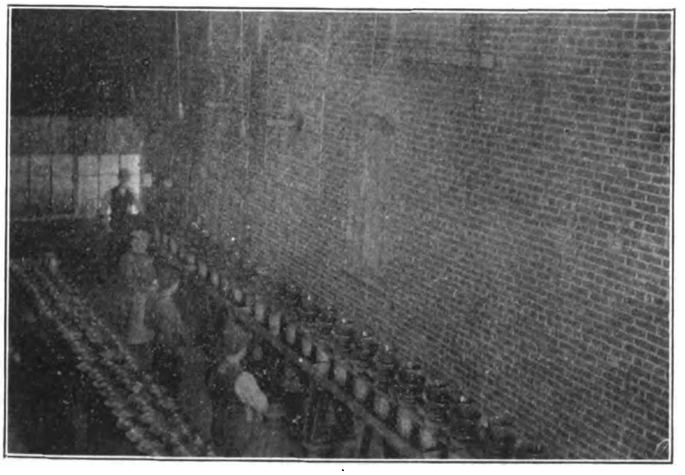
In the early days, the brute strength of the insulating materials was brought into service, little or no attention being paid to the more important details of insulator design, a method which will do very well for moderate voltages but entirely inadequate to the task of effectively insulating lines of very high potential, since insulators for lines of very high potential require the utmost care in their manufacture in order that a reliable and trustworthy product may result.

The pioneer work along this line was done at the works of the Locke Insulator Manufacturing Company at Victor, N. Y., where the "Victor" insulator, used in almost every country of the world, is made, and where the work is to-day carried on along strictly scientific lines, no effort being spared to keep abreast and, if possible, a little in advance of the times.

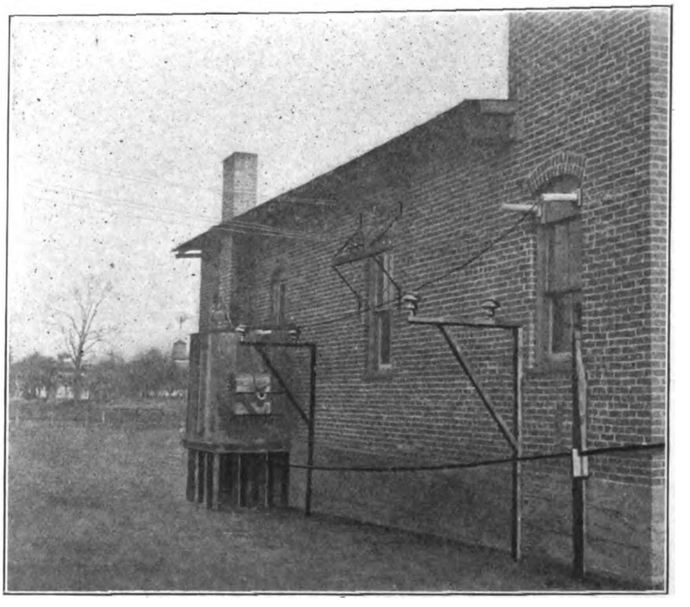
All high-grade porcelain is made of the very best clays, and the ware of which the modern insulator is made may well be classed as of the highest grade of material; for none but the first quality of clay is used in its construction. From the time the clays are placed in storage bins to the time the finished insulator is shipped from the factory, an expert in this line of work has a watchful eye upon every process and a daily record of all conditions is accurately kept.

Having ascertained, by chemical analysis, the constitution of the various clays, the ceramic man's first concern is so to mix them that a body of maximum electrical and mechanical strength shall result, this being attained only by the utmost nicety of adjustment and constant exercise of engineering judgment.

An electrical porcelain pottery is unlike any other kind of works, unlike even any other type of pottery, for not only must drying conditions be carefully watched, but the absence of either mechanical or electrical strength in the finished product brings disaster, before



HIGH-TENSION INSULATORS—ONE OF THE TEST RACKS.



HIGH-TENSION INSULATORS—THE HIGH-POTENTIAL LABORATORY, SHOWING CABIN FOR WET TESTS.

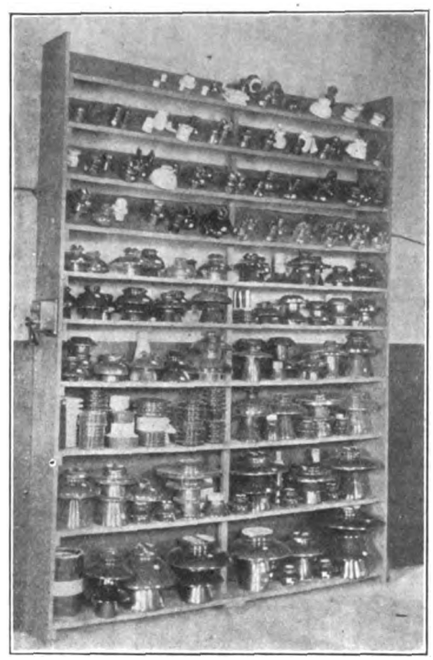
Digitized by Google

the discovery of which thousands of dollars' worth of ware may have been rendered valueless.

Though very finely ground and apparently in the last stage of subdivision, the clays after having been properly mixed as to quantity of each are placed, together with sufficient water, to form a liquid mass, in a ball mill or large iron tub lined with porcelain brick and half filled with quartz pebbles selected from glacial drift in Iceland. The tub is caused to rotate on its supporting axle and the quartz pebbles still further reduce the clays in matter of fineness and thoroughness of mixture.

From the ball mill the mixture of clay and water is run through a lawn or 150-mesh screen to a cistern from which it is drawn by means of a power pump and forced into filter presses. Filter presses for this class of work are of the type used in many potteries and consist of a series of cast-iron rings separated by sheets of canvas pierced by a three-inch hole to admit the liquid clay. The canvas sheets so arranged form a series of pockets from which water may readily leak but in which the clay is retained, thus forming "leaves" about thirty inches in diameter. As the pockets become filled with clay the pressure steadily rises until no more can, with safety, be applied. The clay is then ready for working, but to ensure its being homogeneous and thoroughly pliable it is put through a pug mill or large sausage machine which forces it through a die under pressure, from whence it emerges as a long "sausage" about four inches in diameter. In this state it is delivered to the potter who is thus furnished with a perfectly pliable and reliable clay upon which to expend his efforts.

The process of drying and firing of electrical porcelain causes it to shrink about fifteen per cent, and accordingly the model of the insulator from which all moulds are made is fifteen per cent larger than the finished piece of ware. Such models are usually turned from blocks of plaster of paris, their surfaces oiled, and the moulds cast from them in one, two or three parts as occasion may require.

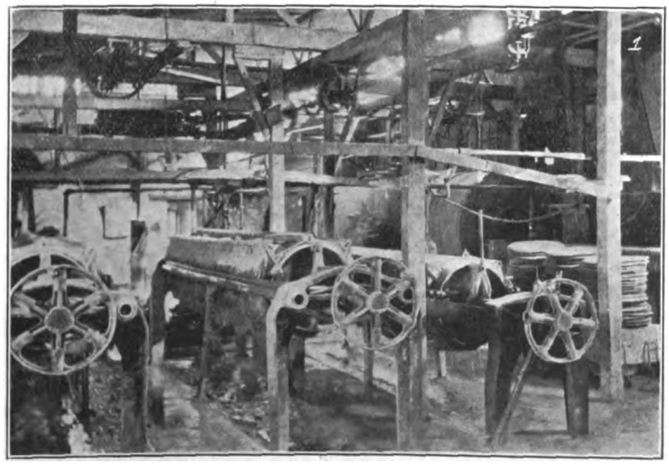


HIGH-TENSION INSULATORS—SAMPLES OF SOME OF THE PRODUCTS.

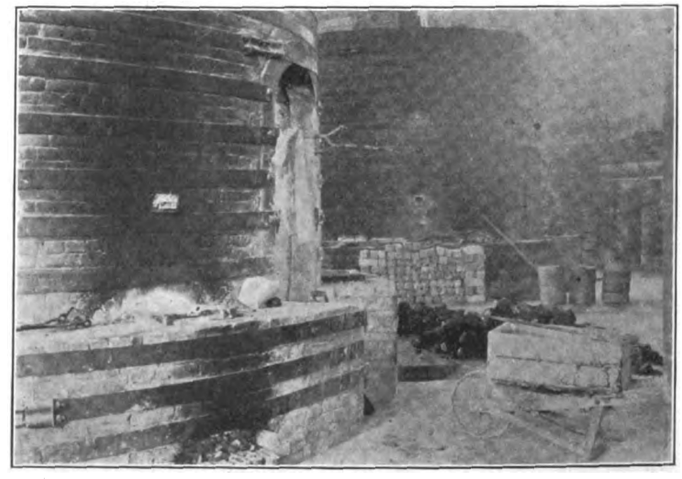
Having been properly dried the moulds are filled with just enough clay by the potter's assistant and are placed by the potter upon his wheel where the operation of shaping the inner side of the particular piece under consideration is carried on by the aid of the hands and a properly shaped former, which is held in place mechanically, and thus produces a perfectly uniform shape inside. The outside, of course, is determined by shape of the mould. The mould with its clay is now set aside for some hours, during which time the plaster performs its function of absorbing the water of the clay immediately adjacent to it. The clay has now become dry enough to handle and is removed from the mould, carried to the finisher who by means of a revolving table sets the partially dry ware to rotating, a wet sponge and, if necessary, a sharp knife being used to remove any irregularities and produce a smooth exterior. The piece thus finished is now set away and allowed to dry completely, after which it is dipped in a silicate solution, some of which is absorbed by the ware, thus forming a thin glaze or glasslike surface, whose only function is to produce a smooth finish as well as impart color to the insulator. At present a dark-brown color is usually employed because of its supposed inconspicuousness compared to white; however, it is possible to produce any desired color by placing in the glaze the proper coloring matter.

In some of the smaller-sized insulators the glaze accomplishes a double purpose, for besides covering the surface of the ware it is made to serve as a cement for fastening the parts together, forming a neat and strong joint, for the glaze liquefies at the temperature at which the body vitrifies.

The kilns in which the ware thus prepared is fired are cylindrical, being about eighteen feet in diameter and sixteen feet high, lined with firebrick, and arranged with fire bags around the base, the fire from which is drawn over into the kiln and down through the floor thence to the chimney. In order to protect the insulators during firing they are placed in fireclay receptacles called "saggers," which are piled one on the other until the inside of the kiln is completely filled, after which



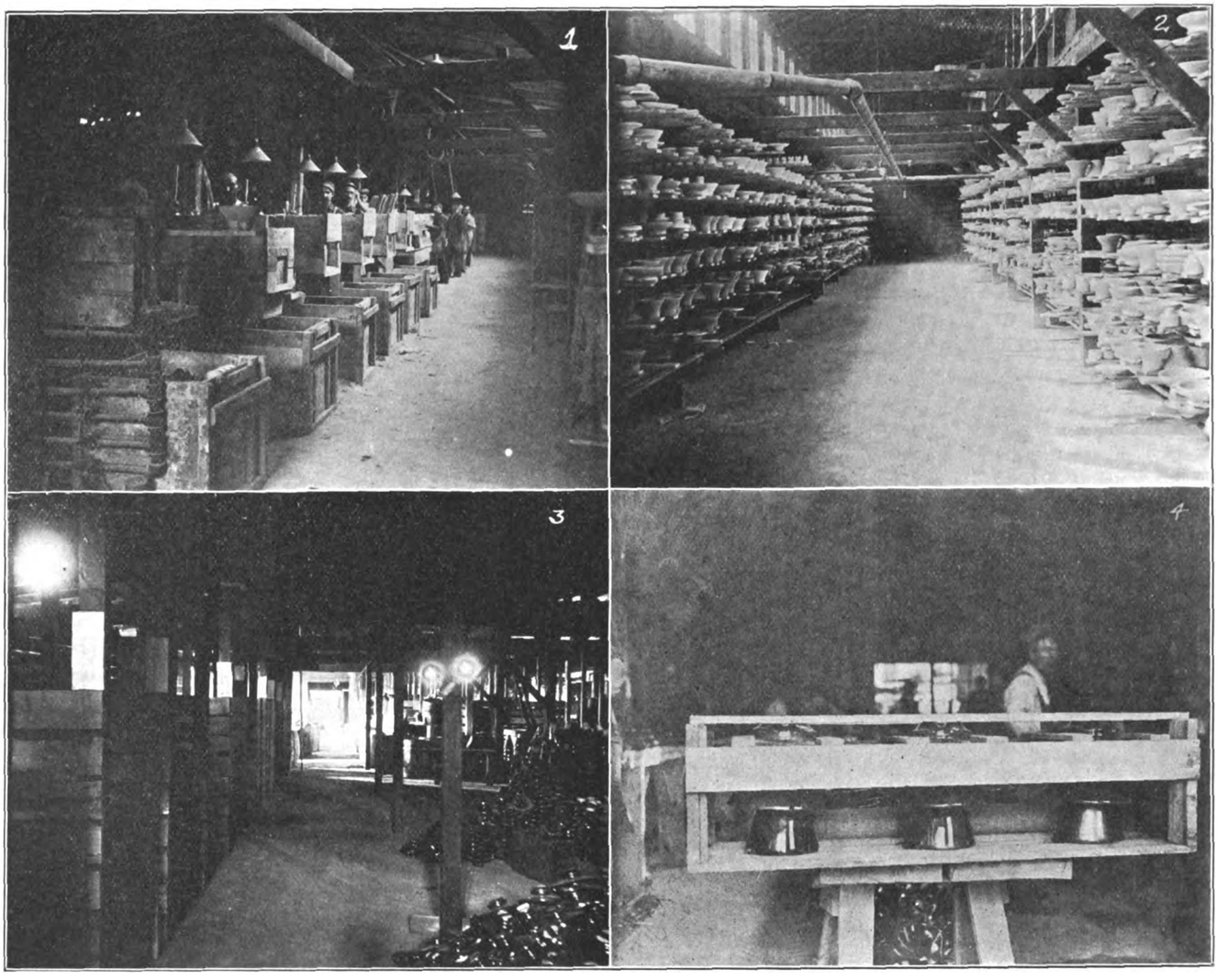
HIGH-TENSION INSULATORS—FILTER PRESSES AND BALL MILLS, SHOWING "LEAVES" OF CLAY AT RIGHT.



HIGH-TENSION INSULATORS—TWO OF THE PORCELAIN KILNS.

Digitized by Google

the entrance to the kiln is bricked up and sealed with fire-clay mortar. There remains now but to raise gradually the temperature to the required degree, which point is made evident by the fusing of small porcelain cones placed at regular intervals about the kiln, an opening being left so that ready access may be had to them. Before each opening are placed four cones which fuse at various heats, and in firing a kiln the temperature is raised till three of each set of cones are fused and the fourth very nearly so. In watching the cones the heat is so intense that a man can not face it unprotected and the light is so dazzling that a colored hand-glass is necessary to soften it so that the eyes can endure it. A thorough knowledge of the exact rate at which the temperature rises has been found very important, and for this purpose one of the famous Le Chatelier pyrometers has just been installed. This has a very delicate electric galvanometer which is connected with a platinum-rhodium thermo-couple projected into the kiln. By means of this instrument the temperature can be determined with absolute accuracy. With this knowledge at hand the temperature is raised with such regularity that no unnecessary strains are created in the ware by sudden variations in temperature. The heat within some parts of the kiln is so intense as to fuse the firebrick with which sides are lined. The proper heat having been attained the fires are allowed to cool down and the annealing process carried on until an insulator absolutely free from internal strains is assured. The door is broken down and the finished insulators pass from the ceramic to the electrical test and shipping departments.



HIGH-TENSION INSULATORS 1—VIEW IN GREEN WARE FINISHING DEPARTMENT. 2—WARE DRYING. 3—VIEW IN STOCK DEPARTMENT. 4—INSULATORS CRATED FOR SHIPMENT.

ELECTRICAL TESTING OF HIGH-TENSION INSULATORS.

Insulators designed to carry more than 5,000 volts are subjected to a high-voltage test before leaving the factory. The voltage to which any insulator or part is subjected is usually made as high as it can be conveniently raised without the annoyance of flashing over. The length of time which such test is applied is usually about one-half to two minutes, according to the purchaser's specifications. Insulators or parts to be tested are inverted in a pan of salt water and a chain from the high-tension wire directly overhead is dropped into the water with which the insulator is partially filled. The pans in which the insulators are inverted are about thirty-five feet in length and enough chains are provided to test as many as thirty large insulators at once on a single rack, additional racks being provided which may be switched on and off by means of a large air-break switch, thus allowing a transformer to be run continuously, eliminating any waits while loading or testing a rack of insulators. In order to avoid danger of injuring workmen employed about the test, the pans in which the insulators are placed are operated at earth potential so that all danger

Digitized by Google

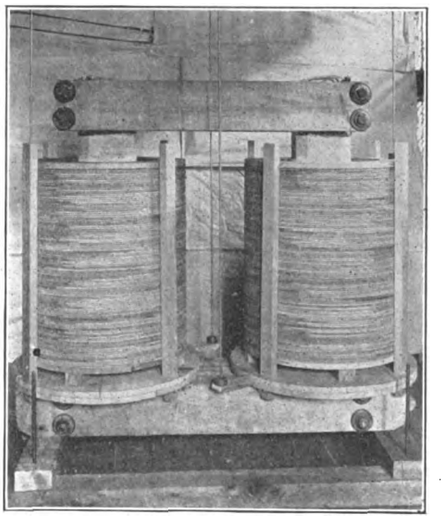
is confined to the chains and their supporting conductors.

It is customary to test all parts of an insulator separately before cementing, in order that only perfect parts may be used and also in order that on the final test the failure of a single part may not necessitate the throwing away of a complete insulator, for once the hydraulic cement used for this work becomes set it is impossible to separate the parts without destroying them.

The object of the electrical test is to seek out all defects not visible to the eye, such as minute cracks or soft spots in the body of the ware, and to do this with certainty it has been found necessary to provide a testing equipment with large capacity in order that a moderate draught of current from the secondary shall not reduce its voltage to a low value.

At the Victor factory the test voltage is supplied by a 200-kilowatt 300,000-volt transformer which is capable of operating as high as 500,000 volts potential and is designed to carry 100 per cent overload for a considerable time. This transformer is of the core type with an iron section of approximately 100 square inches. Normal operation of the transformer at 300,000 volts requires 1,100 volts on the primary which is made up of four sections to obtain flexibility in connections. The secondary is wound in large flat coils utilizing approximately forty-two miles of No. 26 B. & S. wire; the ends of the windings being available it is a matter of but a few moments' work to change from series to parallel connections. This constitutes by far the largest piece of test apparatus of its kind in the world and is in constant use for commercial testing as well as experimental work.

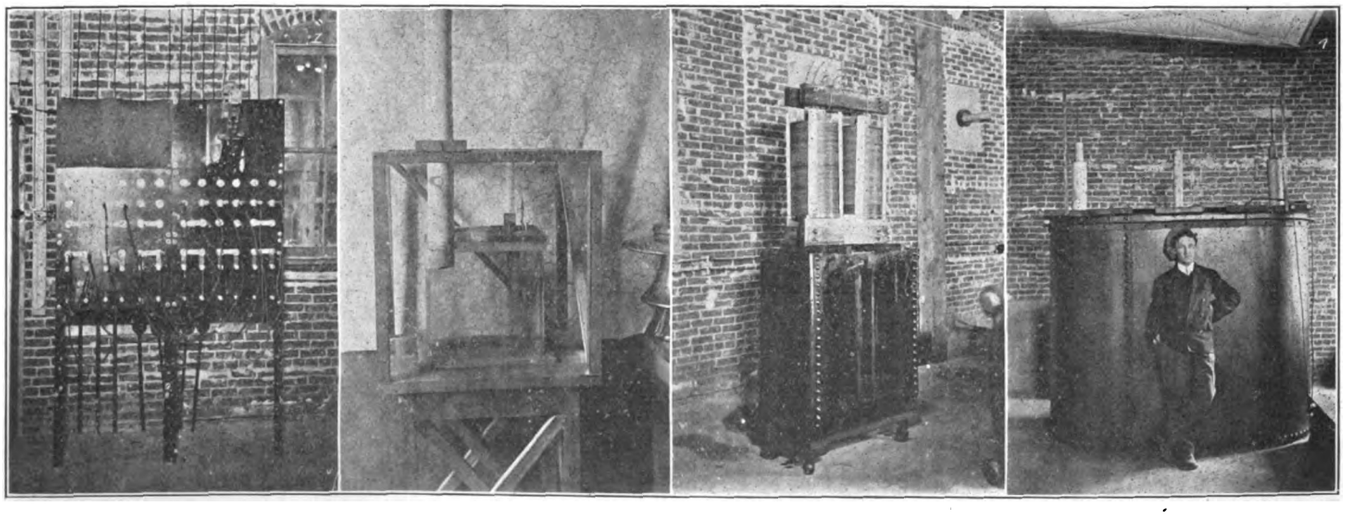
There is available for use with the testing equipment 600 volts from a thirty-kilowatt, sixty-cycle, two-phase Stanley alternator; 1,100 volts from a General Electric sixty-cycle A. T. B., and 400 volts at twenty-five cycles direct from the substation of the Rochester & Eastern Rapid Railway. Normally the transformer is operated with current from the motor-generator set which has a capacity of 200 kilowatts, but for limited periods of time power may be drawn from the railway company to the extent of 500 kilowatts. By this means it is possible to fulfil almost any test requirements.



HIGH-TENSION TESTING TRANSFORMER.

Adjacent to the commercial test and packing room is the special test and research laboratory, a fireproof building twenty-one feet by forty-eight feet. The floor is of heavy concrete construction so that the vibration of heavy machinery will not be communicated to any delicate measuring instruments. One part is reserved for machinery and transformers, while the other is used as an exhibition and test room, where experiments with the highest voltages may be carried out. The necessary switches and controlling rheostats are located in this room, the high-tension wires entering through large porcelain tubes extending to spark-gap and test rack. As this room may be darkened all experimental work is carried on here to witness better high-tension phenomena. For ordinary measurement of high voltages an ordinary spark-gap fitted with sharp needles is employed, but for the sake of a greater facility a simple electrostatic voltmeter has been designed which will measure voltages up to 250,000 without difficulty and with considerable accuracy. It consists merely of a glass jar filled with oil in which are submerged two plates, one being movable and carrying a light vertical plane mirror. The plates are connected so as to be at the same potential, which upon being applied causes the movable plate to swing away from the stationary one, the amount of such deflection being observed by means of a cross-hair telescope and a scale as in an ordinary galvanometer. Any degree of sensitiveness is obtained by varying the distance between the fixed and movable plates. This device greatly facilitates the test of insulators or test plates, as the spark-gap is slow to operate, and is as well subject to considerable error if the needles happen to become burned.

In order to be able at all times to keep a watchful eye upon the ware a novel testing device has been designed. These are plates of ware which dry and are fired much more quickly than the regular insulators and are tested several days in advance of the time when the insulators of that particular "mix" enter the kiln. If, then, for any reason, the dielectric strength is low it is known before the



HIGH-TENSION INSULATORS, TESTING DEPARTMENT. 1—DISTRIBUTING-BOARD. 2—ELECTROSTATIC VOLTMETER. 3—PORTABLE 50-KILOWATT, 200,000-VOLT TRANSFORMER. 4—500,000-VOLT, 200-KILOWATT TRANSFORMER.

Digitized by Google

clay has been rendered useless. To accomplish this a large porcelain basin filled with oil, supported upon a suitable table, is utilized. In the bottom of the basin a needle-holder is arranged and connection made to one terminal of the testing transformer. Over the basin a small framework supports the other terminal of the transformer which also terminates in a needle point. Needles are used in order that the radius of curvature may be made as important as possible in the various tests.

A plate having been inserted the upper terminal is lowered till the needle touches the surface of the porcelain and the voltage raised till puncture occurs, the voltage being observed by the voltmeter. The plate is then taken out, broken and carefully measured by means of a micrometer. This system of always being forewarned of any fault in the product leads to some very interesting results and yields much positive information regarding the dielectric strength of porcelain and the factors influencing it.

All research on dielectric strength of insulators or similar work is carried on inside the laboratory, but in order to test line insulators under nearly the same conditions to which they will be subjected when in service a cabin has been constructed just outside the laboratory which is fitted with steam and water pipes for humidity and precipitation tests. As this cabin is entirely dark and covers one of the windows of the laboratory, the applied potential may be regulated by the observer, darkness here as in other high-tension experiments aiding materially in observing the phenomena. Much work along the line of experimenting with various forms has been done in an effort to ascertain the best form of construction as well as the lines along which progress is most desired.

In the machinery room of the laboratory are located the transformers, generating set, and controlling switchboard. All power and lighting circuits are controlled from this point, and by a system of plug connectors any combination of circuits may be secured.

For power, current and voltage measurements, Thompson inclined coil instruments are utilized. For very small secondary currents, a voltmeter calibrated for current is introduced at the point of earth potential of secondary winding, at which point the current coil of the wattmeter is also introduced, the wattmeter voltage coil being placed across the primary; the fact that primary and secondary voltages are at 180 degrees justifying this method of measurement.

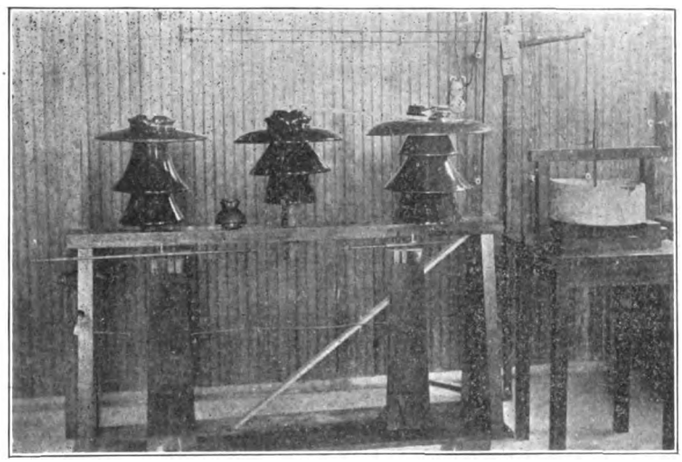
The motor-generator set, which is standard General Electric apparatus, is ordinarily operated direct-connected, but for purposes of special test at lower or higher frequencies belt and countershaft connections furnish means by which any requirement may be met.

In all factory tests it is, of course, possible to make use of the large 200-kilowatt transformer, but in cases where testing must be done at the point of erection a portable transformer is very desirable. To meet this demand the engineering department of the company has constructed a fifty-kilowatt 200,000-volt transformer which has been designed to withstand the rough usage incident to a freight traffic. Primary and secondary connections are so made that practically any voltage from 110 to 1,000 may be made to yield the required secondary potential for purposes of test.

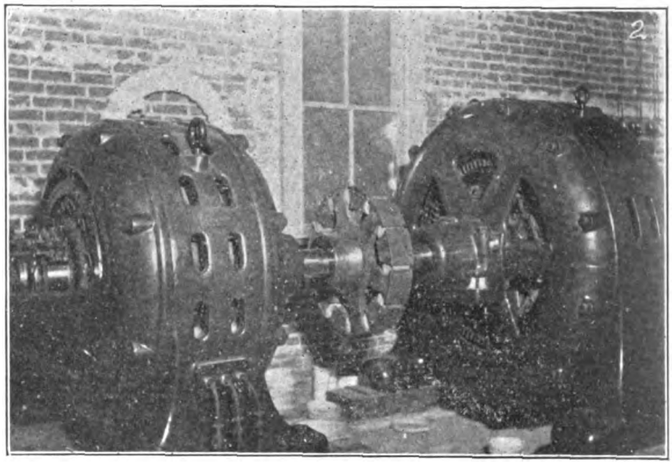
The foregoing shows in a general way that the work of making and testing insulators at the Victor factory is laid out on scientific lines, combining ceramic and electrical skill with economical factory operation, in an endeavor to put insulator production upon the high plane of other electrical industries.

Efforts are not confined to the manufacture of line insulators, though doubtless the exhibit room would show greater variety of such insulators than could be found elsewhere, but every branch of high-tension work is thoroughly gone into and the possibility of the adaptation of porcelain to its service investigated.

The ideal aimed at is to produce a perfectly uniform product as to color and quality, and no effort is being spared to gain and merit the confidence of electrical engineers who are coming more and more to look to the specialist for a solution of their line troubles.



HIGH-TENSION INSULATORS—EXPERIMENTAL TESTING RACK AND OIL TESTER.



HIGH-TENSION INSULATORS—200-KILOWATT MOTOR-GENERATOR SET.

Raising Steam in Boilers.

The National Fire Protection Association gives in one of its recent bulletins an account of several tests made to determine the time required to raise steam in cold boilers. In one case the time required to raise steam to fifty pounds pressure in a 125-horse-power horizontal boiler of the tubular type was one hour and a half, the temperature of the water being eighty-four degrees Fahrenheit. In the case of an upright boiler, with a grate area of thirty-three square feet, fifty pounds of steam was raised in one hour and ten minutes. Tests were also made on the time required to raise steam in boilers under banked fires. In the case of the first-mentioned boiler the pressure under banked fires was fifty pounds. The fires were spread and a fire-pump started at the same time, and in about thirteen minutes the pump was working with throttle wide open. In the case also of the first boiler the amount of coal required to keep up banked fires was found to be 732 pounds per day.—*Canadian Electrical Engineer.*

Digitized by Google

THE EDDY CURRENT BRAKE FOR TESTING MOTORS.[1]

BY D. K. MORRIS, PH.D., AND G. A. LISTER.

The eddy current brake has many advantages over the band or rope methods of motor-testing. Among these are:

(*a*) Sensitiveness combined with convenience of adjustment to exact balance.

(*b*) Uniformity of load, and exact constancy after final temperature conditions have been reached.

(*c*) Heat produced in energy-absorbing element not conducted to bearing.

(*d*) Absence of wear.

(*e*) Retarding torque only occurs.

The first three arise from the nature of the friction employed, and from the simplicity and fineness of rheostatic control. The advantage referred to in (*c*) is one of great importance. The continual stream of air outward past the copper disc carries away the heat in a remarkable manner, so that the copper disc may be very hot indeed for long periods, while the adjacent bearing remains quite cold. The nature of the stresses, too, permits of a relatively perfect thermal isolation of the disc as compared with a pulley rim.

Methods based upon mechanical friction demand water-cooling where time tests have to be made on motors above one or two horse-power. With specially large pulleys this limit can, of course, be raised. No such limit exists with the eddy current brake. With such apparatus, correctly designed, the absorption capacity appears to be determined only by the heating of the magnetizing coils.

The mechanical forms of brake combine great simplicity with considerable sensitiveness; but the advantages enumerated above have sufficed to direct attention to the construction of the eddy current brake, several patterns having been produced.

The types of eddy brake on the market, however, have not been very widely used, mainly on account of the high initial cost, and the difficulty of applying them to various sizes and types of motors.

They are constructed on one of the following principles:

(1) The revolving element is secured to a spindle, one end of which is coupled to, or belt-driven from, the motor-shaft. This brake-spindle revolves in bearings carried by an independent frame, which also carries by means of ball-bearings the floating portion of the brake.

(2) The revolving element is secured direct to the motor-shaft, the fixed portion being provided with knife edges, and mounted on a separate frame.

In the former case a correction of an uncertain nature arises on account of the friction of the bearings, and probably on account of air friction, while in the latter either the brake or the motor has to be specially mounted, that the centres may be brought approximately into line. In such brakes, also, end play should be minimized.

To surmount these difficulties the authors, in designing a brake for the electrical laboratory of the University of Birmingham, decided to entirely dispense with separate bearings or frame. This brake is illustrated in Fig. 1. It is intended to be mounted on the motor-shaft in place of the ordinary pulley. The fixed portion of the brake is carried by the revolving system, and though there is friction at the brushes B and D, this small load is duly represented as torque on the brake lever. A similar argument applies to the air friction. Mechanical and electrical symmetry are ensured by the use of two copper discs, one revolving on either side of the magnetizing coils. This doubles the capacity of the brake for a given diameter and, incidentally, renders it completely astatic. A multipolar design was employed, since in this case the weight is less than that for a two-pole design.

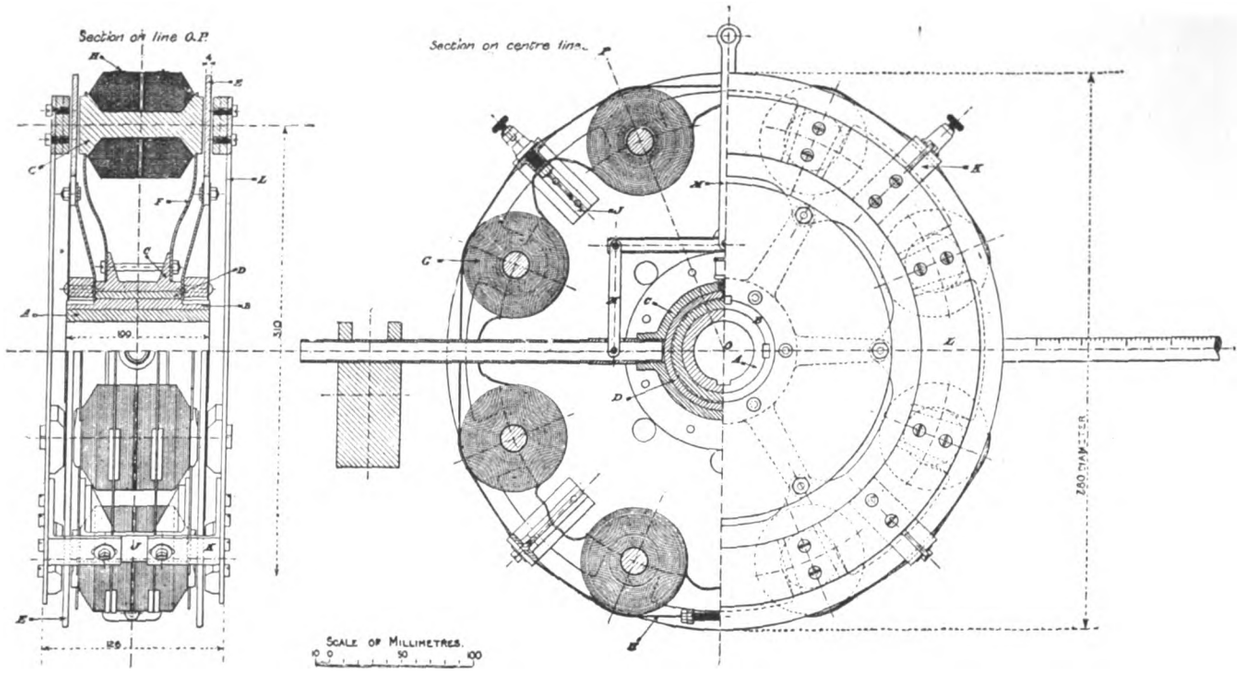


FIG. 1.—EDDY CURRENT BRAKE.

For testing motors up to five brake-horse-power at 1,000 revolutions per minute, or seven and one-half brake-horse-power at 1,750 revolutions per minute, with an overload capacity of twenty-five per cent in each case.

Fig. 2 shows the brake mounted on the spindle of an electric motor, and indicates the manner in which the pressure on the motor-bearing may be adjusted. The brake is provided with a link suspension, so that an upward pull gives rise to no twisting moment. This suspension is attached to a spring balance, which can conveniently be carried by the hook of the crane or blocks serving the testing bed. By means of the lifting gear the pressure on the bearing may be reduced to nothing, or it can be given any desired value. Bearings in friction motors may be tested with this brake with great accuracy.

In cases where lifting gear is not avail-

[1] Abstract of paper read before the Birmingham section of the Institution of Electrical Engineers, of Great Britain, April 12, 1905.

Digitized by Google

able, the suspension and balance could be carried by a special frame, provided with screw and hand-wheel. For ordinary testing the whole brake can very well be carried on the motor spindle without suspension.

The construction described has therefore the following additional advantages

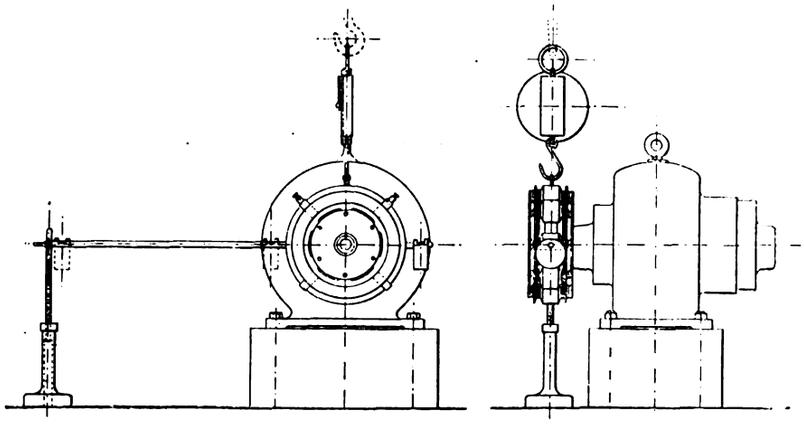


FIG. 2.—THE EDDY CURRENT BRAKE READY FOR CARRYING OUT TESTS.

without in any way sacrificing those previously enumerated.

(*f*) Apparatus self-contained; no separate frame required; an advantage over all other practical types of brake.

(*g*) Brake is completely astatic.

(*h*) Air-friction error is practically eliminated.

(*i*) Pressure on motor-bearing during test may be adjusted to any desired amount, independent of the load.

The revolving discs E are made of high conductivity hard-rolled copper. They are supported by a thin steel plate and steel arms on the outer and inner sides respectively, each hub being keyed to the bush B. Between these discs is the casting C, which is fitted with a gun-metal bush D, bored to suit the bush B. Into this casting are screwed two tubes, the shorter carrying the counterpoise, and the longer constituting the lever arm. This arm is marked with a scale of feet divided into tenths and hundredths of a foot, the maximum leverage being three feet. The brass plates F are bolted to the casting C, and carry at their circumference the magnet coils G. These coils, which are eight in number, are securely held in position by the steel wires H. Each consists of a wrought-iron core wound with 1,400 turns of No. 20 S. C. C. copper wire. The resistance of each coil is 5.1 ohms when cold. There is a ventilating duct at the middle of the coil.

The aluminum castings J act as distance pieces, the two upper ones being fitted with insulated terminals. Secured to these castings by set pins are the aluminum castings K which carry the external yoke rings L. A slotted hole in the castings K allows the length of the external air-gap to be adjusted. The length of the internal air-gap is fixed, and in consequence of the rigidity and smooth running can be kept short. Steel bushes A are turned to suit the inside of bush B, into which they are keyed. They are bored out to various sizes to suit the spindles of the motors which have to be tested. The suspension links M are fitted to the graduated lever and to the counterpoise lever at equal distances from the centre. Accurately adjusted sliding weights of two and one-half pounds, five pounds, seven and one-half pounds, and ten pounds are used.

After completion the brake was supported on a central knife edge, and the counterpoise lever loaded until an accurate balance was obtained.

(1) A test to determine the result of reducing the number of magnets showed that the braking effect is practically proportional to the number of coils excited. The slight reduction observed was probably due to the increased length of the iron portion of the magnetic circuit. In other words, the braking effect depends only on the total flux cutting the copper, and is independent of the number of points at which it may be applied. (2) The removal of the external yoke rings resulted in a reduction of the absorption capacity to about fifty per cent of the normal for a given number of ampere-turns per coil. (3) The torque produced by bearing and air friction alone (the magnets being unexcited) was found to be about 0.3 foot per pound at 500 revolutions per minute. This increased to 0.365 foot pound at 1,250 revolutions per minute. (4) At moderate excitations, such as 4,000 ampere-turns per coil, the horse-power absorbed increases, except at first, nearly with the speed up to 1,000 revolutions per minute. Above this speed, however, there is a noticeable falling off. At low excitations, such as 1,500 ampere-turns per coil, the falling off occurs at about 600 revolutions per minute. This failure to reach proportionality is due to increased distortion of field at high speeds and consequent reduction of resultant flux. Fig. 3A represents the flux (obtained ballistically) in one of the yoke rings with the brake stationary, and also when running at 1,000 revolutions per minute, the excitation being constant at 3,500 ampere-turns per pole. The flux which usefully cuts the copper may be taken as that which actually arrives at the yoke ring. The dotted curves, which are determined from the flux curves, represent the approximate

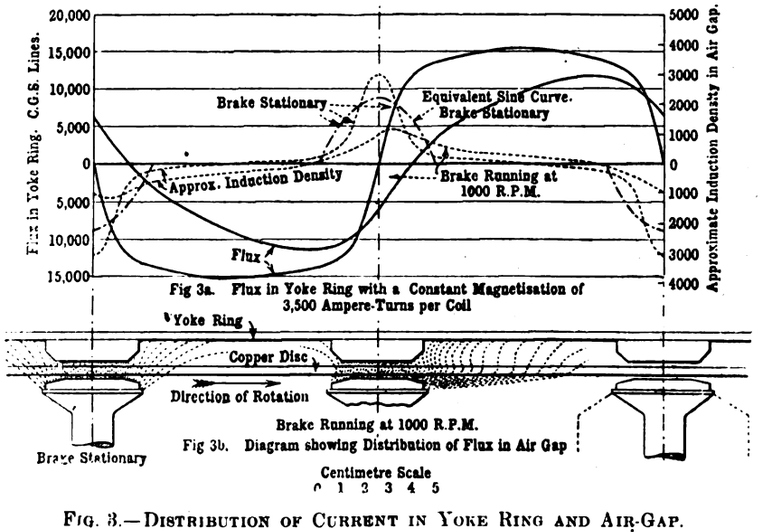


FIG. 3.—DISTRIBUTION OF CURRENT IN YOKE RING AND AIR-GAP.

induction density in the air-gap in each case. It will be seen that, on the average, the flux is shifted forward in the direction of rotation. This is represented in Fig. 3B. (5) The brake was originally made with a plain yoke ring without pole-pieces. Its performance under these conditions is shown in Fig. 4, curve i, abscissæ

Digitized by Google

representing ampere-turns per pole and ordinates the horse-power absorbed. The addition of pole-pieces one centimetre deep, and having a radial length slightly less than the diameter of the magnet core, somewhat increased the efficiency of the brake, as indicated by curve ii. The best position for the pole-pieces was found to be five millimetres forward of the magnet coil, but the effect was not sufficient to warrant their being permanently placed in this position. (6) An attempt to prevent the flux from being dragged off the

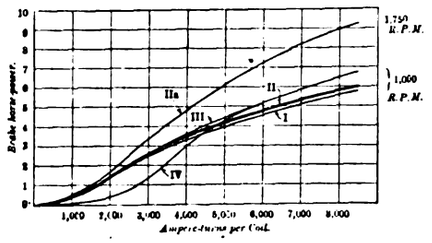


FIG. 4.—ABSORPTION CAPACITY OF BRAKE.

pole-pieces, and so prevent excessive lengthening of lines, and consequent reduction of field strength was made by winding the yoke rings with additional magnetizing coils situated between the pole-pieces. There were sixteen coils, or two coils per magnet, each consisting of twenty-five turns of No. 18 D. C. C. copper wire. The effect was very noticeable, as will be seen on reference to Fig. 4, curve iii, which shows the effect of a constant current in the main coils giving 3,500 ampere-turns combined with increased excitation applied by means of these supplementary coils, up to a total of 6,000 ampere-turns. Curve iv shows the result of a constant excitation of 2,000 ampere-turns maintained by the yoke ring coils, supplemented by currents in the main coils. The result of these two curves is to show that, up to an excitation of, say, 5,000 ampere-turns, the maximum effect will be obtained by using the main coils only. Above this figure, however, the strength of the eddy currents in the discs tends to cause excessive distortion of the field, and a great advantage will result by transferring a large portion of the energy supplied to the brake to the yoke ring coils. The advantage, however, probably does not warrant the extra complication. (7) It was found that the braking effect for a given excitation is not perceptibly dependent upon the temperature of the copper discs. This shows that any decrease in the eddy currents due to increased resistance of path is counteracted by the consequently reduced distortion. (8) Experiments carried out with different lengths of air-gap emphasized the necessity of keeping this as small as possible. When absorbing five horse-power at 1,000 revolutions per minute a reduction in the air-gap from ten millimetres to eight millimetres reduced the current required by fifteen per cent, thus resulting in a saving of power of rather more than thirty per cent. (9) Fig. 5 shows the variation of flux with excitation both with brake stationary and when running at 1,000 revolutions per minute. The thickness of the copper disc is four millimetres and the length of air-gap between pole-tips approximately nine millimetres. In each case the flux was measured at the centre of the magnetizing coil. (10) Fig. 6 shows the variation of flux with speed, the excitation being constant at 1,400 ampere-turns per coil. The measurements were taken at the centre of the coil. (11) As a result of theoretical considerations the brake was tried with copper discs of special section. This section enables the length of the air-gap to be considerably reduced, while at the same time affording a high conductivity path for the eddy currents in a circumferential direction.

One of the characteristics of the brake is the steady manner in which the lever floats after the magnetizing current has been adjusted. This is due to the fact that the centre of gravity of the sliding weights is slightly below the centre line. This feature is obtained without any material reduction in the sensitiveness

Another noticeable feature when using the brake is the absence of trouble due to

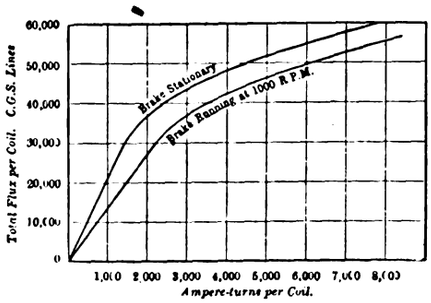


FIG. 5.—VARIATION OF THE FLUX WITH THE EXCITATION.

end play of motor. This is extremely serious in the case of brakes in which the copper disc is mounted on the motor spindle while the magnet system rests on a separate frame.

It is found that by the use of properly suspended flexible leads, the magnet coils can be supplied with current without the use of mercury cups.

The limit to the absorption capacity of the brake is determined by the heating of the magnetizing coils. The fan action referred to is found to be an entirely satisfactory way of getting rid of the heat generated in the discs. Long continued tests give rise to no difficulty at all on this account.

The brake was originally designed to absorb five horse-power when running at 1,000 revolutions per minute, and it has been found to work most efficiently at speeds of this order. At speeds above, say,

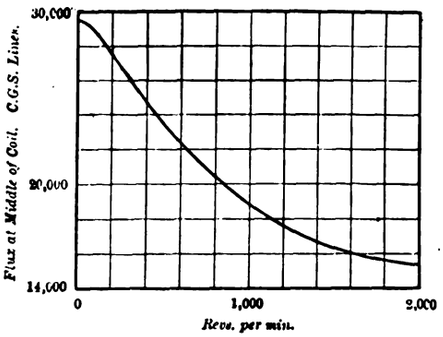


FIG. 6.—VARIATION OF THE FLUX WITH THE SPEED.

1,500 revolutions per minute the falling off of braking effect due to field distortion becomes noticeable, and at speeds lower than 500 the magnetizing current required to brake, say, five horse-power becomes too great for the capacity of the coils.

The brake is found very convenient for testing motors as regards temperature rise and overload capacity. When temperatures have settled down, and the magnetizing current is finally adjusted, the load remains perfectly constant.

Fig. 4, curve ii, shows the absorption capacity of the brake for given excitations at 1,000 revolutions per minute, and curve ii*a*, under same conditions for 1,750 revolutions per minute.

Motors may be tested for starting torque by locking the revolving discs to the fixed portion of the brake.

In any type of eddy current brake it is important that the power absorbed in the magnetizing coils be kept down as low as possible. The ratio

$$\frac{\text{Absorption power of brake}}{\text{Power absorbed in magnetizing coils}}$$

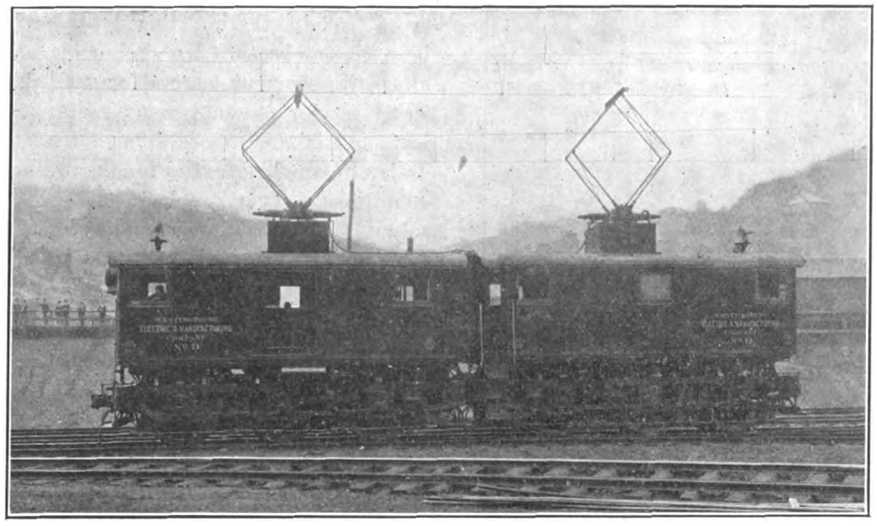
may conveniently be termed the "figure of merit" of the brake. This figure should be as high as possible over the whole range of the brake, but more especially at or near its full rated capacity. It is at this point it will be most frequently used, especially in connection with time tests. The figure of merit will, of course, rise with the speed.

The brake, besides being quite the most convenient and compact for ordinary motor-testing, will compare favorably, when correctly designed, with mechanical water-cooled brakes in all respects except that of initial cost.

Digitized by Google

A Large Single-Phase Locomotive for Heavy Railroad Service.

OF THE many interesting exhibits of railway appliances prepared for the inspection of the delegates to the International Railway Congress, probably one of the most novel, and one of great importance in its bearing on the use of electricity as a motive power for heavy railroad service, was the Westinghouse-Baldwin single-phase alternating-current locomotive shown in operation May 16 on the interworks railway at East Pittsburg. This locomotive was built by the Westinghouse Electric and Manufacturing Company in order to convince the railway managers of the world of the possibilities and advantages of the use of single-phase current for heavy electric traction and to demonstrate in the most convincing manner possible the ability of the company to supply the necessary apparatus. It was shown in operation, first running light and then hauling a train of fifty new steel gondola cars weighing approximately 1,200 tons.



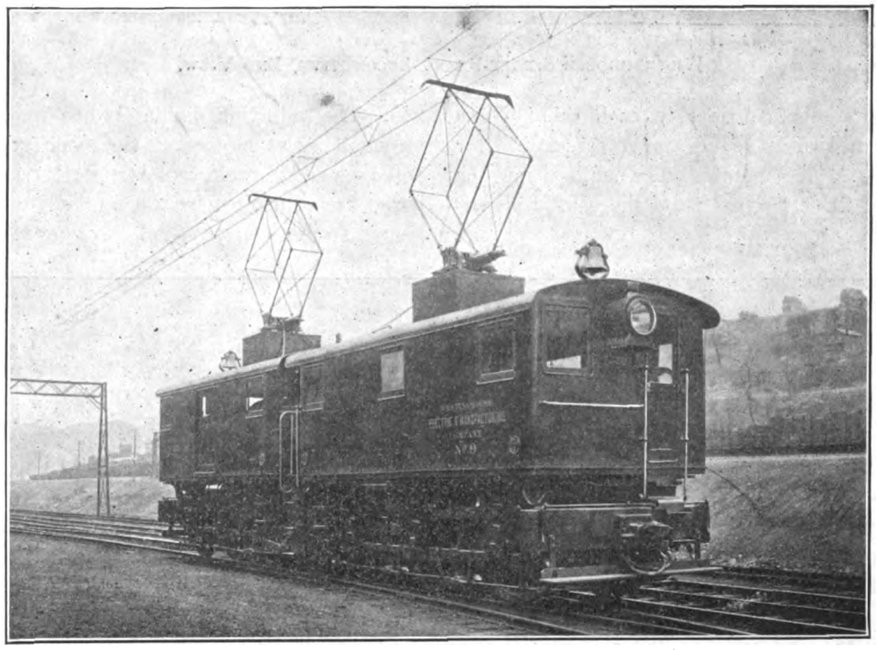
WESTINGHOUSE SINGLE-PHASE LOCOMOTIVE.

From the various details which are given below it will be seen that a number of new features are embodied in the construction of this locomotive and it is stated that claims of priority may be made for it in many respects. It is, for instance, the largest alternating-current locomotive in the world; the largest to be operated by single-phase current, and it is equipped with six of the largest single-phase motors ever built. It is the first alternating-current locomotive for use in America and is designed for the highest trolley voltage ever used in this country. This locomotive is also the largest ever operated by means of overhead trolleys, is the first on which forced ventilation is used in the motors, and is unique in many other similar ways.

The weight of the locomotive complete is 135 tons. It is built in two halves, each having one six-wheel truck with rigid wheel base. These are coupled together and are intended to operate normally as a single unit, but each half may be operated separately if desired. The locomotive is approximately forty-five feet long over all, and nine feet eight inches wide. The total height above the rail with trolleys lowered is seventeen feet. The wheels are sixty inches in diameter and are mounted on eight-inch axles, six feet four inches between centres. The side frames of the truck are of cast steel and are spring-supported in the usual manner, the weight on the two inside axles of each truck being equalized. The cabs are built of sheet steel with angle-iron supports and the entire cab as a whole is removable from the truck.

Each axle carries a 225-horse-power single-phase series motor of the single reduction geared type, making a total of six motors for the locomotive. One side of each motor is supported directly on the axle and the other is suspended by spiral springs from the locomotive body. The motors are of the same general construction as the standard Westinghouse alternating-current railway motors of smaller size which have been previously described in these columns. They are so arranged that forced ventilation may be used and increased output thus secured.

The locomotive is designed for a current of twenty-five cycles and a trolley voltage of 5,000, and one of the most striking points of the exhibition to those who have been accustomed to the enormous currents required in heavy direct-current traction work was the sight of so large a locomotive accelerating a 1,200-ton train over a third of a mile in length and receiving its entire power supply from a single No. 000 trolley wire.

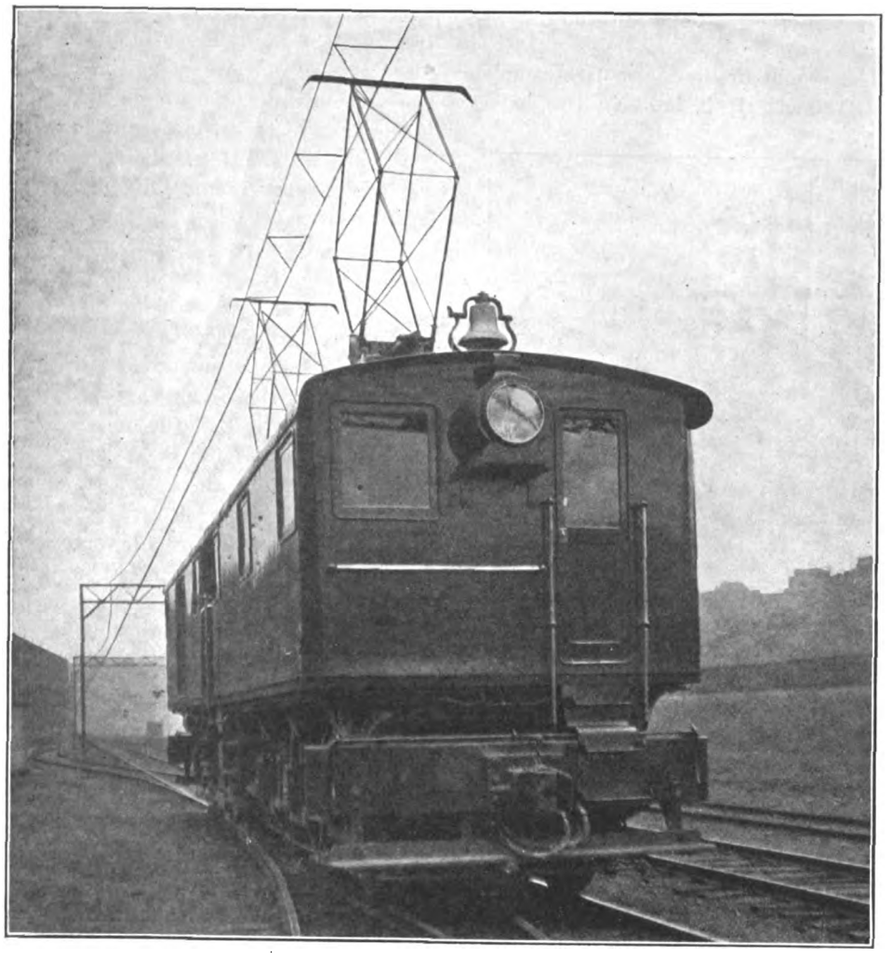


WESTINGHOUSE SINGLE-PHASE LOCOMOTIVE.

The 5,000-volt current is collected from the trolley wire by a pneumatically

Digitized by Google

operated pantagraph trolley on each half of the locomotive and is carried through a suitable oil-switch and circuit-breaker to an induction regulator, which, under the direction of the operator, varies the voltage at the motors from about 140 to



WESTINGHOUSE SINGLE-PHASE LOCOMOTIVE, END VIEW.

an autotransformer in each cab. These transformers reduce the voltage to 225 for use at the motors. The trolleys may be raised or lowered from the cab by a suitable air-valve.

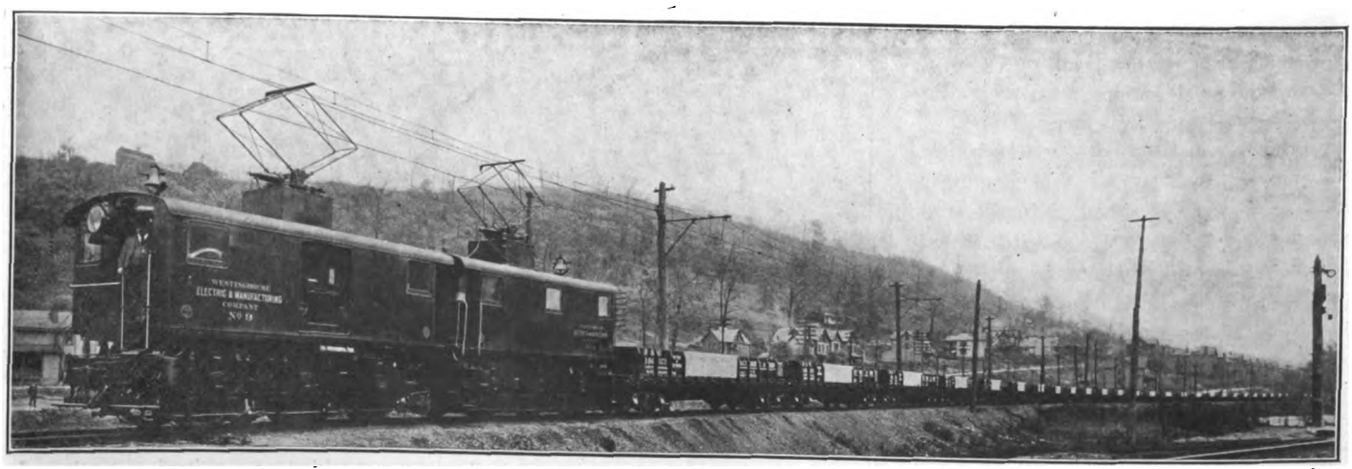
325. The induction regulators are driven by small series motors of the same general type as the main motors. Both regulators are controlled by the multiple-unit system from a master switch at either end.

facility and economy as a steam locomotive.

Forced ventilation is used with the autotransformers and induction regulators as well as with the motors, the necessary air being supplied by suitable motor-driven blowers. Motor-driven air-compressors are also used.

The locomotive is designed for slow-speed freight service, this type having been chosen because the design of series alternating-current motors for very slow-speed service presents many more problems and is much more difficult than the design of equal capacities for the ordinary conditions. This problem having been solved, the production of similar locomotives for passenger service becomes a relatively simple matter. With the motors working at nominal full-load output the locomotive will develop a draw-bar pull of 50,000 pounds at a speed of approximately ten miles per hour. On several occasions, however, when hauling the fifty-car train referred to above, steady draw-bar pulls of from 60,000 to 65,000 pounds have been recorded on the dynamometer car and momentary efforts as high as 100,000 pounds have been obtained with no sign of slipping of the wheels. With lighter loads the locomotive may be run at higher speeds up to a maximum of about thirty miles per hour.

The successful completion of so large and powerful an alternating-current locomotive without the usual series of developments through gradually increasing sizes, which is ordinarily required when so great a problem is undertaken, marks a distinct advance in the production of electrical apparatus for heavy traction work, and now that the first important step has been taken should certainly prove



WESTINGHOUSE SINGLE-PHASE LOCOMOTIVE HAULING A TRAIN OF FIFTY GONDOLA CARS.

The three motors on each half of the locomotive are connected permanently in parallel and are controlled by means of

They may be stopped at any desired point in their travel and thus the locomotive may be run at any speed with the same

the forerunner of the use of electric traction on trunk-line railroads, which has so long been looked for.

Digitized by Google

Central Station Protection.

A Symposium of Ideas on the Protection of Central Stations from Interrupted Service.

AT THE 197th meeting of the American Institute of Electrical Engineers on May 16, 1905, a great many ideas were presented by different gentlemen for the ensuring of uninterrupted service of central stations. Mr. H. W. Buck presented a paper entitled "Duplication of Electrical Apparatus to Secure Reliability of Service."

H. W. BUCK.

Before a decision can be made upon the degree of duplication advisable for any given piece of apparatus, an analysis must be made of the defects which may develop therein, the length of time required for repairs in case of a breakdown, and the number and importance of the power customers dependent upon that particular appliance.

For purposes of discussion electrical reserves may be divided into several classes of apparatus, each governed by different conditions. These classes are:

1. Generating units.
2. Generating plant switchboard.
3. Generating plant transformers.
4. Underground and distribution system.
5. Overhead lines.
6. Substation apparatus.
7. Apparatus on premises of individual customers.

Reserve apparatus applicable to the above can again be divided into two classes:

(*a*) Actual apparatus installed complete ready for service.

(*b*) Reserve parts held in storeroom.

There is no place in a power system where reserve apparatus is so important as in the generating station. The following conditions should be observed in every large generating plant where continuous service is demanded: the maximum overload capacity of the generators normally operating on the bus-bars should be such that at any time and under any conditions of load any one of the generators can be instantly disconnected from the bus-bars without necessitating a reduction of station load or causing a serious momentary drop of pressure. Furthermore, there should, if possible, be one unit held as absolute reserve which need not be operated except as a substitute. This enables any one generator to be out of service for repairs, even during load-peaks. The size of generating unit selected for an installation has an important bearing on the question of reserve. The larger the unit the lower the cost of the plant per kilowatt, but, by necessity, the larger will be the investment in the idle reserve machinery. The proper relation can only be determined by a study of the local conditions under which the plant is to operate.

A station operated by steam turbines or by water power has certain advantages in reserve conditions. With steam turbo-generators, on account of the comparatively high part-load efficiency of the steam turbine, all the units installed in the plant, including the reserves, can be kept in operation on the bus-bars at all times without serious sacrifice in steam economy due to the part load on each unit. This enables a generator to be quickly disconnected from the bus-bars at any time without overloading the remainder or causing a serious drop in pressure. This condition also obtains in a water-power plant, since the additional use of water caused by the continuous operation of the reserve units has only little effect on the cost of producing the power. With a reciprocating engine, however, each unit must be operated as far as possible at exactly the full-load point on account of the economy required in steam consumption. This prevents obtaining the full utility of the reserve machines.

The exciters in an alternating-current generating station are, of course, the heart of the entire system, and the most careful provision should be made to ensure continuity of service therefrom. Since the cost of the exciters is in every case only a small proportion of the cost of the plant, there is little excuse for not installing ample reserves in connection with the exciter equipment.

Of equal importance with the complete reserve machinery installed is the stock of reserve parts held in the storeroom. There should be kept on hand at all times, ready for immediate use, a complete outfit of the parts of the prime movers and generators which are most likely to wear out or break down. In the selection of such spare parts the most careful judgment should be exercised. In many instances a carefully selected reserve will enable breakdowns to be repaired in a few hours, that might require weeks, if the new parts, many of which might be special, had to be obtained from the manufacturer. From the standpoint of reserve, then, there is no part of the power plant of more importance than the storeroom.

Under the heading of generating plant switchboard might be included all of the electrical equipment of the station from the terminals of the generators to the point where the outgoing feeders leave the power-house. Here the question of reserve is almost wholly a storeroom proposition. The actual installation of duplicate cables in the station wiring and duplicate switches, controlling devices, etc., should be avoided as far as possible. There should, however, be kept on hand, preferably in the power-house itself, the fullest inventory of switch parts which are liable to injury, and full length of all sizes of cables used in the installation. The duplication of bus-bars is of course quite necessary in a generating plant, but more for reasons of flexibility of operation than for reserve. A great deal can be accomplished toward reserve in the case of switchboard equipment by keeping on hand a suitable outfit of jumpers with proper terminals soldered on to use for emergency connections to temporarily transfer feeder or generator leads from one switch to another.

Many of the considerations involved in the generating unit enter into the question of duplication for reserve in a transformer equipment. Here also, in regard to the size of unit selected, a proper balance must be established between the saving in cost per kilowatt by the adoption of large units and the saving in investment in reserve transformers by the installation of smaller ones. Another important question has recently been brought up in connection with transformer plants by the introduction of one polyphase transformer as a substitute for two or three single-phase transformers for a bank. A polyphase transformer occupies less space and costs less than a bank of single-phase transformers, but when reserve is considered it is not so good. If a bank of separate single-phase transformers breaks down the trouble is not likely to involve more than one of the component transformers and this can be replaced by a small kilowatt reserve. If, however, a

Digitized by Google

polyphase transformer breaks down, capacity equal to its full polyphase rating is put out of service.

All important transformer stations should have a complete spare bank which can be shut down at any time without overloading the remaining transformers, and in addition one single-phase transformer should be held in stock to make good any bank in case one of the component transformers should break down.

A transformer station usually involves more or less of an equipment of high-pressure cables, switches, lightning arresters, etc.; and in the present state of the high-pressure art there is nothing more liable to frequent destruction than the devices involved in this part of an electrical system. Consequently here the storeroom reserves should be most carefully provided for.

If there is a single element in an electrical system where trouble is sure to develop sooner or later it is on the overhead lines, and the higher the pressure the more likely is the trouble to occur. This is so because the overhead lines are subjected to influences over which the power company has no control. These influences are principally lightning, general abnormal weather conditions, malicious interference, and accidental interference caused by the contact of other companies' wires during construction work. For these reasons it is practically out of the question to attempt to maintain a continuous power service over a single circuit overhead line. There should always be enough circuits installed so that at least one can always be shut down without necessitating a reduction in load. This is specially true in the case of high-pressure lines. In low-pressure systems of 2,300 volts or less it is nearly always possible to replace insulators and do other work on the line while it is "alive," but at higher pressures this should not be allowed if there is any regard for human life. In many plants where important interests are dependent upon the power transmitted the matter of duplication should be carried beyond the circuits and reserve pole-lines installed. Carried to its limit without regard to cost, the ideal condition would be a number of single circuits, each installed on a single pole-line and each line following a different route. With this arrangement lightning would not be likely to disturb more than one line at a given time, and a complete shutdown from malicious interference involving all the lines would be very improbable. The cost, however, in such a separation of lines would in most cases be prohibitive on account of purchase of right of way, patroling, etc.

In an underground feeder breakdowns are difficult to locate, and when found, repairs frequently occupy many hours on account of the necessity for pulling out the defective cable from the ducts, putting in new cables and resplicing. Duplicate or triplicate cables should always be installed where important service is involved. This obligation is conceded by most engineers, and spare underground cables are usually installed. The installation, however, is apt to be carried out in such a way that the security of the reserve cables is impaired. Underground conduits as now generally constructed consist of a congested mass of ducts grouped in such a way that in the manholes the cables are crowded closely together and all in constant danger of destruction in case of a violent short-circuit in the manhole. There is little value in installing spare cables when they are liable to be damaged at just the time when they are most urgently required. Such risk can only be obviated by constructing electrical conduits in such a way that the cables can be separated in the manholes by short-circuit proof barriers. Preferably, whenever possible, duplicate conduits should be constructed on opposite sides of the street or, still better, laid through different streets. Only by such precautions can the full benefit of the reserve cables be ensured.

Investment in duplication of generating units and transformers for reserve purposes does not result in any saving in operating expenses. On the contrary, if the reserves are kept in continuous service, in general the losses will be increased and consequently the efficiency of the plant lowered by just so much. Investment, on the other hand, in reserve cables and overhead circuits can be made to pay directly; for if such reserve circuits are kept in operation the efficiency of the transmission is raised and the cost of producing the power lowered by that amount.

The general considerations which apply to generating plant reserves also apply to outlying substations but in a less degree, for the complete shutdown of a substation involves only a portion of the power system. Farther out on the power network to the plants of individual customers, where the transformers or other apparatus is supplied by the power company, no reserve seems necessary under the ordinary obligations of such cases. If a breakdown occurs only the individual is inconvenienced, and therefore the risk is usually justified.

The above stated conditions of reserve apply particularly where certain public utilities are involved. Among which may be mentioned: (1) Electrified steam railroads. (2) Traction system in large cities. (3) Street lighting and the lighting of large public buildings.

Where such interests are at stake storage battery reserves are probably justified aside from all considerations of economy resulting from improvement in load-factor.

Where water power is used for the operation of important power systems duplication of generating stations is especially important. In steam plants as now constructed with multiple stacks there is no single element of the plant which is common to and necessary for the operation of all the power units. Consequently any part of the equipment can be inspected and repaired without a total station shutdown. In an hydraulic plant, however, there are a number of elements in the development which are essential to the operation of the whole plant, among which may be mentioned the dam, flume, forebay, tail-race, tunnel, etc. In cases of emergency it may become necessary to shut off the main water supply in order to get access to these parts. Furthermore, hydraulic plants are subject to ice troubles and floods in winter and low water in the summer. It therefore seems essential if steam roads or other public utilities are to be operated electrically by hydraulic power that the system should be operated by more than one generating station.

Such are some of the considerations entering into this problem of duplication for reserve. The details are subject to the local conditions of each particular installation. The matter of reserve grows more important each year with the development of electrical applications. Ten years ago or more shutdowns on electrical power systems were taken as a matter of course, and no one used electrical power unless interruptions to service could be taken without serious inconvenience. At the present time, though the obligations of the power generating companies are much more serious, and absolutely continuous supply of electric power is demanded by all users. To avoid loss of revenue and possibility of damage suits from shutdowns every power company is justified now in making a large investment in reserve to assure continuity of service.

H. G. STOTT.

I do not quite agree with the recommendations in Mr. Buck's paper in regard to the treatment of some of the apparatus. The whole principle of design in modern

Digitized by Google

power stations is to make each individual unit virtually a separate power station in itself. The isolation of the generators, the cables connected with them, the individual cables connected to these main cables, the oil switches, bus-bars, etc., permits all operating devices, where it is possible, in almost all modern stations, to operate in one unit. Economy does not dictate this separate operation. The question as to how large to make the station is simply a question of how safe each individual unit can be made, and the impression should not be conveyed that the final size of the large power plants has been reached unless there is some special point, especially as indicated in the hydraulic plant where there are any unreliable items, such as the dam, flume, forebay, tail-race, etc., which controls the entire amount of power. In the steam plant there is no one item controlling the whole amount of power. The nearest approach to this condition is found in the water supply. That, in practically all stations, is in duplicate and is also further protected by the use of large storage tanks.

In regard to the safety of underground cables, there seems to be a point which is rather neglected, and that is the higher the voltage the less the damage likely to occur in surrounding cables. It is a fact which has been verified by experiments, that the safety of the cable, in regard to its neighbors, varies inversely with the voltage; in other words, the larger the current carried, the greater danger to the surrounding cables, and the damage is proportional to the square of the current.

PHILIP TORCHIO.

The problem of protection of high-tension systems against shutdowns is of great importance and it has necessarily received the careful attention of the engineers who have been connected with the operation of the central stations.

It is probably true that our largest central stations are now equipped with protective devices to meet almost all of the exigencies of the service for each particular condition. It is also true that these conditions vary greatly from station to station, and it is doubtful if a standard solution could be applied to all cases.

Seven years ago the New York Edison Company adopted, with all its high-tension switchboards, two types of relays, one being a fixed time-limit overload relay installed at the generating end and one at the receiving end of each high-tension feeder, and one instantaneous reverse-current relay added at the receiving end of the feeders. The company at the beginning did not feel enough confidence in the reliability of these safety devices, so that at the start the relays were connected only to signal lamps. The relays were not entirely satisfactory and for considerable time a lot of experimental work had to be done before it was felt safe to connect a few of these relays to the trip mechanisms in a few stations. Then followed a period of investigation to find out whether the relays did more good than harm. About three years ago the experience was greatly discouraging. Investigations made upon relays used on other systems proved to be equally perplexing. A careful study of the problem clearly demonstrated two facts, one that the existing type of relays was inadequate to fulfil all requirements of the service, and the other, that to accomplish any satisfactory results it was necessary to develop a well coordinated scheme of relays in which each element should have its proper relation and function to the other elements of the protective scheme. It was thought that the keynote of this situation lay in the development of a time-limit relay which would operate in an interval of time in inverse proportion to the amount of current. The only relay of this style available at that time was the dashpot arrangement attached to the ordinary overload relays, but this was found to be unsatisfactory in service and it was dismissed from consideration. The manufacturers had been urged to develop a better relay to meet certain specifications which were given in detail. Developments along such a line of apparatus were, however, slow to materialize and in the meantime the New York Edison Company was not making great headway in protecting its increasing high-tension system.

In the spring of 1903 the General Electric Company installed forty double-pole bellows type relays, and upon this type of relay a whole scheme of safety appliances was designed for the whole system, which is briefly as follows:

Aside from the system of protection of auxiliaries at stations and substations, the continuity of the service of the system is safeguarded by the following relays:

Generators—It has not been found desirable to install automatic circuit-breakers on the generators as reliance is put upon the attendant to disconnect the generators by hand operation of the oil-switches whenever he finds it necessary so to do. To guide him in his action an overload relay operating a signal lamp is mounted on each generator. This relay is without time limit.

Feeders—First, high-tension feeders at Waterside station. On each feeder is mounted an overload relay with a variable time limit in inverse proportion to the amount of current.

Second, high-tension feeders at substations. The feeder switch is automatic and controlled by a relay similar to the one at the Waterside station and of the feeder.

Third, high-tension side of rotary converters. Each rotary converter is equipped with a relay of the same kind as previously discussed, its load being proportioned by the current transformer ratio.

Fourth, direct-current side of rotary converters.

To be consistent with the general scheme above outlined, the direct-current side of each rotary converter should be equipped with a reverse-current, inverse time element, direct-current relay. A relay with an instantaneous opening could not be used at this point unless set to operate at a very high reverse current, which would in itself largely defeat its purpose. A fixed time limit irrespective of current would render the relay of very little value, as the short-circuit on the direct-current side might reach disastrous proportions before the fixed time of the relay had expired. The selection of the reverse-current direct-current relay in this instance was made feasible by the fact that each substation is equipped with large storage batteries which can always energize the pressure coils of the reverse-current relays.

In a paper before the Institute the respective features of the relays described were summarized as follows: "all relays must be properly adjusted to operate the different circuit-breakers in the proper order, so that if the trouble is once cleared by the opening of certain circuit-breakers, the other relays reset themselves in the normal position, leaving the rest of the system in operation."

It is gratifying to report that the expectations have been fully realized by subsequent experience. It goes without saying that the success of such a system of protection is dependent upon the care that is given to the maintenance of the several relays, but it is also a fact that we are now in possession of an apparatus which is not freaky and unreliable and certainly sturdier than most of the rest of the instruments on a switchboard.

It is probable that as further experience is obtained it will be found that a number of these delicate and intricate pieces of auxiliary apparatus may be advantageously omitted, but as the matters now

Digitized by Google

stand we must put up with some sort of inconvenience of this kind, and the experience has proved that a system based on the use of the inverse time element relays gives a solution free of serious drawbacks.

There are cases in water-power installations where a short-circuit on one line drags down the speed and voltage of the generators, and when the short-circuit is cleared the pressure and speed increase while the synchronous motors operating on the other lines fall out of step and overload those lines, opening the circuit-breakers on the same. Troubles of this character have created a feeling of uncertainty as to the desirability of installing automatic relays in such cases.

While not wishing to advocate a complex system of protective devices, if such can be omitted to advantage. I must emphasize the necessity, wherever it is found necessary to install these relays, of not confining the installation to a portion of the systems only, but to extend the same to the whole installation so as to coordinate the different factors into a well coordinated protective scheme in which every element bears the proper relation to the other elements.

S. D. SPRONG.

The proper selection and adjustment of the various relays in a large power distribution system is one of the determining elements in the continuity of service rendered.

Is it not probable that during periods of light system load when but one or two units are running, that a short-circuit on one of the feeders, if close to the power station, would so depress the generator voltage as to cause the relays to operate under the characteristics of "short-circuit" rather than those of "overload" at normal pressure? If so, this would reduce the opening point to nearly one-half of what it should be for any kind of feeder trouble, which is in its relation to the generators an overload. It would seem for these reasons that the differential feature is not a desirable one in a generator relay at all points of the twenty-four-hour load, if it is essential to maintain the differential factor. The question arises, however, would a generator under any conditions ever trip its relay due to overload?

It has been stated that a time-limiting device, such as a bellows or dashpot (while ideal from the standpoint of simplicity), is not positive. I would say on this point that one large operating company in New York city has had a varying number, over 150, relays of this type in operation for a period upward of eighteen months, and has not experienced failure in operation in a single instance, nor has the regular periodic inspection and test made on all the relay devices disclosed any of them in an inoperative condition due to the air type of time-limiting device.

Referring to the broad question of relays in the generator circuit, I would ask if it is considered essential for good operation to have automatic opening of switches in the generator circuit under any conditions? It is not the practice among some of the larger companies which have been in operation for some years to have automatic operation of the generator switches. Their practice of having a relay which would signal the operator only at times of extreme load has proven entirely satisfactory.

It has also been stated that in an ideal combination the substation end of the feeder should have an instantaneous reverse-current relay. This seems open to question, unless the relay is set at a high figure in consequence of which it would lose much of its value for the purpose intended. If set at a reasonably low point, practice shows that the momentary reversals due to synchronizing a rotary, or short depressions of voltage due to short-circuit, will cause the rotaries to reverse for an instant due to the energy stored in them, and trip the relay, thus cutting out one or more good feeders. This will occur whether there are storage batteries in multiple with the system or not.

It is stated that a direct-current reverse relay operating a circuit-breaker on the direct-current side may be used to open the circuit of an inverted rotary, thereby preventing the rotary from attaining destructive speed in case of open field circuit. It would seem that relays of the type described, and without time limit either fixed or inverse, would be very liable to disconnect the rotary during momentary depression in the system voltage resulting from short-circuit on a feeder, or other causes. This applies to substations where storage batteries are employed, or where a system is divided into two or more sections operated independently, but each section supplying a portion of each substation's load.

I believe it is the general opinion among engineers that when a speed-limiting device is found necessary it should be a device designed for that purpose only, and its operation should be based entirely on the mechanical feature of the rotary speed.

W. F. WELLS.

Experience is reputed to be a good teacher and the general practice of a large lighting company, deduced from the experience of a number of years, might be of interest. This company generates alternating current at 6,600 volts, which is transmitted underground to substations, where it is transformed to direct current at 120-240 volts.

In general, sufficient equipment is installed and operated to render it possible at all times to instantly disconnect any individual or group unit, without interfering with the service. As the number of units increases, the proportion of investment in emergency or spare equipment diminishes and soon becomes of relatively minor importance. The interest and depreciation charges on account of this spare equipment are partially offset by the greater flexibility in operating, and decreased transmission losses.

The proportion of reserve required in each of the seven classes of apparatus mentioned by Mr. Buck depends to a large extent on the reserve in the following class. It is simpler to discuss them in reverse order.

Commencing with the distribution network supplying the customer, sufficient feeders connect this with the substations to maintain pressure in case any of them burn out. In growing districts this simply means the installation of feeders a year or so in advance, and the fixed charges incident thereto.

In the substations the reserve is proportionately of as great importance as in the generating stations, as it must provide not only for accident in the substation, but for partial interruption of supply caused by accident to the transmission system, or in the generating station. In general, the practice has been to design the substation to contain from four to eight transforming units and to install one more unit than is necessary to carry the maximum load. A storage battery has been found absolutely necessary, the capacity of which at the one-hour discharge rate is equivalent to one of the transforming units. Where more than five units are installed the battery capacity exceeds twenty-five per cent of the maximum load. An important part of the reserve of each substation is the assistance that can be rendered by the adjacent substations.

All the transmission cables are underground, and in order to avoid interrup-

Digitized by Google

tions from "congested mass of ducts and cables crowded in manholes," as referred to by Mr. Buck, four separate and distinct lines of subway have been constructed, starting from four separate manholes in front of the generating station. Each substation has at least one more cable than is required for its maximum load, and these cables are divided among the different subway routes. In this way the greatest possible loss to the transmission system by a violent short-circuit in the manhole would be less than twenty-five per cent of the total. Should this occur at the time of maximum load the overload capacity of the cables following the other routes would be sufficient to maintain the service.

To further guard against a violent short-circuit the cables in all manholes are protected by fireproof covering over the lead, and in seven years' experience on a system containing many miles of high-tension underground cable, there has been no case where a cable burnout has injured an adjacent one.

In the generating plant the high-tension and exciter bus-bars are the only parts of the plant which are common to and necessary for the operation of all power units, and these have been designed and constructed with the greatest possible care. Every known precaution has been taken with each generating unit, consisting of engine with individual condenser, and generator with its armature, field and control cables, switches, rheostats and instruments to protect them from possible injury from adjoining apparatus or external source. The installation of two oil-switches, of the compartment type, in series in generator leads has not only ensured the opening of the circuit between the generator and bus in case of trouble, but has provided an additional means for synchronizing, etc., in case a switch or instrument transformer fails to operate properly. The reliability of the supply of current for the generator fields and control circuits is secured by a storage battery connected at all times to the excitation bus. The station lighting and all auxiliaries can be connected to this bus.

It has not been found necessary to operate reciprocating engines at exactly full load, on account of the consumption. The engines and generators are so proportioned that the variation in steam consumption per kilowatt-hour, as shown by tests, between the limits of twenty-five per cent underload and twenty-five per cent overload, is less than five per cent from the maximum economy. The practice is to operate engine-driven units at slightly under normal load, and depend on their overload capacity in case one is instantly disconnected. Should it be necessary to disconnect two simultaneously, the batteries would supply the necessary energy until an additional unit could be started.

During the maximum all units carry about normal load, and if it is necessary to take one out of service the overload capacity of the remaining units and the batteries can be depended on as a substitute. It has not been deemed commercial, nor has it been found necessary to hold one unit out of service as absolute reserve during the peak as suggested.

In the boiler plant duplication is avoided by arranging the steam piping so that all boilers and engines are connected to a ring main, divided by suitable valves. This renders it possible for any group or groups of boilers to be used with any combination of engines. Boiler feed lines are similarly laid out, and at least one more feed pump operated than is required by load conditions. With such an arrangement it is necessary to run only a very small percentage of boilers for emergency use.

In general, each group of transmitting and transforming equipment has sufficient capacity to permit the withdrawal from service of any individual unit without making it necessary to operate the balance beyond the normal capacity. The generating station is capable of carrying the entire load when operating at normal capacity. In case of accident the substation storage batteries and overload capacities of the remaining equipment are capable of maintaining service until repairs are made.

Electric Lighting at the Lewis and Clark Exposition.

A recent trial of the illuminating facilities at the Lewis and Clark Exposition has demonstrated that the plans laid out by Mr. J. W. Thompson, the electrical engineer, are entirely practical. It is stated that the lighting features which have been provided are equal to, and in some cases surpass, the decorative effects at earlier expositions. Columbia Court, about which are clustered the large exhibit palaces, has been made the centre of the illumination scheme. The Agriculture and Foreign Exhibit buildings are outlined in frosted lamps, and the dome of the former building is visible for a considerable distance. From Lakeview terrace, at the head of Columbia Court, the view embraces the Lake Shore esplanade and the Bridge of Nations. These latter features are brilliantly lighted by clusters of fifty-candle-power lamps, while across Guild's lake the United States government buildings are also brilliantly illuminated. The twin towers on these buildings, which carry an immense number of lights, rise 260 feet.

A new feature in lighting is the submarine illumination of Guild's lake. On either side of the esplanade, which parallels the Lake Shore and the Bridge of Nations, connecting the mainland with government peninsula, fifty-candle-power lights encased in marine receptacles have been placed at intervals of three feet. The effect is to illumine the clear water and make it possible to see fishes swimming among the water plants on the bottom.

NOTES ON THE APPLICATION OF ELECTRIC POWER AT MINES IN GERMANY.[1]

BY E. O. FORSTER BROWN.

Introduction—The principal coal-mining districts of Germany are Westphalia, Silesia and Alsace-Lorraine, with yearly outputs of approximately 60,000,000, 25,000,000 and 12,000,000 tons of coal respectively.

Westphalia has of late made the greatest strides in experimenting with, and applying, electricity in various ways for mining purposes. In Westphalia the seams are fiery, and boiler-coal is of great value, so that any saving of power is an important economy.

The system of current used for general purposes at all of the newer plants is with rare exceptions three-phase. The chief advantages of this system over continuous current are that three-phase machinery is cheaper to construct; it admits of being generated and transmitted at a high voltage, at a relatively smaller cable cost; it can be transformed to any suitable working voltage in the neighborhood of the motor; and the absence of a commutator on the motor considerably simplifies the working and attention required.

The central power-houses of the newer plants are well built and roomy. In addition to the generators, they usually contain the air-compressors and, sometimes, the ventilating-fan engines. The generators are driven by tandem or cross-compound condensing horizontal steam engines with steam at a pressure of from 100 pounds to 180 pounds per square inch. At coking collieries there is a tendency to take the gas from the ovens, and after purification it is used to generate electricity direct by means of gas engines; the saving of power by this method over that of burning the gas under boilers and generating electricity by the steam so raised being rather more than doubled.

The voltage used naturally varies very much with the conditions; for three-phase current, it is usually 2,000 or 3,000 volts, and sometimes 5,000 volts; and, in the majority of cases, it is transformed down to 200 or 300 volts at the motor. The pressure of continuous current does not, as a rule, exceed 500 volts.

The purposes to which electricity is chiefly applied may be stated roughly, in their relative importance, as pumping, ventilation, winding, haulage, coal-cutting and air-compressing.

A large variety of electrically driven

[1] Abstract of a paper read before the Mining Institution of Scotland, at Glasgow, on February 9, 1905.

Digitized by Google

pumps are employed; the tendency in plunger pumps being to increase the speed to the utmost limit of practicability, to drive with comparatively large, slow running motors, and so eliminate the use of gearing. The pump of the future, however, appears to be of centrifugal type. Some of the advantages of this pump over plunger pumps are as follows: it costs less for the same capacity, it occupies less space, requires less attention, lubrication and repair; and it is particularly suited for driving by electricity, as both the pump and the motor give the best results when running at a high speed. The pump and the motor lying above it are fixed together in a vertical frame, which is hung from the surface by ropes and raised or lowered in the sinking shaft as required, the motor-cable being correspondingly coiled or uncoiled from above.

In practically all cases where electricity is applied for power purposes the ventilating fans are driven by motors, sometimes by belts and sometimes direct on the same shaft. An instance of the attention required for one of these electrically driven fans is significant, in comparison with that required for a steam-driven fan of equal capacity. A Rateau fan at an isolated ventilating shaft belonging to the Saar-Mosel Colliery Company displaces 110,000 cubic feet of air per minute, and is driven by a three-phase 5,000-volt motor, keyed direct on the fan-shaft, running at 300 revolutions a minute. The door of the ventilator-house is kept locked; every three weeks the motor is cleaned, which takes two hours, and every three months fresh oil is put into the bearing-cups, otherwise no one goes near the house. The fan has been running satisfactorily and continuously for a year under these conditions.

A few details of electrical plant at some of the collieries will serve to illustrate the foregoing remarks.

Donnersmarckhütte Colliery, Silesia—The power plant is capable of producing 1,060 kilowatts of continuous current at 230 volts, and 2,800 kilowatts of three-phase current at 1,000 volts, a total of 3,860 kilowatts. Two-thirds of this output is generated by gas engines, supplied with gas from the blast furnaces, belonging to the colliery, and the remainder by horizontal tandem-compound condensing steam engines. The current at 1,000 volts is transmitted to a distance of three miles. Electrical power is applied to pit pumps, sinking pumps, ventilators, and hauling and winding gear. The centrifugal sinking pump is at present pumping 400 gallons per minute to a height of 460 feet, and the motor is supplied with current at a pressure of 1,000 volts. The electric winding engine is of 125 horse-power.

Preussen Colliery, Silesia—This colliery is not yet completed and the shafts are still being sunk. Electricity is used for most power purposes, with the exception of winding. The generating station at present contains two three-phase dynamos of 450 kilowatts at 3,000 volts, and one three-phase dynamo of 450 kilowatts at 500 volts. The pumps in use for sinking and pumping from the lodge rooms consist of the following: one centrifugal sinking pump hung in the shaft, and pumping 330 gallons a minute to a height of 279 feet. The pump, in two steps, revolves at 1,450 revolutions a minute and is driven by a 500-volt motor. No. 1 lodge room contains two high-pressure centrifugal pumps, each horizontal, in two parts with two steps in each part, and a 3,000-volt motor between the parts. Each pump, at 1,420 revolutions a minute, can pump 1,100 gallons per minute to a height of 689 feet. The No. 2 lodge room contains a plunger pump, driven direct by the motor without gearing, and pumping 345 gallons a minute to a height of 525 feet. The motor runs at 200 revolutions a minute with current at 500 volts.

Court Colliery, Westphalia—At this colliery there are two three-phase generators capable of producing 550 kilowatts each at 2,000 volts, driven by cross-compound steam engines with steam at a pressure of 100 pounds per square inch.

Electricity is applied at the surface for the ventilation of the mine and most other purposes, with the exception of winding. Underground, thirty-one motors are employed. These work eighteen small winding engines, each of twenty-five horse-power, an air-compressor of seventy-five horse-power supplying air to rock drills, five hauling engines, a centrifugal pump, and six small ventilators, an aggregate of 747 horse-power. Except in the case of two haulage motors of sixty horse-power and seventy-five horse-power respectively, wound for 2,000 volts, the voltage is transformed to 215 volts at the various motors, each motor having a separate transformer. The motors for the small winding engines run at 960 revolutions a minute, and are geared down to the drums, so that the latter wind at the rate of three and one-fourth feet per second, with a load of one ton. The starting and reversing switch lever and the brake lever of these engines are arranged so that the current can not be switched on unless the brake is off.

Victor Colliery, Rauxel, Westphalia—The generating plant consists of a horizontal cross-compound condensing steam engine, driving a three-phase dynamo at 112 revolutions a minute; and the current is transmitted at 5,000 volts to a centrifugal pump at the pit-bottom, over 1,640 feet from the surface. The centrifugal pump is of the Sülzer type in two parts, each part is in four steps and is driven by a separate motor; the first pump lifts the water from a depth of thirteen feet and delivers it to the second part at half the velocity required for the total lift; the second part supplies the remaining velocity required. The motors, of 600 horse-power each, are keyed on the shaft of their respective pumps, and run at 1,035 revolutions a minute. The total quantity of water pumped is 1,540 gallons per minute. As the generating plant only drives the pump, the motors of the latter do not require to be switched on underground, but start working with the steam engine at the surface. From the results of tests made of this pumping plant running under normal conditions, it appears that the efficiency of the pump is seventy-five per cent, and of the dynamo, cable, motors and pump sixty per cent.

Preussen II Colliery, Westphalia—A large electric winding engine has recently been erected at one of the shafts at this colliery for experimental purposes. The generating plant for supplying current to drive the winding engine consists of two cross-compound horizontal steam engines, with steam at a pressure of 150 pounds per square inch, each driving a three-phase dynamo of 2,000 volts at eighty-six to ninety-four revolutions per minute. From 1,550 horse-power downward is required of the two dynamos at different periods during the wind, but the normal capacity of each engine is 650 horse-power.

The winding engine, placed in a house close to the generator, winds with a Kœpe pulley, and is driven by a slip-ring motor keyed direct on the same shaft. The present depth of winding is 1,837 feet (560 metres), but it is eventually intended to wind 100 tons per hour from a depth of 2,300 feet (700 metres).. The engineman is provided with a lever for starting, reversing and cutting off the current, according as it is in its forward, back, or middle position; he also controls a compressed-air or steam brake and an emergency foot brake.

The difficulty of dealing with the large amount of heat generated by the frequent regulation of the motor is overcome by an ingenious water resistance, connected with the rotor slip-rings, arranged in the

Digitized by Google

following manner: the cables from the rotor slip-rings terminate in electrode plates dipping into a small cistern, continually being fed with water by a small electrically driven centrifugal pump, and fitted with a pair of valves, opening outward, which allow the water to escape from the cistern at two points, either near the extremities or just below the extremities of the electrode plates. The valves are regulated by the lever before referred to, and the gradual opening or shutting of the valves raises or lowers the height of water in the cistern, and accordingly increases or decreases the immersion of the plates and the resistance in the rotor circuit. If the pressure during the wind falls to 1,600 volts, an electromagnetic brake comes into operation, and prevents the coils from being burned out. The winding engine appears to be under good control and winds satisfactorily, but the effect of this system on the generator engines is not ideal. Between winds, the steam engines are running at ninety-four revolutions per minute and with only sufficient steam to overcome the friction of the working parts at that speed; on starting to wind, their full power and something more is required of them, and they take their full steam and lose seven or eight revolutions a minute in speed almost instantaneously, gradually regaining their full number of revolutions as the wind proceeds and the demand for power lessens.

Under such conditions, this type of electric winding engine is not likely to prove successful, but, on the other hand, if the generating station were very large and supplied current for a large number of other purposes, the effect of starting the wind would be barely noticeable on the steam engine driving the generators. In the case of a colliery intended to be worked solely by electric power, it would be of advantage to have a reliable winding engine capable of being run and controlled by such power as efficiently as by steam; but it is improbable, however, that any colliery would erect a sufficiently large generating station to satisfy these conditions. An electric winding engine driven by three-phase current has the disadvantage that it can not be so economically regulated as one driven by a continuous-current motor.

Zollern II Colliery, Westphalia—An elaborate electric plant has recently been erected at this colliery. Two shunt-wound direct-current dynamos, each of 500 volts and 2,100 amperes, are driven direct by triple-expansion horizontal steam engines at ninety revolutions per minute, with steam at a pressure of 176 pounds per square inch. Each dynamo has a flywheel fitted on the same shaft. The interesting characteristic of this plant, in comparing it with others recently erected, is the exclusive use of continuous current and the shunt regulation of the motor. At present electricity is not used for power purposes underground, and only within a very restricted radius on the surface, accordingly, there would probably be no economy in transmission cost by the adoption of alternating current, although the possibility of its being required in the future has been foreseen, and the generators are fitted with slip-rings as well as commutators.

Two air-compressors, in the same house as the generators, and of the two-stage type, are each driven by a 500-horse-power motor, keyed direct on the main shaft, with speed regulation of from 75½ to 130 revolutions per minute, and they deliver air at a pressure of ninety pounds per square inch. The cylinders, although water-cooled, owing to the high speed of running, become exceedingly hot, and at seventy-five and one-half revolutions the air from the high-pressure cylinder has a temperature of 102 degrees centigrade. Apart from the question of convenience the economy of this arrangement appears questionable.

The winding engine is constructed on the Ilgner system, by which the fluctuations of power required during winding are averaged by a converter placed between the winding engine and the generators. This type of winding engine, although more costly than the type in use at the Preussen II colliery, has a great advantage in demanding an almost constant instead of an intermittent load from the generators, at the same time being under very efficient control; on the other hand the arrangement of the machinery appears at first sight to be rather complicated, and it is at a disadvantage when used for intermittent winding.

Until electric winding engines of a large size have been conclusively proved to be as reliable and efficient as steam engines, and at the same time show a substantial saving in fuel and upkeep sufficient to repay the original capital outlay, electrical power is not likely to be applied to a large extent at individual collieries not troubled with water, where the winding engines consume the largest proportion of power required for working the colliery.

The First Woman Telephone Operator.

When telephone central offices were established, the operation of the switchboard was entirely done by young men, which continued in Europe to a later date and in fact in some parts until quite recently.

In the year 1878 a young man who was telephone operator at Bridgeport, Ct., was told by the manager of the company that this work would soon be done by young women, as they would be superior for the purpose, being so much more deft in the manipulation of cords and other duties, and he was told that he could have any outside position which he might select.

The young man stated that he did not believe that women could do an operator's work, but in about three weeks he was

MRS. MARGERY M. GRAY.

introduced to his successor, Mrs. Margery M. Gray, now living at Torrington, Ct., who is believed to be the first woman telephone operator, and she continued in this position for many years until a commercial business opportunity presented to her stronger attractions.

From this small initiative the extension of the telephone system has been such that it now gives employment to over 65,000 women operators in the United States, thus affording a new and healthful means of livelihood under particularly agreeable conditions, as the position is a permanent one as far as the wishes of the employé are concerned, and as the business is both constant and increasing, there are no temporary "lay-offs" or diminution of the force, nor do they have to face a general public; and probably more care is taken for their health and comfort than in any other occupation.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

High-Tension Oil Switches.

In the construction of high-tension, alternating-current systems a definite demand has arisen for an oil switch and circuit-breaker which can be installed directly on the back of the switchboard and

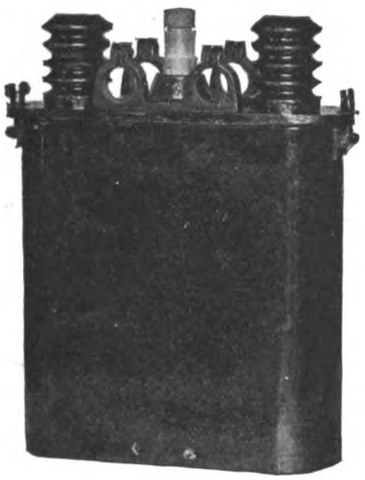


FIG. 1.—ELEMENT OF HIGH-TENSION OIL SWITCH.

operated by hand from the front of the board.

The Hartman Circuit-Breaker Company, of Mansfield, Ohio, has for the past four years been developing a complete line of high-tension oil switches and circuit-breakers, and, in the design which

FIG. 2.—AUTOMATIC HIGH-TENSION OIL SWITCH.

is here presented, particular attention has been given to the insulation of the live parts of the switch from the operating mechanism in order that the switch might be installed on the back of the switchboard and used for very high voltages with entire safety to the operator. This has been accomplished by using a new material in oil-switch construction, *viz.*, moulded fibre treated by a process which gives to it insulating qualities which the company states is substantially equal to porcelain. Each pole of the switch is enclosed in a separate tank or cell made of this fibre. The cover of the tank with its two insulators is also made of treated fibre, and the live parts which are enclosed in the tank are thus completely insulated from the metal-supporting frame and operating mechanism. In switches intended for voltages above 6,600, the oil tank is moulded in such a way that, together with the wooden switch rod, a complete barrier is interposed between the two arcing points of the switch element.

FIG. 3.—THREE-POLE COMBINATION HIGH-TENSION OIL SWITCH.

Two, three and four-pole combinations are made up of the single-pole element shown in Fig. 1. These are clamped side by side (Fig. 3) to sections of seamless, steel tubing fastened rigidly to the switchboard plate. This construction permits of liberal spacing between the poles without increasing the weight of the switch.

In the automatic switch or circuit-breaker two types are made. In the one type, which is shown in Fig. 2, the overload coils are mounted on spools of treated wood and are operated directly from the high-potential circuit. This dispenses with the use of current transformers and effects a corresponding reduction in the price of the circuit-breaker. The insulation of these coils has been worked out with great care and is entirely adequate for the voltages for which these circuit-breakers are recommended. In the second type of circuit-breaker which is made, the overload coils are mounted substantially as shown in Fig. 2, and are energized from the secondaries of series transformers. This circuit-breaker is made for potentials up to 22,000 volts. Both of these circuit-breakers possess the feature that they can not be closed while an overload exists on any phase of the line.

While these switches and circuit-breakers were mainly designed for installing on the switchboard, they can also be installed apart from the panel and operated manually by a simple system of cranks and rods, or they can be operated electrically by means of solenoid control. In this case the operating current is derived from the exciters, a storage battery, or any convenient source of direct-current supply.

Water-Power Plant for Lighting the City of Chicago.

The accompanying illustration shows the stator frame of a 2,000-kilowatt-ampere, water-wheel-type, alternating-current generator built by the Crocker-Wheeler Company, Ampere, N. J. This machine was constructed for the Huronian Company, of Copper Cliff, Ontario, Canada. The illustration shows the massive construction necessary in this type of machine. Similar machines for the sanitary district of Chicago are now in the Crocker-Wheeler shops. These are four 4,000-kilovolt-ampere, three-phase, sixty-cycle alternators, and are to be installed at the lower end of the Chicago Sanitary and Ship canal, which drains the Great Lakes at Chicago.

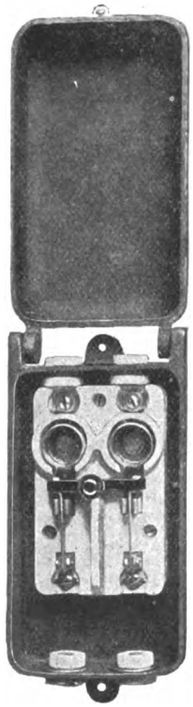
At Lockport, where the power site is located, there is a drop of thirty-two feet. From this point the water makes its way to the Desplaines river and finally reaches the Mississippi.

These generators will be wound for a pressure of 6,600 volts. Current is to be transmitted twenty-eight miles to Chicago, where it will be used to light the streets and public buildings.

Digitized by Google

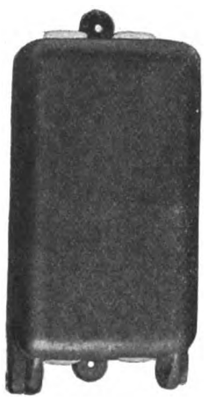
A New Iron-Clad Entrance Switch.

The National Board of Fire Underwriters requires that at all points where service wires enter a building, at the nearest point practicable, a service switch be installed. This service switch must



IRON-CLAD ENTRANCE SWITCH, OPEN.

be mounted in an iron-clad box, and where the wires are run open or in moulding, the wires must pass through porcelain-bushed holes in the box. Where conduit



IRON-CLAD ENTRANCE SWITCH, CLOSED.

is used the box must be suitably arranged for the conduit.

The Troy Electrical Company, 1924 Sixth street, Troy, N. Y., has placed upon the market a new iron-clad, double-pole entrance switch combined with fuse plugs. The box consists of two castings, the cover being nearly as deep as the box itself, so as to allow the face of the switch to come nearly flush with the sides of the box. The box is seven and one-half inches long, four and three-eighths inches wide, and four and one-half inches deep. These are outside measurements over all, with the exception of the screw-ears. The total length of the box over the screw-ears, which are for attaching the box to the wall, is nine and one-quarter inches.

A standard type double-pole, twenty-five-ampere, 110-volt knife switch is mounted in the box, in combination with a fuse plug cutout. The box is neat in appearance and small. It complies with all of the underwriters' rules, and is a departure in having the metal parts more than one inch away from the iron box. The boxes are made a little larger for 220-volt service and for three-wire systems.

The Weber Key Socket.

The Weber Electric Company has placed on the market a new form of key socket for incandescent lamps. Fig. 1 shows the assembled key socket. It will be noted that no screws or rivets are used to hold the shell and cap together. The

FIG. 1.—NEW TYPE OF KEY SOCKET.

shell is locked securely to the cap, and can not become loose. It may easily be removed, however, and as easily replaced, without the use of screw-driver or other tool.

To remove the shell from the cap, the thumb of the right hand is pressed just below the projection on the cap, and the cap and shell separated with a hinge motion, as shown in Fig. 2. To fasten the shell to the cap after wiring, the oblong projection in the shell is placed in line with the guide slot in the cap, and the cap and shell simply pressed together.

Fig. 3 shows the inner construction of the socket. No screws are used to hold the key parts together, these being securely clamped in position between two solid blocks of porcelain. With the exception of the binding screws and two long screws which hold the solid porcelain blocks together, there are no other screw parts.

The cam which makes and breaks the circuit works between two flexible spring contacts, and does not subject the screw shell to any strain. The entire contact is made of spring brass, and holds the lamp well under tension.

The mica washer under the centre con-

FIG. 2.—METHOD OF SEPARATING CAP AND SHELL.

tact is exceptionally heavy, and is held securely in position by a projection in the screw shell, which ensures its being always held in the socket. The cam contact is very positive in action, and upon the break leaves a very large breaking distance. The construction of the Weber key socket eliminates entirely the danger of short-circuits. The socket is handsome in appearance, durable in construc-

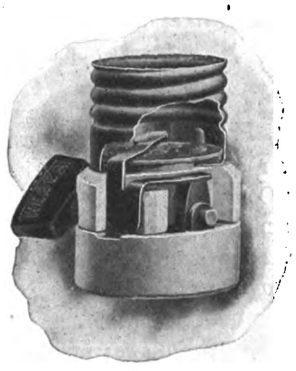


FIG. 3.—INTERIOR CONSTRUCTION OF KEY SOCKET.

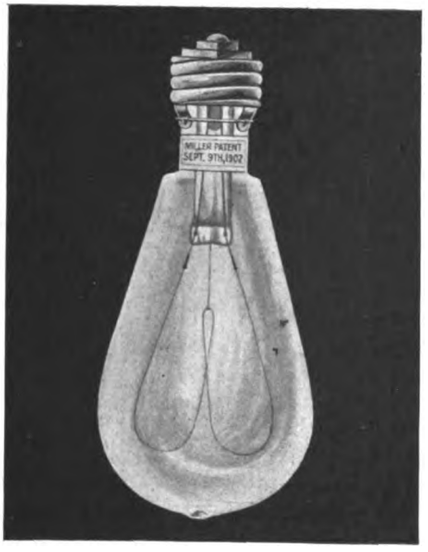
tion, and will, no doubt, be received with great favor in electrical installations throughout the country.

The general sales agent is Henry D. Sears, 131 State street, Boston, Mass. The New York office is at 143 Liberty street.

Digitized by Google

New Form of Incandescent Lamp.

The Missouri American Electric Company, 3327 Locust street, St. Louis, Mo., is placing on the market a new form of incandescent lamp. The particular feature of this incandescent lamp lies in the bulb, which is provided with an improved inner tip. This tip is the subject of patent No. 786,231, issued March 28, 1905, to Mr. George P. McDonnell, vice-president and general superintendent of the company. The advantage of a lamp tip being made in accordance with this patent is that it eliminates the danger of breakage in transportation and in handling the lamps generally, and it is also claimed to leave a much stronger surface at the seal-



NEW TIPLESS INCANDESCENT LAMP BULB.

ing-off point. In forming the new style tip, a bead is made in the centre, which naturally strengthens it at this point. The company is placing this improved lamp on the market at a slight advance over the price list for the company's ordinary lamps.

Prizes for Inventors.

Under date of April 20, 1905, United States Consul General Richard Guenther, of Frankfort, Germany, states that the Associazione degli Industriali d'Italia, No. 61 Foro Bonaparte, Milan, Italy, invites inventors to compete for two prizes offered by it, as follows: first prize, $1,600 and a gold medal, for a new method to prevent danger which may arise from the contact of high-tension with low-tension winding of three-phase transformers; second prize, $100 and a gold medal, for a simple, strong and reliable safety device for stopping cars running on an inclined plane in case of the breaking of the wire cable. The device must be capable of adjustment to ordinary cable roads now in use.

The New Home of the Electric Appliance Company, Chicago, Ill.

The Electric Appliance Company was incorporated about fourteen years ago by Mr. Willard W. Low and Mr. Thomas I. Stacey, and the business was established in Chicago in a very small way. Of course at that time the number of articles in the electrical supply business was only about ten per cent of the number that is now carried. The policy that the company established at that time of making prompt and complete shipments and billing material to its customers on open orders at the same price that would be given on written quotations has been maintained ever since.

The company believed that it would be known by the specialties that it would handle, and therefore made at that time, and always has made since, a special effort to handle only the best specialties. Among the first the company secured were Packard incandescent lamps and Paranite rubber-covered wire. Several months later "O. K." weatherproof wire, Packard transformers and Whitney instruments were added to the list. The phenomenal success of the Gutmann wattmeter in the three years that it was on the market simply bears out the correctness of the company's idea.

The first quarters secured by the Electric Appliance Company were at 242 Madison street, and comprised the first floor only. As the company's business increased, which it was bound to do on account of the policy, it was found necessary to take in the basement, and about a year afterward the two upper floors were added, giving ample facilities for handling the business which was growing every day. Six years ago it was found necessary, in order to handle the business, to engage larger quarters, and the double five-story building and basement at the corner of Van Buren and Jefferson street was secured. This was ample for about two years, at which time warehouse No. 2 was established at 165 South Canal street for the accommodation of cross-arms, insulators and electrogalvanized conduit, and other heavy and bulky material. This arrangement worked out very nicely until

NEW HOME OF THE ELECTRIC APPLIANCE COMPANY, CHICAGO, ILL.

MR. W. W. LOW, PRESIDENT, ELECTRIC APPLIANCE COMPANY.

MR. THOMAS I. STACEY, SECRETARY-TREASURER, ELECTRIC APPLIANCE COMPANY.

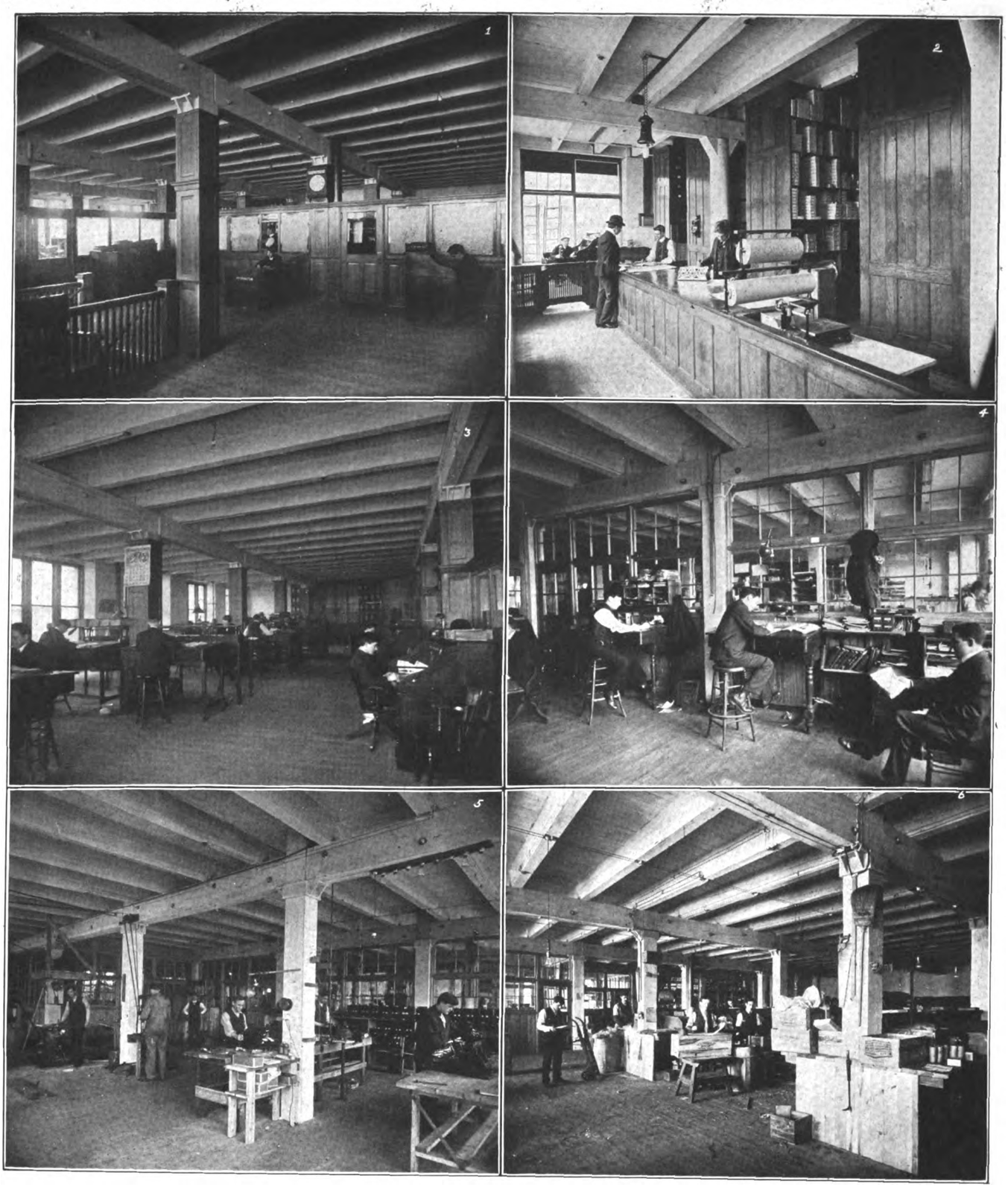
Digitized by Google

the business had grown so that the Electric Appliance Company was in danger of losing, on account of being so crowded, its reputation for making prompt shipments.

Last summer the architects for the company were given instructions as to what was required in order to make a model supply house handling the large

Company now occupies at 134, 136, 138, 140 West Jackson Boulevard is the result.

This building is six stories high and includes a large basement, having a front-



THE ELECTRIC APPLIANCE COMPANY. 1—ENTRANCE TO GENERAL OFFICE. 2—CITY SALES DEPARTMENT. 3—AUDITING DEPARTMENT. 4—SHIPPING DEPARTMENT. 5—ASSEMBLING SHOP, TELEPHONE DEPARTMENT. 6—PACKING ROOM.

It was then decided that the company would need about double the floor space it was occupying.

volume of business at that time, also allowing for a considerable increase, and the building that the Electric Appliance

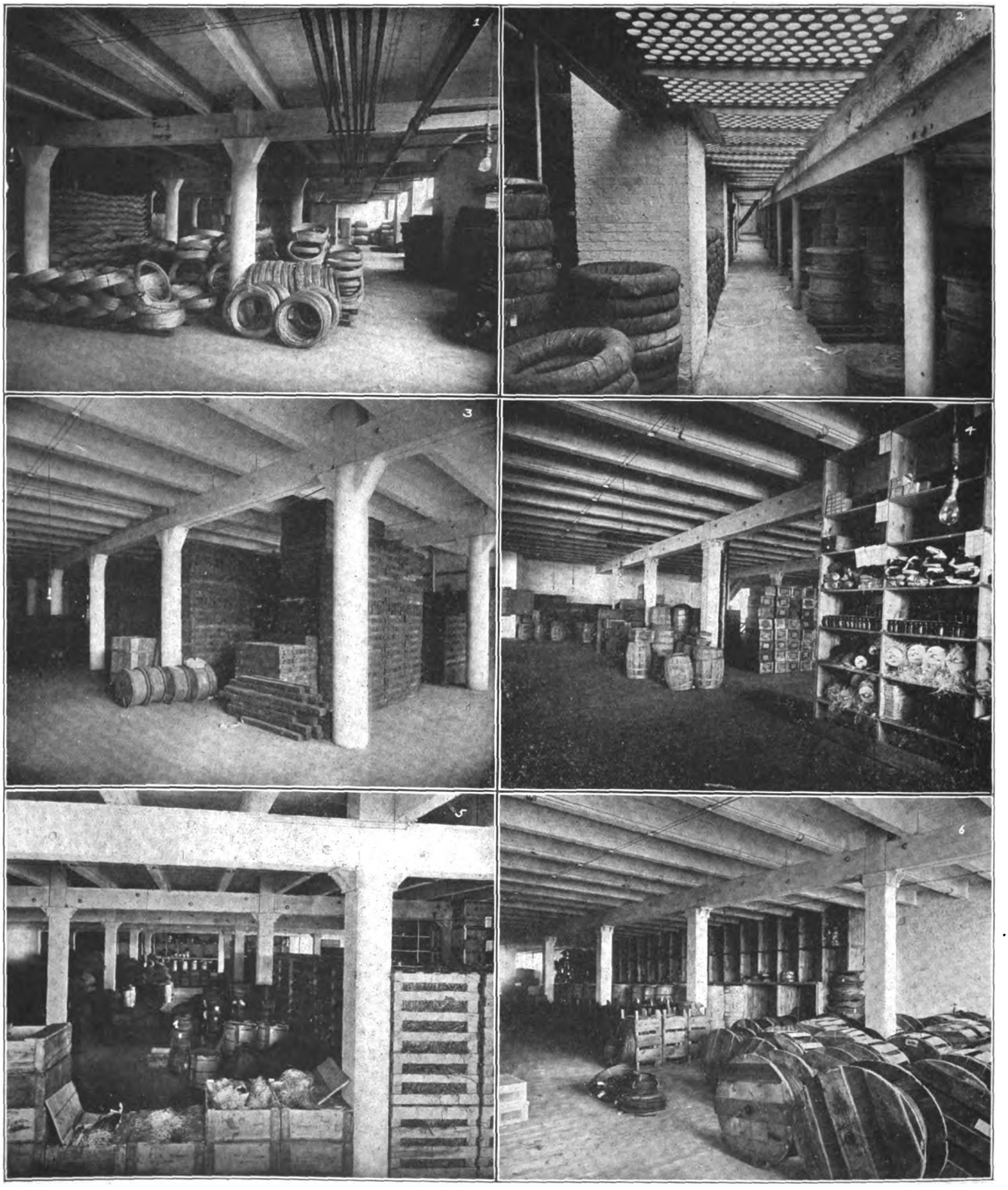
age of 100 feet on West Jackson Boulevard and 100 feet on Desplaines street. The largest stock of weatherproof wire

Digitized by Google

west of the Allegheny mountains is carried in the basement of the building. "O. K." weatherproof wire has a reputation among central stations second to none, and the company finds that its stock has to be replenished weekly. Galvanized telephone wire is also carried in the basement. Heavy material such as cross-arms, electrogalvanized conduit, etc., is carried on the first floor.

The receiving department and the city sales department also occupy the first floor. The company aims, in its city sales department, to fill orders over the counter more quickly than it has ever been able to do before, believing it will only be a short time when its reputation in the city will be unexcelled.

The general offices of the company occupy the entire second floor, one-half being given to the sales department and the



THE ELECTRIC APPLIANCE COMPANY. 1—BASEMENT STOCKROOM. 2—BASEMENT STOCKROOM. 3—FIRST FLOOR STOCKROOM. 4—FOURTH FLOOR STOCKROOM. 5—FIFTH FLOOR STOCKROOM. 6—FIFTH FLOOR STOCKROOM.

Digitized by Google

other half to the auditing department. Special provision has been made for the comfort of out-of-town customers, and a cordial invitation is extended by the company to inspect its new quarters.

The balance of the building is given up entirely to the large stock carried by the company. Two freight elevators facilitate the handling of all material, and the company is in better shape than ever before to not only handle its present business, but to allow for a large increase. The location of the building being in close proximity to nearly all of the freight depots, the company is in position to make its usual prompt shipments.

In addition to the large stock carried by the company in Chicago, the branch house located at San Francisco carries as large a stock as there is on the coast. This branch house was established last year, and the business has been very satisfactory. Mr. C. C. Hillis, who occupied the position of auditor for the company in Chicago for a number of years, is general manager of the Pacific coast branch, assisted by Mr. F. J. Cram, who represented the company in that territory before the branch house was opened. The same policy that has made the company a success in Chicago is being pursued in San Francisco.

Prior to the establishment of the San Francisco house, the company put in a stock of staple supplies at Dallas, Tex., in charge of Mr. W. M. Brooke, who is well known in the Southwest, having been located there for the past ten years. This stock at Dallas has been increased from time to time, as it was found necessary in order to take care of the business.

New Line of Direct-Current Motors and Dynamos.

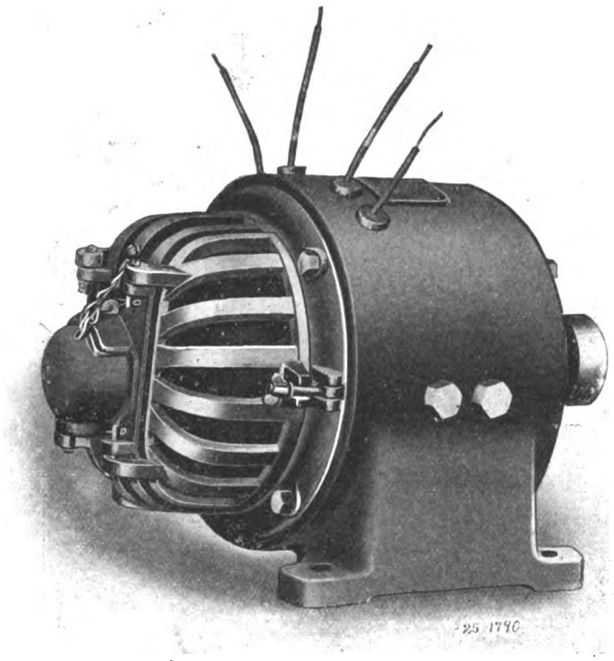
The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has developed a line of motors and generators which it designates as type L. The machines are semi-enclosed, with hinged covers to protect the commutator, and are designed to meet a demand for a rugged and compact machine readily adapted to special uses, such as direct applications to various mechanical devices. For belted work the motors may be used upon the floor, wall or ceiling by giving the end cases a quarter or a half turn.

The field ring of machines from one-quarter to five horse-power is of the bipolar type, and from seven and one-half to fifteen horse-power of the multipolar type. It is made of cast steel in one piece. Laminated pole-shoes are used, which are bolted to the pole-pieces, and are designed to assist in commutation, so that the operation of these machines is sparkless under all conditions of load. The journals are made of hard phosphor-bronze, and are self-aligning. They are provided with oil rings which maintain an additional circulation of oil around the shaft by means of oil grooves in the journal. The shaft is of crucible steel, ground to gauge, and polished at the bearings. The armature core is of the drum type, and is built up of thin discs of soft annealed steel slotted to allow the armature coils to sink below the surface. The coils are machine-formed, and are made of round insulated copper wire ribbon or bar copper, depending on the size and purpose of the machine. They are without joint, except at the commutator.

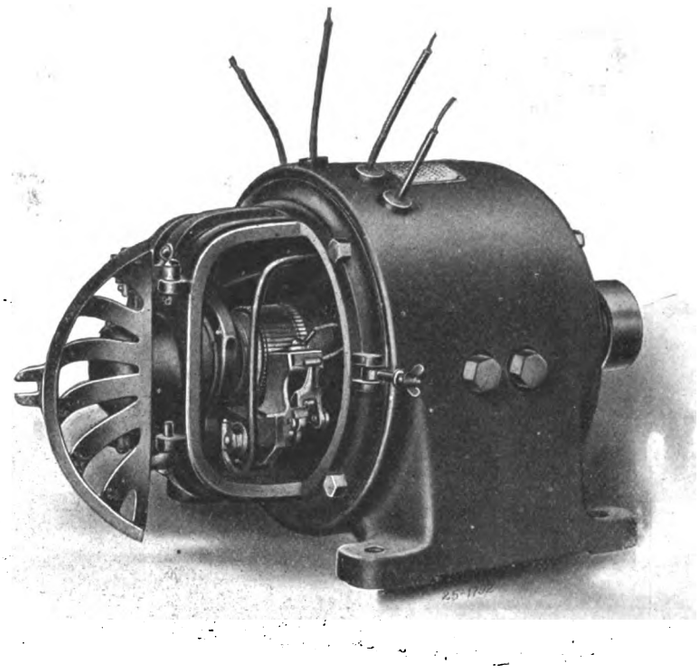
The commutator segments are of drop-forged copper in the larger, and of hard-drawn copper in the smaller machines. The insulation between the segments is of soft mica, which will wear evenly with the segments.

On all machines the brush-holders are of the box type, and can easily be adjusted to any degree of tension without interfering with the operation of the machine. The design of the brush-holder is such that no current is carried over the spring or other members. The shunt flexible cable is provided with ample carrying capacity, securely connected to the carbon brush and to the brush-holder proper, thus providing a good electrical connection. The brush-holders are steady and practically noiseless in operation. Light-weight carbon brushes are employed, ensuring prompt response to spring pressure.

The temperature rise is guaranteed to be within a limit of forty-five degrees centigrade for a day's continuous run at full load. The maker further guarantees the machines to withstand an overload of fifty per cent for one hour, or 100 per cent momentarily without injurious heating, and without adjusting the brushes. The efficiency of the machines will vary from about sixty-six per cent in the smaller sizes to ninety-five per cent in the larger sizes.



NEW TYPE DIRECT-CURRENT MOTORS AND DYNAMOS.

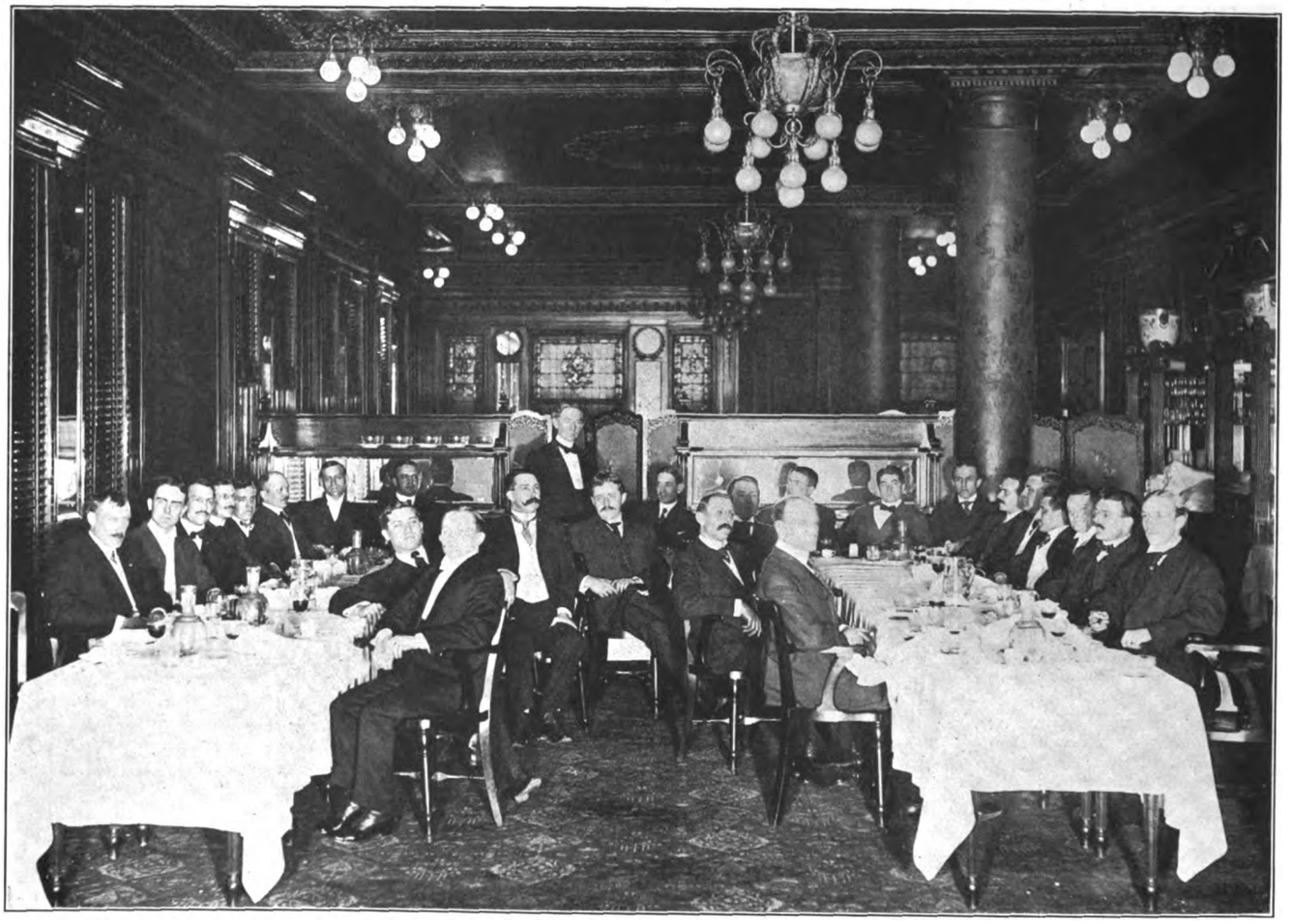


NEW TYPE DIRECT-CURRENT MOTORS AND DYNAMOS, VIEW SHOWING HINGED COVER.

Digitized by Google

Group Photograph of the Members Present at the Dinner of the Technical Publicity Association.

On April 27 the annual dinner of the Technical Publicity Association was held at the Hardware Club, New York city. This organization represents a number of large manufacturers and many concerns engaged in allied branches of industry. The association is made up, in the main, of managers of publicity for these concerns, and has for its object the discussion of improved methods for developing scientific and artistic publicity. The address of the evening was presented by Emerson P. Harris, on "The Machinery for Marketing Machinery."



THE INAUGURAL DINNER OF THE TECHNICAL PUBLICITY ASSOCIATION.

Among those who attended the dinner and who appear in the illustration herewith were the following:

Jas. R. Paterson, *Railway and Locomotive Engineer;* A. E. Michel, International Steam Pump Company; F. E. Matthews, De La Vergne Machine Company; F. H. Gale, General Electric Company; F. C. Cheston, the American Woodworking Machinery Company; H. M. Davis, Sprague Electric Company; Clyde Oswald, president Oswald Publishing Company; H. M. Cleaver, the Niles-Bement-Pond Company; E. P. Harris, New York city; P. P. Kobbe, Rand Drill Company; Dean Park, Hammacher, Schlemmer & Company; N. Estabrook, Niles-Bement-Pond Company; Graham Smith, Westinghouse Companies' Publishing Department, New York, Rodman Gilder, Crocker-Wheeler Company, Ampere, N. J.; C. B. Morse, Ingersoll-Sergeant Drill Company; John A. Hill, president Hill Publishing Company; Fred C. Iglehart, Jr., Ingersoll-Sergeant Drill Company; C. W. Dibble, *Power*; E. H. Dibble, E. P. Harris; H. M. Lauritzen, Holophane Glass Company; J. C. McQuiston, Westinghouse Companies' Publishing Department, Pittsburg, Pa.; Dixon Boardman, Hall Signal Company; W. J. Johnston, president *Mining Magazine;* George H. Gibson, International Steam Pump Company; F. S. Wayne, Robins Conveying Belt Company; A. N. Barber, John A. Roebling's Sons Company.

New Wisconsin Power Company.

The Rhinelander Power Company, of Rhinelander, Wis., composed largely, if not entirely, of local parties, has completed arrangements to develop the water power of the Wisconsin river at a point about six miles below the city of Rhinelander. A dam will be built giving a head of about twenty-four feet, and sufficient water is obtainable to develop an average of about 600 horse-power. In the rainy season more than 2,000 horse-power, at a conservative estimate, is obtainable.

The Allis-Chalmers Company will furnish the entire electrical equipment, which includes three 400-kilowatt, 1,100-volt, three-phase, sixty-cycle generators, with three seventy and one-half-kilowatt, 120-volt, separately driven exciters; six 150-kilowatt, 10,000-volt transformers, and complete switchboards at both the generating station and the substation at Rhinelander.

The current will be carried at 11,000 volts over a single three-phase circuit to the substation at Rhinelander, a distance of about six and one-half miles, and from this substation will be distributed at 1,000 volts for illuminating purposes, both commercial and street lighting, and also at 440 volts to the mill of the Rhinelander Paper Company and other industries in the neighborhood of the substation.

This plant is one of the first long-distance transmission plants on the upper Wisconsin river. It is expected that many more enterprises of a similar character will be undertaken in that region within the next two years.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

EXTENSION OF PACIFIC COMMERCIAL CABLE—The Pacific Commercial Cable Company has announced the extension of its cable to the Yap and Celebes Islands.

MORTGAGE OF THE IROQUOIS ELECTRIC COMPANY—The directors of the Iroquois Electric Company, Buffalo, N. Y., have given a mortgage to the Fidelity Trust Company, of the same city, as trustee for the bondholders, for $2,500,000. The mortgage is dated June 1, 1905, and will secure the payment of the bonds. The term of the mortgage is forty years.

NEW POWER PLANT IN ALABAMA—H. T. Henderson, of Durango, Col., contemplates the erection of a water-power plant on Little river, at Blanche, Cherokee County, Ala. The dam will be 125 feet long and fifty feet high. The plant will be capable of developing 12,000 horse-power, and the electricity generated will be transmitted to the towns in the adjacent country. Current will eventually be transmitted at least 100 miles.

SALE OF CHICAGO & SOUTH SHORE INTERURBAN SYSTEM—The Chicago & South Shore interurban system, which runs from Laporte, Ind., to Michigan City, Ind., has been sold at receiver's sale to the bondholders. These will sell the system to the Indiana Railway Company, which owns the lines running out of South Bend, Ind. The latter company will build a line from South Bend to Laporte and it will be ultimately extended to Chicago.

TELEPHONE MERGER IN INDIANA—The Central Union Telephone Company has taken over the United Telephone Company, an independent organization which held a monopoly of the telephone business of Wells, Grant, Blackford and Huntington counties in Indiana. The United Telephone Company operates about 5,000 telephones in Marion, Hartford City, Huntington, Montpelier, Bluffton and Upland, and has toll-line connections with a large number of rural systems in the counties above mentioned.

CLEVELAND ELECTRIC RAILWAY REFUSES TO TURN OVER PROPERTY—The Cleveland Electric Railway Company has rejected the plan proposed by Mayor Johnson, by which the street railway company was to turn over its property to a holding company which would issue bonds in payment for it. The bonds would have as their security the extension of franchises which the city council is expected to give. The holding company was to have been conducted for the benefit of the city, and did not expect to pay more than a five per cent dividend on the bonds, besides furnishing lower fares and better accommodations. The street railway company will now make a proposition to the city for an extension of the franchises.

SYNDICATE FORMED TO BID ON CHICAGO CITY RAILWAYS—A syndicate with a capital of $500,000, and composed of men connected with the manufacturing of supplies for street railway lines, has been formed to bid on the construction of a proposed municipally owned line in Adams street, Chicago, Ill. This line is to take the place of the expired Chicago Passenger Railway line. Mr. J. J. Cummings, of the McGuire-Cummings Manufacturing Company, has announced that plans for the ten miles of road to be constructed have been made, and that the cost of the work to be done is estimated at $350,000. The estimate includes everything but cars, of which sixty will be necessary. It is thought that these can be provided for $5,000 apiece.

ELECTRIC RAILWAY TO CONNECT SAN FRANCISCO AND SANTA CRUZ, CAL.—The Ocean Shore Railway Company proposes to build an electric railway connecting the cities of San Francisco and Santa Cruz. The company has a capital stock of $3,000,000, consisting of 30,000 shares of $100 each. The road will compete with the Southern Pacific for passenger traffic. It will follow Islas Creek from San Francisco to Ocean View, and then pass through Half-Moon Bay, Purissima, San Gregorio, and Pescadero to Santa Cruz. The total length of the line will be eighty-three miles. The company has already acquired a right of way sixty feet wide for the entire distance. There will be no grades heavier than two per cent on the route, and not over 500 feet of tunnels. The principal stockholders are Walter E. Dean, J. Downey Harvey, Charles Carpy, C. E. Green, Charles C. Moore, Alfred D. Bowen and Burke Corbet. Mr. Corbet is attorney for the company, and John P. Rogers is engineer.

ELECTRICAL NOTES FROM MEXICO—A new telegraph line is to be built connecting the cities of Nogales, Sonora, and Ciudad Juarez, Chihuahua. The cost of construction is estimated at $40,000. The Mexico Light and Power Company has purchased the San Ildefonso Lighting Company, of Mexico, and has asked permission to issue $20,000,000 consolidated first mortgage bonds to consummate the purchase. The firm of Federico Zorrilla, of Oxaca, has been awarded a contract for the public lighting of that city. It will require 200 arc lamps. The Compañia Noruego Mexicana has obtained a concession for the installation of telephone systems through the state of Guanajuato. Installations will be made at Silao, Irapuato and Guanajuato. The systems at these places will eventually be combined into an interurban system. Under the terms of the concession all the plants which may be established in the state of Guanajuato will be exempt from taxation for a period of ten years.

TITLE OF THE NEW YORK, WESTCHESTER & BOSTON RAILROAD COMPANY UPHELD—Attorney-General Mayer, of the state of New York, has decided in favor of the New York, Westchester & Boston Railroad Company, in the matter of the application of Anthony Stumpf for permission to bring an action in the Supreme Court against the directors of the company. The purpose of the action was to obtain a judgment that the company never legally existed and had never acquired the right to construct and operate a railroad to connect with the subway system of the city of New York. The attorney-general has decided that the company has legal grounds for the contention that it is a valid railroad corporation clothed with attendant corporate rights, and that both the local public authorities and private land owners have the fullest opportunity, without the intervention of the state, to protect themselves in the courts if they desire to resist the construction and operation of the road. He states that a grave injustice might be done if an action were brought, in view of the fact that the city of New York has already granted its consent to this company to cross the streets of the city upon terms involving the payment of a substantial sum of money which is subject to forfeiture. The application involves a contest between two railway companies for important and desirable operative territory, and the attorney-general concludes that this case should be left to a contest between themselves, without action by the attorney-general. Mr. Stumpf, who made the application, is a director of the New York & Portchester Railway Company, which carries a parallel route. The Portchester company secured all the necessary consents from the towns in Westchester County. When it applied, however, for a concession to enter the city of New York, its proposed ordinance was held up by the board of aldermen, and an ordinance passed giving the right to the Westchester company. The latter company has deposited with the city comptroller of New York securities to the amount of $20,000 to ensure the construction of the road, and is required to pay the city an annual rental of $8,000, and, in addition, forty cents per annum for each foot of single track laid over or across all streets. This rate of compensation is to continue for ten years from the date of passage of the ordinance. For the next fifteen years thereafter the company is to pay a fixed rental of $16,000 per annum, and an additional sum of eighty cents per lineal foot of single-track railroad. The company proposes to construct a four-track, third-rail electric railroad crossing all streets or highways over or under grade. It will maintain a continuous service with five or ten-minute headway during the rush hours, and ten to fifteen-minute headway during the rest of the day. The company has announced that the construction of the lines in the Bronx and in Westchester will begin by June 5.

Digitized by Google

ELECTRIC RAILWAYS.

NORWAY, ME.—Work on the new electric road from Norway to Waterford is to begin at once.

MIDDLETOWN, N. Y.—At a meeting of the stockholders of the Catskill Electric Railway it was decided to begin an extension to Carlo.

WESTMORELAND, PA.—A trolley line is being projected to connect the town of Boquet, in the northern part of Westmoreland County, with Aspinwall, in Allegheny County.

INDIANAPOLIS, IND.—A. W. Fishbaugh, Portland, Ind., chief engineer of the Fort Wayne & Springfield Traction Company, has completed the survey for the Portland-Decatur division.

UNION, N. J.—The New Orange Land Improvement Company has decided to construct a trolley road connecting New Orange and Lyons Farms, to be completed before the close of 1905.

WILKINSBURG, PA.—It is stated that the projectors of the Wilkinsburg, Turtle Creek & East Pittsburg Street Railway are preparing to begin work upon the line, and that it is to be built at once.

CINCINNATI, OHIO—It is said that the extension of the Fort Wayne & Wabash Valley traction line from Logansport to Lafayette will be begun at once. The route will probably lie through Delphi and Battleground.

INDIANAPOLIS, IND.—The directors of the Winona assembly, Warsaw, have awarded to John B. Marshall, representing a New York construction company, the contract to construct the Warsaw-Goshen electric railroad.

BUFFALO, N. Y.—North Tonawanda is to have a trolley belt line in the near future. The International Traction Company has decided to connect the Kenmore & Gratwick line with the Niagara Falls line by a line down the Nash road.

ALLENTOWN, PA.—Judge Enlich, of Reading, has appointed Frank Jacobs as master to sell the Allentown & Slatington Electric Railway under foreclosure. The price was fixed at $275,000. Bidders must deposit certified checks for $10,000.

GALLATIN, TENN.—The company which purposes to build an electric road to the Cumberland river has elected the following officers: president, Charles A. Whiteside; vice-president, L. B. Payne; treasurer, H. C. Rutledge; secretary, E. O. Buchanan.

WILLOWS, CAL.—W. T. Forsman and W. H. Buster have filed with the board of supervisors a petition for electric road franchises, the lines to extend from Princeton to St. John, from Butte City to the Butte County line and from Orland to the Chico bridge.

BUFFALO, N. Y.—Work has been resumed on the Buffalo, Dunkirk & Western Railway, running thirty miles from Buffalo to Silver Creek. This road, which will form the last link of a complete trolley system from Buffalo to Detroit, has been held up for two years.

RED BLUFF, CAL.—The board of supervisors has awarded the franchise to build an electric railroad between Red Bluff and Tuscan Springs, about twelve miles east of this city by the route projected, to E. B. Walbridge, proprietor of the resort, and the only bidder.

SYRACUSE, N. Y.—At the annual meeting of the stockholders of the Auburn & Syracuse Electric Railroad the directors were reelected and the customary annual meeting business transacted. It is understood that the directors received very favorable reports on the year's business.

PITTSBURG, PA.—A new electric railroad is being built between Charleroi and Ellsworth, which will give direct connection with the Charleroi line of the Pittsburg Railways Company. The new road will be completed this summer, and will be operated under the title of the West Side Electric Railroad.

NEW YORK, N. Y.—The directors of the New York, New Haven & Hartford Railroad at a meeting in Manhattan effected the consolidation of the Duffield Street Railway and Duffield Village Water and Power Company, of which it has gained control. The organization of the Springfield Street Railway was discussed, but no action was taken.

ALLENTOWN, PA.—The Boyertown-Palm Electric Railway Company will build its line this year. It is to have connection with the Oley Valley line, and will extend to Limerick. Thomas J. B. Rhoads is president. This line will be a connecting link in the trolley service between Reading and Philadelphia.

BANGOR, ME.—It is announced that the directors of the Penobscott Central Railway have decided to discontinue operations, beginning June 3, until such time as some means can be found to put the road on a paying basis. The company operates an electric road to Charleston, a distance of twenty-five miles.

ALBANY, GA.—An amendment has been filed to the charter of the Albany & Northern Railway Company, by which the company is authorized to build an extension forty-eight miles in length, to run from Albany to Colquitt, in Miller County, *via* Newton, in Baker County. J. S. Crews is vice-president and general manager.

NAPA, CAL.—The electric road between Vallejo and Napa will in all probability be carried to Calistoga, and from there continue on through Knight's Valley to Sonoma County, pass through Healdsburg and effect a junction with the new electric road recently placed in operation between Petaluma, Sebastopol and Santa Rosa at Santa Rosa.

SAN DIEGO, CAL.—D. C. Collier has made application to the San Diego council for a franchise to construct and operate for a term of twenty-five years an electric street railway through the eastern part of University Heights from the intersection of University avenue and University boulevard to the eastern boundary of San Diego.

WEST CHESTER, PA.—President A. M. Taylor, of the Philadelphia & West Chester Traction Company, announces that a deal has been closed, whereby his company acquires possession of some valuable property in Clifton Heights. Nearly all the rights of way have been secured, and the new extension to Clifton Heights will be built soon.

NORWALK, OHIO—The Huron county commissioners have granted to D. D. Washburn, trustee for the Mansfield, Greenwich & Norwalk Electric Railway Company, a franchise to construct, maintain and operate an electric railroad upon the highway through the village of Olena and wherever else it may become imperative to use the highway.

TACOMA, WASH.—J. Donald Fletcher, acting for himself and eastern capitalists, has applied to the county commissioners for a franchise for a double-track steam or electric road through Pierce County. Mr. Fletcher stated that the road through Pierce County would eventually become part of a system between Tacoma, Portland and Seattle.

LEWISTON, ME.—Good progress is being made on the construction of the electric road from Auburn to Turner. A twenty-five-year contract for electric power supply for the Auburn-Turner Electric Railroad Company has been signed by Libbey & Dingley. The amount of power to be supplied is not less than 100 horse-power, with a maximum of 400 horse-power.

ST. PAUL, MINN.—C. G. Goodrich, vice-president of the Twin City Rapid Transit Company, has announced that his company has completed negotiations to secure the Chicago, Milwaukee & St. Paul company's short line from West Minneapolis to Hotel St. Louis, Minnetonka. This road, it is intended, shall be converted into a second electric railway line to Lake Minnetonka.

NIAGARA FALLS, N. Y.—Promoters of the Albion & Rochester Electric Railroad have bought the right of way and grading has been commenced. It is expected that the road will be in operation by next fall. This company will have a line through to Lockport and connect with trolley lines to Lockport and Buffalo. Beyond Albion the road is operated under another franchise.

EVERETT, WASH.—The Rapid Railroad Company announces that it will ask a trolley franchise to build a line between Everett and Bellingham. The promoters promise to begin work within one year and to complete the road within three years, and state

Digitized by Google

that at the expiration of five years they will give Everett $5,000. They have obtained the right of way practically all the distance from Everett to Bellingham.

SANTA CRUZ, CAL.—Application has been made to the supervisors for a franchise to construct an electric railway from Chittenden to Watsonville. J. C. Kemp Van Ee and Gustav Bauman, of New York, are behind the enterprise. The projectors have also asked in San Benito County for a franchise for a road from Chittenden to Hollister. The possibility of an electric road from Santa Cruz to Fresno is being discussed.

MUSKEGON, MICH.—The Grand Rapids, Grand Haven & Muskegon Interurban Electric Railway Company has made a ten-year contract with the Muskegon & Grand Rapids Water-Power Company to use the power of the latter in running its cars. The power company's station on the Muskegon river, near Big Rapids, will be built this summer, and it is expected that it will be ready to supply power for the interurban cars by December 1.

SEATTLE, WASH.—Mayor Balinger has approved the ordinance granting a franchise to the Seattle Electric Company to build a street car line to Fort Lawton. The company was notified of the approval of the measure, and instructed its contractors to commence work at once. The new road is to connect with the Ballard line at Interbay station, and will run from there to the reservation, and then across the reservation to the barracks. Both passenger and freight cars will be operated over the new line.

HARTFORD, CT.—The charter of the Shore Line Division Electric Railway Company, of which Otis S. Northrop, of Waterbury, is one of the incorporators, has just been passed by the Senate. An amendment was adopted, giving the company the right to build a track down to the steamboat dock in the town of Essex. The line is to run from the terminus of the Consolidated Railway Company's line in Branford along the shore, through Pine Orchard, Guilford, Madison, Clinton and Westbrook, to Saybrook, and thence through Old Saybrook to Essex.

CONNELLSVILLE, PA.—The franchise for the Jeannette-West Newton Street Railway has been signed by the West Newton officials and the contract for construction let. This line connects with the Webster-West Newton and the Webster, Monessen, Belle Vernon & Fayette City road at Webster. When completed the three lines will give Westmoreland County a direct trolley route to Greensburg, the county seat. The Webster & West Newton line will cross the proposed joint-county bridge at Webster, connecting Donora, Monongahela and other towns on the Washington County side of the Monongahela river.

MOUND CITY, KAN.—The first survey for an electric line through Linn County has been finished. The line will run north through a territory not pierced by railroads, meeting the line from Kansas City to Paola. From a point near Mound City a line will run through the Mound City gas fields and the Pleasanton coal fields. One line will run in a southwesterly direction to Iola, where it will connect with the Iola-Humboldt line, forming a connecting link between the roads now being constructed at the two extremities. Another line will run from a point near Mound City to Pittsburg, *via* Fort Scott, connecting eventually with the Joplin lines.

NEWARK, OHIO—The annual stockholders' meeting of the Columbus, Buckeye Lake & Newark Traction Company was held on May 17. The directors elected for the ensuing year are as follows: S. Reed Anthony, P. L. Saltonstall, Chauncey Eldridge, J. R. Harrigan, C. C. Williams and George S. Shinnick. The directors elected the following officers: S. Reed Anthony, president; P. L. Saltonstall, vice-president; C. C. Williams, secretary; Chauncey Eldridge, treasurer; Nathan Anthony, assistant treasurer. The stockholders of the Columbus, Newark & Zanesville Electric Railway Company also held their annual meeting the same day. The following directors were elected for the ensuing year: P. L. Saltonstall, S. Reed Anthony, Chauncey Eldridge, J. R. Fitzgibbon, J. R. Harrigan, George S. Shinnick and C. C. Williams. The board of directors elected the following officers: president, P. L. Saltonstall; vice-president, S. Reed Anthony; secretary, C. C. Williams; treasurer, Chauncey Eldridge; assistant treasurer, Nathan Anthony. Reports of both roads showed increased earnings. For the year ending December 31, 1904, the Columbus, Buckeye Lake & Newark showed net earnings of $97,891, and so far this year the estimates of increases have been largely exceeded.

TELEPHONE AND TELEGRAPH.

CORNING, N. Y.—The Watkins Telephone Company has about completed its extension to Tyrone.

JACKSONVILLE, FLA.—The Southern Bell Telephone Company will expend $45,000 in improving its lines.

OGDENSBURG, N. Y.—The Central New York Telephone and Telegraph Company has opened its new exchange.

TOWANDA, PA.—The New York & Pennsylvania Telephone and Telegraph Company is rebuilding its lines in Towanda.

ONAWA, IOWA—At the special election held in Moorhead a franchise was voted to the New Monona Telephone Company.

DENVER, COL.—The Colorado Telephone Company has been authorized to install a telephone exchange in the state capitol.

LITCHFIELD, MINN.—A new franchise has been granted to the Tri-State Telephone and Telegraph Company for thirteen years.

PORTAGE, WIS.—The right of way for the new telephone line from Madison to Stevens Point has been bought through Portage.

MEXICO, MEXICO—A new telephone line has been inaugurated between the city of San Luis Potosi and the Villa de Armadillo.

WILMINGTON, N. C.—It is the purpose of the Postal Telegraph company next year to build large additions to its system in eastern Carolina.

COVINGTON, KY.—The Independent Telephone Company has been given permission to transfer its franchise to the Citizens' Telephone Company.

PITTSBURG, PA.—The Federal Telephone Company, of McKeesport, has decided to close its exchange in that city June 30, and has sent out notices to that effect.

CORONA, CAL.—W. G. Lambert, representing the United States Long-Distance Telegraph and Telephone Company, has been granted permission to erect poles and string wires through Corona.

STERLING, ILL.—The Western Union Telegraph Company has made Sterling the distributing point for all of its lines between Chicago and Clinton, Iowa, and between Sterling and Peoria.

MADISON, MINN.—The Tri-State Telephone Company has a large force of men at work constructing the new line that is to be built from Minneapolis to Aberdeen, passing through Appleton.

BEAUMONT, TEX.—The work of installing the metallic circuit for the telephone system of the Southwestern Telephone and Telegraph Company, which began January 1 last, has been completed.

PHILADELPHIA, PA.—Farmers of Douglass township, Montgomery County, are organizing a private telephone company, which will embrace about twenty square miles and have 200 subscribers.

TAYLORSVILLE, MISS.—The directors of the Smith County Telephone Company have arranged to put in an exchange at Taylorsville and at Raleigh. The line is in operation to Raleigh, *via* Hissop and Bezer.

PITTSTON, N. Y.—The telephone line which has been built at Lincolnville has joined the line at Nortonville, and the two will consolidate with the Hudson River line. A central office will be located in the near future.

WARWICK, N. Y.—Arrangements are being made for the erection of a farmers' telephone line from Vernon to Stockholm. A line will also be erected from Stockholm to Milton and New Foundland, and possibly to Butler, N. J.

CHEYENNE, WYO.—Work has been commenced on the construction of a new telephone line from Douglas east to Lost Springs, Manville and Lusk, opening up eastern Converse County. The new line will be fifty-nine miles in length.

KANSAS CITY, KAN.—The Missouri & Kansas Telephone Company at a special meeting voted to increase the number of directors from nine to eleven, and authorized the sale of the company's lines in Oklahoma and Indian Territory to the Pioneer Telephone

Digitized by Google

and Telegraph Company, and the purchase of the latter company's lines in Kansas.

TRINIDAD, COL.—Southern Colorado will soon be placed in telephonic communication with Albuquerque, Santa Fe and other New Mexico places, as the Colorado Telephone Company's line is nearly completed into Albuquerque.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange has purchased two lots, on which to locate its North Side branch building. The new telephone building will be a two-story brick structure. Work will be commenced at once.

MEMPHIS, TENN.—Plans have been drawn for an $18,000 branch exchange at McNeil and Madison streets, to be erected for the Cumberland Telephone and Telegraph Company. It is expected that the building will be ready for occupancy August 1.

LITTLE FALLS, N. Y.—The Central New York Telephone and Telegraph Company has purchased a plot upon which it will erect a fireproof brick structure this summer. Work will also soon be begun on the subway for which the company secured a franchise some months ago.

WILSON, N. Y.—The Bell Telephone Company is about to make more extensive improvements and additions to its telephone service in Wilson. An automatic exchange will be put in. The line will be extended along the town line to North Ridge, also to the Daniels road and Randall road.

FRANKLINVILLE, N. Y.—A movement is on foot to form a new stock company with $10,000 capital to acquire the Bell telephone exchanges at Ellicottville, Salamanca, East and West Salamanca, Elksdale, Great Valley, Humphrey Center, Red House and Ashford Junction. George E. DeGolia, the present lessee of the lines, is back of the movement.

UNIONTOWN, PA.—The Big Redstone Mutual Telephone Company has been organized in Jefferson township, with H. J. English, president; W. B. Hall, vice-president; H. G. Deyermon, secretary; G. M. Blythe, treasurer, and James H. Goe, Charles H. Nutt and Jacob Bradmon, directors. The company will construct a line five miles long to connect with the Tri-State Telephone Company's line.

OMAHA, NEB.—The Independent Telephone Company, of Council Bluffs, has chosen Clarence Judson as chief engineer. His estimate is that the new plant will involve the expenditure of about $200,000, and that about $100,000 will be spent in Council Bluffs this summer. The actual work of construction will begin about the middle of June, and a force of sixty to seventy men will be employed in the city work, and fully as many on the lines outside of town.

EUGENE, ORE.—A company has been formed for the construction of a rural telephone line from Blackleg, thirty-five miles west of Eugene to Five Rivers, in the extreme northwestern corner of Lane County. The officers of the new company are: president, G. L. Prindel; vice-president, Clayton Pope; secretary and treasurer, Marion P. Wheeler; directors, James Johnson, Alex Power and Lafayette Prindel. The proposed line will be about thirty miles long.

DOVER, DEL.—The consolidation of all the important telephone lines of the peninsula and their merger into the Diamond State Telephone Company, of Dover, is being planned. The companies include the Maryland & Delaware Telegraph and Telephone Company, of Wicomico County; Eastern Shore Telegraph and Telephone Company, of Caroline County; Onancock Telephone Company, Peninsula Telephone Company and the Atlantic Telephone Company, of Virginia.

ALBUQUERQUE, N. M.—The Mutual Automatic Telephone Company, a home institution, has passed to new owners. It is understood that for the time being it will be under the management of W. H. Grear and D. K. B. Sellers, but eventually it will be consolidated with the Colorado Telephone Company. It is stated that the Colorado company in a few months will improve its exchange by a larger and more efficient switchboard and make other needed improvements.

SIOUX CITY, IOWA—Negotiations have been concluded for the transfer of all the Bills Brothers stock in the Sioux City Telephone Company, to a syndicate of Sioux City business men. The Bills Brothers stock amounted to about $300,000, while the plant represents an actual investment of about $375,000. The following eight Sioux City men are the purchasers of the stock: T. Arthur Thompson, E. W. Rice, William Milchrist, Geo. H. Rathman, Geo. C. Scott, W. P. Manley, F. L. Eaton and T. A. Black.

LOS ANGELES, CAL.—Important extensions through southern California are planned by the United States Long-Distance Telephone Company, of Los Angeles. A large appropriation has been made and work will be pushed during the coming summer. New points will be San Diego, Capistrano, Oceanside, Pomona, San Bernardino, Covina, Monrovia, Redlands, Riverside and Long Beach. Thirty exchanges and 110 toll stations are now connected, giving Los Angeles connection with nearly 40,000 telephones.

AUSTIN, TEX.—At the annual meeting of the board of directors of the Texas Telephone and Telegraph Company the following officers were elected: president and general manager, C. C. Gibbs, of San Antonio; vice-president, W. R. Hamby, of Austin; superintendent, A. G. Miller, of Llano. The directors authorized the construction of important extensions. This company is now extending its system to Brady and Georgetown, and recently completed extensions to Castell and other places. Its lines now aggregate 700 miles.

BAY CITY, MICH.—The Northeastern Telegraph and Telephone Company, which operates telephone wires from Bay City to Alpena and Cheboygan, along the Detroit & Mackinac, and along the Michigan Central north nearly to Mackinaw, to which it is building, has filed in Wayne county a trust mortgage for $150,000 to secure a bond issue of that amount. The money raised is to be used in extending the system in the various counties from this city north. The company connects at Bay City with the Michigan State Telephone Company.

SCHENECTADY, N. Y.—The annual meeting of the Home Telephone Company was held recently. The directors were reelected as formerly, with the exception of J. F. Deems and E. E. Williams who are succeeded by Homer Strong and J. W. Smitley. The officers elected for the ensuing year by the directors are: Charles F. Veeder, president; Irving H. Griswold, vice-president; Sam M. Strong, secretary; Evans S. Kellogg, treasurer. A large amount of new cable work was authorized and will be installed at once to accommodate the growing list of subscriptions.

MEADVILLE, PA.—Representatives of independent telephone companies of Western Pennsylvania met at Cambridge Springs recently, and organized the Western Pennsylvania Independent Telephone Company. Twenty-two telephone companies were represented, including Pittsburg, Cleveland, Buffalo, Erie and other concerns. These officers were elected: president, Frank Hart, of the Pittsburg & Allegheny Telephone Company, Pittsburg; secretary, H. B. Mitchell, Emlenton; treasurer, John H. Wright, Jamestown, N. Y. Contracts were let for additional wires between Meadville and Pittsburg and Meadville and Cleveland.

BELOIT, WIS.—The Beloit Telephone Company recently declared a dividend of four per cent at its annual meeting. The stockholders were enthusiastic at the showing made by the directors and management for the past year. The same board of directors was unanimously reelected. The company made fourteen per cent on the stock during the past year. The amount remaining after the payment of the dividend will be left in the treasury for future extension and improvements. The officers chosen were as follows: president, Rev. M. J. Ward; vice-president, W. H. Grinnell; treasurer, W. N. Brittan; secretary and manager, Alfred Slater. Much of the success of the company's operation is due to the remarkable work of Mr. Slater in developing new business and in improving the physical condition of the property.

Digitized by Google

PERSONAL MENTION.

MR. HERMAN W. DELONG has resigned his position as manager of the Bell Telephone Company at Dansville, N. Y.

MR. WILLIAM S. BARSTOW, consulting engineer, of 56 Pine street, New York, has recently returned from an extended trip to the Pacific coast.

MR. H. H. HENSHAW has resigned his position as secretary and treasurer of the Montreal Light, Heat and Power Company. He will, in future, be general manager in Canada of the Allis-Chalmers-Bullock Company, Limited, Milwaukee, Wis.

MR. ARTHUR J. HAYCOX has tendered his resignation as superintendent of the street railway department of the Mansfield (Ohio) Railway, Light and Power Company. Mr. Haycox has been connected with the street railway company since its organization.

MR. HARRISON R. FEHR, of Philadelphia, Pa., has been elected president of the Easton Transit Company, succeeding Mr. W. Hinkle Smith, of Philadelphia, Pa. Mr. Fehr, for the past year, has been general manager of the company, and will now fill both positions.

MR. H. H. KELLOGG has taken charge of the winding and repair department of the Doubleday-Hill Electric Company, of Pittsburg. He formerly was connected with the winding department of the Siemens-Halske Company, and also with the same department in the Westinghouse Electric and Manufacturing Company.

MR. C. J. H. WOODBURY, assistant engineer of the American Telephone and Telegraph Company, Boston, Mass., will deliver the address to the graduating class of the Thomas A. Clarkson Memorial School of Technology, Potsdam, N. Y., at the sixth annual commencement, June 9. His theme will be "The Engineer as an Economist."

MR. ALFRED B. NELSON has taken the position of chief engineer of the Lancaster & Easton Street Railway Company. He will have charge of the construction of that road. He was formerly chief engineer of the Trenton, New Hope & Lambertville Trolley Company, with headquarters at Lancaster, and is well known in railway circles as a constructor of great ability. He built the Trenton, Lawrenceville & Princeton railway and the Yardley, Morrisville & Trenton railway, and located the line from Yardley to Newton, Pa.

OBITUARY NOTICES.

MR. FRANKLIN LEONARD WAINWRIGHT POPE, son of the late Franklin Leonard Pope, and nephew of Ralph W. Pope, secretary of the American Institute of Electrical Engineers, died at the home of his sister, Mrs. George W. Shirk, at Cornwall, N. Y., May 27. Mr. Pope was born in Elizabeth, N. J., July 29, 1880, and graduated from Amherst College in 1903. He was on the staff of the assistant signal engineers of the Pennsylvania Railroad, but failing health compelled him to resign September, 1904. He spent the winter at Saranac Lake, but the change was not beneficial. He was greatly interested in railroad work, and gave every promise of a brilliant future.

MR. J. P. McKINSTRY, treasurer of the Cleveland Telephone Company, Cleveland, Ohio, died at his home in Lakewood on May 11. Mr. McKinstry was sixty-three years old, and was born in Cleveland. He was a telegrapher in his early youth, and was employed in 1859 with the Lake Shore Railroad. In 1863 he became connected with the Western Union Telegraph Company. When the Cleveland Telephone Company was formed he was elected treasurer, and held this position until the time of his death, at which time he was in charge of that division of the Bell Telephone comprising the Cleveland district, the northwestern and southwestern districts, the states of Minnesota, the Dakotas, Texas and Arkansas. He was a member of the Masonic fraternity, the Cleveland Chamber of Commerce, and was affiliated with the Colonial and Electric clubs of Cleveland.

BARON ALPHONSE DE ROTHSCHILD, head of the Paris branch of the great banking house, died on May 26, in Paris, of bronchitis. Baron Alphonse de Rothschild was the third son of Baron James de Rothschild, founder of the Paris house. Baron James died in 1868, leaving four sons—Edward, Gustave, Alphonse and Nathaniel. Edward, the eldest, became the head of the partnership. At his death in 1880 the firm was reorganized with a capitalization of 50,000,000 francs. Baron Alphonse then became the head, and from that time until his death was a great figure in the financial affairs of Europe. Baron Alphonse was born on February 1, 1827. He married a daughter of his cousin, Baron Lionel, of the English house of Rothschild, and leaves three children—Bettina, Beatrix and Alphonse. A grandson, Alphonse, visited this city last December. Baron Alphonse was considered by bankers to be the leading spirit of the Rothschilds in their relations with the governments of Europe. He financed the indemnity paid by France to Germany after the Franco-Prussian war, and his dealings in Italy included the finances of both the government and the vatican. The house also has large interests in Spain, and largely controls Austrian railroad development. The industrial holdings of the house include the petroleum fields of Baku. The house has also had large dealings in American securities through the Belmonts, and has extensive interests in mines in California. The baron was a prominent figure in the turf world, and his horses have won some of the classic races in Paris and England. He spent a great deal of money on works of art, and entertained lavishly in his town house in the Place de la Concorde. He also contributed liberally to charities. He was a member of the institute, regent of the Bank of France, and commander of the Legion of Honor. He was also an honorary member of the National Electric Light Association.

ELECTRICAL SECURITIES.

The business world and the stock market are now so closely interested that ordinarily we are inclined to believe that a condition such as has obtained for some weeks in the stock market either portends a slackening of industrial progress or the reaction of a prior period of depression. The latter is, at the present time, out of the reckoning, for while there has been a pause in the march of industrial development, this has never, within the past two years, even approached the dimensions of a halt. And, on the other hand, the indications do not warrant a belief that we are approaching a period of retrogression. The result of the long-pending sea-battle between Russia and Japan will, it is hoped, hasten negotiations for an ending of hostilities, which will have a beneficial effect upon both home and foreign markets.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 27.

New York:	*Closing.*
Brooklyn Rapid Transit	58½
Consolidated Gas	185
General Electric	170
Interborough Rapid Transit	201
Kings County Electric	200
Manhattan Elevated	161½
Metropolitan Street Railway	114¾
New York & New Jersey Telephone	171
Westinghouse Manufacturing Company	190

The Kings County Electric Light and Power Company paid a dividend of 2 per cent on June 1.

Boston:	*Closing.*
American Telephone and Telegraph	137¾
Edison Electric Illuminating	242
Massachusetts Electric	58¾
New England Telephone	136
Western Telephone and Telegraph preferred	98

Philadelphia:	*Closing.*
Electric Company of America	11½
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	10
Philadelphia Rapid Transit	31
United Gas Improvement	103

Chicago:	*Closing.*
Chicago Telephone	133
Chicago Edison Light	155
Metropolitan Elevated preferred	62
National Carbon common	60
National Carbon preferred	115
Union Traction common	7⅜
Union Traction preferred	37

Directors of South Side Elevated have declared the regular quarterly dividend of 1 per cent, payable June 30. Books close June 19 and reopen July 1.

Digitized by Google

NEW INCORPORATIONS.

LONOKE, ARK.—Jacksonville Telephone Company. $10,000.

DES MOINES, IOWA—Oak Grove Telephone Company. $1,000.

PRIMROSE, IOWA—Northwestern Telephone Company. $2,000.

GOWRIE, IOWA—The Lena-Gowrie Mutual Telephone Company. $15,000.

AUSTIN, TEX.—Western Telephone Company. Increased from $30,000 to $60,000.

COLUMBUS, OHIO—Ulrichsville & New Comerstown Railway Company. $10,000.

PRINCETON, ILL.—Bureau County Independent Telephone Company. Increased from $120,000 to $200,000.

ALBANY, ME.—Albany Telephone and Telegraph Company. $3,000. Officers: president, A. G. Bean; treasurer, L. J. Andrews.

ALBANY, N. Y.—Livingston Telephone Company. $200,000. Incorporators: William Kramer, J. H. Jackson, Frank Fielder, Dansfield.

WHEATLAND, N. D.—Wheatland Telephone Company. $15,000. Incorporators: E. Q. Powlison, B. H. Powlison, J. W. Mitchell, all of Wheatland.

SALT LAKE CITY, UTAH—Cramer Electric Company. $50,000. President, Lee Cramer; vice-president, Hugh Cramer; secretary and treasurer, John Cramer.

LEBANON, OHIO—The Loveland Citizens' Electric Company. $100,000. Incorporators: H. C. Hubbell, C. B. Vandervort, Joseph Spaeth, H. S. Stevenson and H. C. Ramsey.

WILLISTON, N. D.—Great Northern Telephone Company. $50,000. Incorporators: J. J. Delaney, H. C. Delaney, L. H. Dow, of Williston, and George Dow, of Madison, Wis.

BOSTON, MASS.—United Automatic Lighting Company. To deal in lighting systems, etc. $100,000. President, George W. Faulkner, Cambridge; treasurer, Harris B. Mitchell, Malden.

YONKERS, N. Y.—The Lawrence Park Heat, Light and Power Company. $50,000. Incorporators: William Van D. Lawrence, New York city; Joseph J. Laanin, Arthur W. Lawrence, Bronxville.

DES MOINES, IOWA—Cedar Rapids & Marion Telephone Company; increased to $300,000. Farmers' Mutual Cooperative Society, of Lester, Lyon County; $25,000; incorporator: Henry Schwenck.

STAUNTON, VA.—Virginia Valley Traction Company. $25,000. President, H. B. Sproul, Staunton; vice-president, J. Frank Clemmer, Middlebrook; secretary and treasurer, H. G. McGary, Middlebrook.

DES MOINES, IOWA—Vincennes & Wayland Telephone Company; $3,000; incorporators: L. W. Sargent and others. The Communia Telephone Company; $1,500; incorporators: H. D. Cord and others.

FRANKFORT, KY.—Fort Hill Telephone Company; $500. The Cumberland Railway Company, of Knox County; increased from $30,000 to $100,000. Hanke & Folsom Telephone Company, of Grant County; $500.

UTICA, N. Y.—The Coventry & Greene Telephone Company. $1,000. George O. Williams, Dr. Frank Burton, Matthew F. Smith, Frank B. Willoughby, Frank Brachler, Jerome Watrous and William Wiley.

SACRAMENTO, CAL.—Sacramento Southern Railroad Company. $3,000,000. Directors: I. W. Hellman, Jr., Charles Hollbrook, J. M. Israel, C. A. Harp and John C. Kirkpatrick, all of San Francisco.

SAN BERNARDINO, CAL.—Holton Power Company. To furnish power for general purposes to the town of Holton. $500 000 Directors: W. F. Holt, C. S. Lombard, C. A. Barker, A. G. Hubbard and M. M. Phinney.

SPRINGFIELD, ILL.—Kirkwood Electric Company; $12,000; incorporators: J. F. White, J. F. Kyler, R. M. Houston. Mount Pleasant Telephone Company; $10,000; incorporators, S. O. Stout, U. G. Ragsdale, James F. Dick.

ALBANY, N. Y.—General Public Service Corporation; $2,000,000. Universal Service Company; $1,000,000; to furnish gas and electricity; directors: Frederick H. Toden, William C. Dreyer and Samuel H. Gainberg, of New York city.

TUSCUMBIA, ALA.—The Mussel Shoal Electric Company. $10,000. Incorporators: Thomas H. Jackson, of Memphis, Tenn.; Oakley H. Bynum and John H. Harris, of Courtland, Ala.; James Jackson, of Tuscumbia, Ala., and others.

WILMINGTON, DEL.—The Wilmington Electric Light and Power Company. $1,000,000. Incorporators: Horace W. Cause, Samuel K. Smith, Henry P. Scott and Charles C. Kurtz, all of Wilmington, and George R. Webb, of Baltimore.

HELENA, MONT.—Rocky Mountain Development Company. To generate electricity for light and power, to deal in electric light and power plants, etc. $50,000. Incorporators: Frank L. Sizer, A. W. Martin and L. K. MacNeil, all of Helena.

FRANKFORT, KY.—The Georgetown Water, Light, Heat and Power Company, of Georgetown. $250,000. Incorporators: David J. Hauss and Ross Holtzman, of Cincinnati; R. W. Nelson and F. X. Long, of Newport, and S. L. Allen, of Georgetown.

PORTLAND, ME.—The Champlain Valley Telephone Company. Formed for the purpose of constructing, owning, maintaining and operating telegraph and telephone lines in other states than Maine $150,000. Officers: president, F. W. Story, Boston, Mass.; treasurer, Charles H. Adams, Portland.

JERSEY CITY, N. J.—National Light and Improvement Company. To construct and operate plants for the supply of gas and electricity, also street railways, waterworks, telephone lines, etc. $2,000,000. Incorporators: Henry C. Scott, St. Louis; Louis B. Dailey and Thomas F. Barrett, Jersey City.

ALBANY, N. Y.—Troy Public Service Company. Operations to be carried on in Troy, Rensselaer, Poestenkill, North Greenbush, Sand Lake, East Greenbush, Colonie, Green Island, Watervliet, Albany and Cohoes. $100,000. Directors: Michael F. O'Connor, Charles S. Aldrich and Edward Murphy, 2d, of Troy.

INDIANAPOLIS, IND.—Marion, Bluffton & Eastern Traction Company. To build a line connecting Liberty Center, Warren and Van Buren in Wells, Huntington and Grant counties. $30,000. Directors: Frank McGovern, Robert J. Cummins, Louis C. Justus, F. Van Tuyl, William Edwards, Joseph H. Edwards, Herbert J. North.

ALBANY, N. Y.—The Northern Westchester Lighting Company, of Ossining. To supply gas and electricity for light, heat and power purposes. $1,000,000. Directors: William J. Bagnell, Louis B. Grant and James H. Hagerty, of Brooklyn; Charles T. Lark and Ashley T. Cole, of New York, and Alexander Keogh, of New Rochelle.

ALBANY, N. Y.—The Interinsular Heat, Light and Power Company, of New York city. To operate in the boroughs of Richmond and Queens, New York city, and in various towns and villages in Nassau and Suffolk counties. $500,000. Directors: John Eckhard, of New York city; E. D. McLean, of Yonkers, and Edward A. Kracke, of Brooklyn.

AUSTIN, TEX.—Galveston Electric Company. To construct and operate electric railways, also to own and construct union depots. $2,000,000. Incorporators: G. E. Tripp, of Boston; M. M. Phinney, of Dallas; E. B. Parker, A. W. Q. Birtwell, of Houston; Sealy Hutchings, W. C. Ansell, E. D. Cavin, E. M. Robertson, R. B. Wilkins and Ballinger Mills, of Galveston.

ALBANY, N. Y.—The Hanover Light and Power Company, of Albany. To furnish gas and electricity for light, heat and power purposes to public and private interests in all cities and villages of the state. $2,000,000. Directors: Edmund G. DuMazuel, Frederick K. Morris, Frank B. Pierce, Francis A. Huck, John D. Fearhake, Charles A. Voetach, Wesley Farrington, Arnold L. Davis and William C. Janney, of New York city, and William Brower and Maurice S. Decker, of East Orange, N. J.

Digitized by Google

LEGAL NOTES.

SUIT FOR ALLEGED INFRINGEMENT OF SINGLE-PHASE, ALTERNATING-CURRENT MOTOR PATENTS—Suit was filed on May 13 by the St. Louis Union Trust Company, as trustee, and the Wagner Electric Manufacturing Company, as licensee, against the Century Electric Company, of St. Louis, for alleged infringement of United States Letters-Patent Nos. 458,162, 530,176 and 530,177. These are patents pertaining to the Wagner company's type of single-phase, alternating-current motor. The Wagner company has an exclusive license from the St. Louis Union Trust Company as trustee for the owner of these patents.

NEW YORK TELEPHONE COMPANY UPHELD IN REFUSAL TO SUPPLY TELEPHONE SERVICE—In Part I, Special Term, Supreme Court of the State of New York, application was made to Justice Samuel Greenbaum for a mandamus requiring the New York Telephone Company to furnish telephone service to a client who announced that he was engaged in the business of furnishing "news of all descriptions to athletic associations, hotels, etc." The company had refused his request for service on the ground that his place had been raided by the police, who removed the telephones then there and arrested several persons on the charge of betting on horse-races, etc., in violation of section 351 of the Penal Code. Although unable to convict these persons so arrested, the police officials, in affidavits made in opposition to the application for a mandamus, alleged facts indicating the truth of their charge that the law mentioned had been violated. Justice Greenbaum rendered the following decision: "the opposing affidavits show that the telephones were originally removed by the police under circumstances establishing that they were used for the purpose of selling pools, in violation of section 351 of the Penal Code. Mandamus will not lie upon such a showing. Motion denied with $10 costs."

EDUCATIONAL NOTES.

WORCESTER POLYTECHNIC INSTITUTE—The following programme has been announced for commencement week, 1905: Sunday, June 4, 7.30 P. M., the baccalaureate sermon by the Rev. Francis J. Van Horn, in Central Church, Institute Road. Monday, June 5, 11 A. M., the entrance examinations begin in Boynton Hall. Tuesday, June 6, 8 P. M., the annual commencement lecture will be given in the lecture room, mechanical engineering laboratories, by Mr. W. W. Bird, professor of mechanical engineering and director of the Washburn shops of the Worcester Polytechnic Institute: subject "The Labor Problem from an Engineer's Point of View." Wednesday, June 7, 3 P. M., the hydraulic testing plant at Chaffins in full operation; a four-stage centrifugal pump, an eighty-horse-power horizontal turbine, a turbine flow recorder, a pitometer of latest design and a Pelton wheel-current meter, under test; 8 to 10 P. M., the president's reception to the alumni and senior class. Thursday, June 8, 10.30 A. M., graduating exercises in the assembly room, Boynton Hall. Commencement address by Dr. Robert Fletcher, director of the Thayer School of Civil Engineering, Dartmouth College; subject "A Definition of Engineering Education;" 1 P. M., the alumni dinner, at the institute, followed by the annual meeting of the alumni association. The buildings and laboratories of the institute, including the dormitory of Newton Hall, 2 State street, will be open for inspection on commencement day.

NEW MANUFACTURING COMPANIES.

WHEELING, W. VA.—The charter of the Home Electric Company has been filed in the county clerk's office. The company is capitalized at $10,000, and will engage in a general electrical construction business, manufacturing and installing electrical machinery, appliances, etc. The incorporators are J. C. McCurdy, V. McCoy, of Woodsdale; George J. Gibson, of Greggs, and W. P. Keyser, of Wheeling.

EVANSVILLE, IND.—The Evansville Battery and Electrical Company has been incorporated with a capital of $100,000. The directors and incorporators are Willis F. Copeland, Albert F. Karges, John C. Zutt, Louis A. Daus and Henry C. Porter. The purpose of the company, as stated in the articles of incorporation, is the manufacture and sale of electrical storage batteries, vehicles and all classes of electrical devices and machines.

ELECTRIC LIGHTING.

ABERDEEN, S. D.—Local business men will install a new electric lighting plant.

MINNEAPOLIS, MINN.—Moorhead will expend $2,000 in enlarging its electric light plant.

PLEASANTVILLE, N. J.—The Shore Electric Light Company has sold its plant to the new Atlantic City company.

HAGERSTOWN, MD.—The Harpers Ferry Electric Company has asked permission to construct a line for the purpose of furnishing electric light to Weverton, Sandy Hook, Brunswick, Knoxville and other towns in that section.

DAYTON, OHIO—The Dayton Lighting Company has mortgaged its entire property to the Colonial Trust Company for a sum of $2,500,000. The sum of $2,500,000 is to be let out in 2,500 bonds of $1,000 value each, bearing four per cent interest.

SHREVEPORT, LA.—A report has been made by J. F. McCulloch, of St. Louis, in which the cost of a municipal light plant is placed at $171,000. The plant would have a capacity of 10,000 incandescent lamps, and 200 arc lamps. It is probable that the city will take steps to build the plant.

LYNN, MASS.—The Lynn Gas and Electric Light Company has been authorized to issue 2,300 additional shares of capital stock at $200 per share. Floating debt will be paid by the use of 600 shares and the proceeds of the remaining 1,700 shares will be used to pay for enlargement of the plant.

BOSTON, MASS.—The Cambridge Gas Light Company has been authorized to issue 1,200 additional shares of capital stock at $200 a share. The proceeds of 500 shares will be used to take up the floating debt, and the proceeds of the remaining 700 shares will be used to pay for additions to the plant since April 1, 1905.

GREEN BAY, WIS.—Green Bay Gas and Electric Company will expend $200,000 for improvements in the gas and electric service during the year. Officers have been elected as follows: president, William Mainland, of Oshkosh; vice-president and treasurer, Sinclair Mainland, of Green Bay; secretary, H. Fisk, of Green Bay.

ARMOUR, S. D.—A twenty-year lighting and heating franchise has been granted to Fred L. Kellogg. Work must be commenced before September 15 and the plant must be in operation by May 1, 1906. The city retains the right to purchase the plant on January 7, 1915, or on January 1 of any year thereafter for a period of five years.

FALL RIVER, MASS.—The Fall River Electric Lighting Company will increase its capital stock from $350,000 to $600,000 to obtain funds to construct a new generating plant. The president of the company has petitioned the gas and electric light commissioners of the state for authority to make the increase and to carry out the plans for the new work as proposed.

MEMPHIS, TENN.—A committee has been appointed by Mayor Williams to carry out the provisions of the act which authorizes the city to issue $1,000,000 bonds in order to build a municipal electric light plant. The General Electric Company has offered to furnish light to the city at eight cents per kilowatt-hour. The present price paid to the Memphis Consolidated Gas and Electric Company is twelve cents per kilowatt-hour.

INDUSTRIAL ITEMS.

THE REEVES ENGINE COMPANY, Trenton, N. J., has moved its Chicago office from 1612 Monadnock Building to 805 Ellsworth Building, at 355 Dearborn street. The telephone number, Harrison 5060, has not been changed. Mr. Joseph B. Hall is the manager of the Chicago office.

THE L. B. ALLEN COMPANY, INCORPORATED, Chicago, Ill., is calling attention to the Allen commutator lubricant in a neat mailing folder. This commutator lubricant appears to be doing lots of good wherever it is being used. The Allen soldering stick and soldering fluxes are also making more friends every week.

THE CRESCENT COMPANY, manufacturer and manufacturers' agent for electrical specialties, announces that it has moved to its

Digitized by Google

new factory at Valparaiso, Ind. At this new location the company has much better facilities for the manufacture of its "Crescent" coloring fluid, "Crescent" soldering fluxes and other specialties.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., are distributing some attractive literature descriptive and illustrative of the "P. & S." standard sockets for 250 volts. These sockets are made according to the latest requirements of the National Electric Code. Price lists giving quotations on various quantities will be furnished upon application.

THE SPLITDORF LABORATORY, 17-27 Vandewater street, New York city, is carrying on an extensive business of model-making and experimental work and engineering of a strictly high-class nature. The company has a fully equipped machine shop, and will send a representative, for conference as to the best means for developing apparatus, on request.

THE EWING-MERKLE ELECTRIC COMPANY, 1106 Pine street, St. Louis, Mo., is distributing an attractive publication designated as the "Everbest" magazine. This magazine calls attention, in a pleasing way, to various specialties which the Ewing-Merkle company handles. The advertising literature is supplemented by selections from numerous current publications.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., will be pleased to send leaflets No. 131 and No. 143-A, to any one interested in the problem of factory ventilation. These leaflets discuss the subject of ventilation by means of motor-driven fans and blowers, pointing out the essential features which make for convenient and economical service.

THE CONDUIT ELECTRICAL MANUFACTURING COMPANY has opened an office at 39 Cortlandt street, New York city, under the management of Mr. Fred W. Nason. This company's main office and factory are at Boston. It manufactures a complete line of circuit-breakers; also oil-switches and complete central station switchboard equipments for both direct and alternating-current service.

THE BRISTOL COMPANY, Waterbury, Ct., has issued catalogue No. 28, describing its direct-recording thermometers In this edition the company has classified thermometers according to the principles upon which they depend for their operation. The thermometers cover all ranges up to 1,200 degrees Fahrenheit, and have been so arranged as to make it convenient for a prospective user of these instruments to easily select the one best adapted to any special condition.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Walker, Minn.; Susquehanna, Pa.; Coalville, Utah; Mt. Vernon, Ind.; Hayden, Ind.; Velardena, Mexico; American Fork, Utah; Lyons, N. Y.; Columbus, Ohio; Atlantic, Iowa; Ishpeming, Mich.; Scotts Hill, Tenn.; Chinock, Mont.; Paris, Tenn.; Toronto, Ontario; Maquoketa, Iowa; Wray, Col.; Lowry, Minn.; San Antonio, Tex.; Cuymon, Okla.; Rochester, N. Y.; Park City, Utah.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., will have an extensive exhibit in the rotunda of the Brown Palace Hotel, Denver, Col., during the convention of the National Electric Light Association. The exhibit will be in charge of Mr. J. Walter Gillette, general sales manager. The company has closed a contract with the Syracuse & Suburban Railroad Company, of Syracuse, N. Y., to install an electric storage battery consisting of 240 cells of type W-9 unit accumulator in W-13 glass jars. This battery will be installed out on the line at DeWitt, to boost the voltage at that point and help carry the heavy summer load. This installation is now under way.

THE AITON MACHINE COMPANY, 39 Cortlandt street, New York city, has been incorporated under the laws of New Jersey for the manufacture and sale of machinery covered by the patents of Mr. Thomas A. Aiton, for all classes of wire, insulation, cabling and rubber machinery. The company is now established in connection with the Marine Engine and Machine Company, with works at Harrison, N. J. Mr. Aiton announces that his business, recently conducted in conjunction with the Chase Machine Company, of Cleveland, Ohio, has been dissolved. The factory facilities provide for prompt execution of orders of any size. The officials of the Aiton company are Mr. Gardiner C. Sims, president; Thomas A. Aiton, vice-president; Arthur S. Beves, secretary and treasurer.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, Chicago, Ill., is enjoying a very busy season. Owing to this rush, Mr. C. F. Ziegler, president of the company, will be unable to attend the Denver convention of the National Electric Light Association, but will be represented by Mr. L. A. Bennett, who will have headquarters on the eighth floor of Brown's Palace Hotel. Mr. Bennett is well known among the electric fraternity and will make a valuable substitute for Mr. Ziegler. He will have a number of the celebrated "Reco" and improved Reynolds flashers on exhibition and will take pleasure in explaining their features to all who are interested. This will be a good opportunity for those who attend the convention to see these machines in operation.

THE CONSOLIDATED ENGINE-STOP COMPANY, 100 Broadway, New York city, is distributing a very attractive folder entitled "The Law of Employers' Liability." This rehearses a portion of the decision by Justice Douglas in the Supreme Court of Rhode Island, in the suit of Derosiers *versus* Bourn, for damages sustained by the plaintiff while operating a machine at the works of the Bourn Rubber Company, Providence, R. I. The plaintiff was painfully injured by coming into contact with some of the running machinery. It was proved that the engine was equipped with the "Monarch" system, and that, immediately upon the cry of the injured person being heard, the engine was stopped by a push-button situated in another part of the works. It appeared that no neglect of duty on the part of the defendant was shown. The case was therefore remanded to the Common Pleas Division, with directions to enter judgment for the defendant.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., announces very satisfactory sales of its line of "P-K" panel and entrance cutouts. This line, up to the present time, has comprised eight different styles of cutouts for the use of the contracting engineer. These standard "P-K" panel cutouts are used generally where main feed wires enter the panel box at the top and the branch circuits are carried out at the side of the boxes. The company found, however, that other conditions were to be met, as the contractor has often needed to bring his main wires into the side of the box and carry the branches out either at the top or bottom. The National Electric Code rules for wiring require that switches shall be hinged in such a manner that gravity will tend to open instead of close them. This rule, in panel-box work, necessitates a new lot of these blocks, which the company now has ready for the market, with the switches hung as required. Attractive literature has been published, which the company will be pleased to send upon application.

THE STUART-HOWLAND COMPANY, Boston, Mass., is showing considerable activity in pushing the sale of its supplies throughout the United States and Canada. It has recently established agencies in Halifax, Nova Scotia; Winnipeg, Manitoba, and Los Angeles, Cal. It has also added to its force of traveling salesmen Mr. J. Brinton Bailey, formerly in the employ of Sampson & Allen, contractors in Lynn, Mass., and Mr. J. T. Hessel, for many years connected with the Western Electric Company, and more recently with the Carleton Chase Company, of New York. The business so far this year was considerably in advance of any year in its history. This report is confirmed by an observation of the general activity around its warerooms, and especially in the shipping department. Everything is systematized to accomplish maximum results with a minimum of labor. Each clerk has his work laid out, and each carries out instructions with a will. The large and spacious warerooms are filled to the limit with a well assorted stock of railway, telephone and lighting supplies. A further evidence of this company's activity is shown in the fact that it has recently acquired several valuable exclusive selling agencies. The Stuart-Howland Company ranks among the largest electrical supply houses in America, and judging from the recent acquisitions to its selling department, and to its shipping force as well, there is every indication that it proposes to at least keep abreast of the procession.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 23. NEW YORK, SATURDAY, JUNE 10, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
Steam Turbine Wear ... 919
High-Speed Trains ... 919
Slow Progress in Train Lighting ... 919
Wireless in War ... 920
Lightning Protection ... 920
National Electric Light Association Convention ... 922
Railway Men's Conventions ... 926
The Colorado Springs Electric Company, by E. P. Dillon ... 927
Installation and Maintenance of Storage Battery for Track Circuits, by C. C. Anthony ... 931
Automobiles and Electric Cars for Lima, Peru ... 932
The Choice of an Insulated Cable, by Wallace S. Clark ... 933
High-Speed, Long-Distance Electric Traction ... 936
Transportation Arrangements, Convention of American Institute of Electrical Engineers ... 940
Electrical Notes from Europe ... 941
The Faraday Society ... 943
International Electrical Exhibition ... 944
A Communicative Elephant ... 944
ELECTRICAL PATENTS ... 945
Nominations for Officers of the New York Electrical Society—New Members Elected ... 945
The Convention of the Street Railway Association of the State of New York ... 945
Wireless Telegraphy Experiments at Purdue University ... 945
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE ... 946
INDUSTRIAL SECTION:
Fort Wayne Prepayment Wattmeters ... 948
Orders for Westinghouse Draft Gear ... 949
Richmond Electric Company's Induction Motors ... 949
A New Type of Moulding Branch Block ... 950
Exhibit of the H. W. Johns-Manville Company ... 950
A New Type of Dynamotor ... 950
A Modern Hydraulic Elevator Plant ... 951
Milo G. Kellogg's Present Plans and Work ... 952
Incorporation of Manning, Maxwell & Moore ... 952
CURRENT ELECTRICAL NEWS ... 953

STEAM TURBINE WEAR.

The steam turbine although comparatively a new applicant for central-station honors has been received with enthusiasm, and is now accorded a prominent position in that field of usefulness. That many mechanical engineers have confidence in it is proved by the number of enormous electric generating stations now being erected, in which this engine will be the prime mover.

Although the principle is not new, there are not many turbines of the recent improved types which have been in service long enough to prove their freedom from wear. Hence every bit of evidence which can be obtained on successful turbine operation is eagerly sought. Some information on this subject is given in a brief article by Mr. J. R. Bibbins in the June issue of the *Electric Journal*. Mr. Bibbins describes conditions of a Westinghouse-Parsons turbine which was installed in the plant of the Westinghouse Air Brake Company, and which has been in continuous service there for nearly six years. The machine is rated at 400 kilowatts and was installed in August, 1899. It was opened in March of the present year. It was found that the vanes had suffered little or no wear. They had maintained their full cross-section, and consequently their full mechanical strength. And the vane angles were unimpaired, and hence their efficiency not decreased. The working surfaces were also smooth. This is in spite of the fact that the steam supplied to these turbines is frequently wet. At times, even water was carried over into the turbines. Moreover, it is said that not infrequently the purity of the feed water was in question. It is significant that these results have been obtained with one of the early turbines, for six years have resulted in great improvements in the design and manufacture of these engines.

HIGH-SPEED TRAINS.

The decision of the New York Central & Hudson River Railroad Company to establish a nineteen-hour train between New York and Chicago has spurred the Pennsylvania Railroad to an increased effort. The latter road will attempt to maintain an eighteen-hour schedule between these two cities, and to test the practicability of doing this, a run was made on June 5, in which the distance was covered in sixteen hours including all stops. This gives an average speed of a little less than fifty-six miles per hour. To maintain an eighteen-hour schedule, instead of one which requires twenty hours, will impose a greatly increased strain upon all who are responsible for the safety of the passengers and the schedule; but the passengers themselves will hardly realize the additional effort required to cut down the running time ten per cent. Now the New York Central has announced that it will also run an eighteen-hour train between the metropolis of the East and that of the West.

As each road thus redoubles its efforts to keep ahead of the other, one wonders whether these exceptional trains are really profitable, or, at least, as profitable as the regular trains; or whether it is the advertising which is being sought. Is it done merely to enable the road to say that it maintains the fastest schedule?

In either case, one wonders how far this competition will be carried, and whether it will eventually lead some road to build a high-speed electric line. If high speed is sought for its own sake, the electric motor should soon come into its own. If, on the other hand, it is merely advertising, the electric system should be a trump card.

SLOW PROGRESS IN TRAIN LIGHTING.

In a report presented by Mr. Charles B. Dudley, of the Pennsylvania Railroad, to the International Railway Congress, which met recently at Washington, D. C., the present status of various systems of railway car lighting is considered. The tendency seems to be toward an increase in the use of com-

Digitized by Google

pressed oil gas, and away from the use of compressed coal gas. One difficulty in the use of coal gas is the loss of illuminating power due to the compression, and the small number of hours of light which can be supplied with one charging. In an effort to prolong the life of the compressed coal gas system it is sought to use Welsbach mantles on the cars. This would remove the objection to the loss of illuminating power; but, as yet, the experiments have not shown that Welsbach mantles can be burned successfully under railway conditions.

The increase in the use of compressed oil—by which is meant an illuminating gas formed by passing air through volatile oil—is attributed to several causes. A quantity sufficient for a number of days can be introduced at one charging, and there is no loss of illuminating power due to compression. Furthermore, for branch lines or lines where it is not convenient to install charging stations, the carbureter system may be used. The advantage of this is that the same lamps are used, and a charge will last a number of days. In this system the oil is placed in a carbureter—a vessel filled with some absorbent material—and air at a reduced pressure, drawn from the air-brake supply, is passed through. The system is simple and gives a good light, as gas lights go. Acetylene is used to a slight extent, but is not free from serious objections and dangers.

It is somewhat disappointing to be told that electric lighting of trains is making but slow progress. There are a number of through trains fitted with electric lights which draw current from a small generator driven by a steam engine. The objection made to the simple storage battery system is the rapid deterioration of the batteries. Another electric system which is tried more or less is that in which each car contains a complete equipment of dynamo, storage battery and lights. The principle of this system seems to appeal to the railway engineer; but, from what we can learn, he is demanding apparatus which will give results comparable with those obtained from a good electric light station, yet he insists upon having apparatus so rugged that it will require no expert attention. Give him a car-lighting system which he can put under his cars and inspect once, say, in six months, and he will consider it. But it is rather difficult to devise apparatus which will regulate within two per cent for all variations of speed and load, and which can be looked after by the air-brake inspector with no other tools but a crowbar and a monkey-wrench.

The advantages of the electric light are so evident that it would seem worth a greater effort on the part of the railway engineer to test out different systems, and to assist in this way in developing a satisfactory one. So far as securing the best results is concerned, no other method can be compared with the electric, and in case of accident it does not introduce any danger. On the other hand, that the gas-lighting systems are hazardous has been only too well demonstrated within the last few months by several bad railway accidents, in which the horror of fire has been added to that of collision. Although it is admitted that the outlook for the electric systems is hopeful, we wish that we could see, in the near future, the end of the gas-lighting systems.

WIRELESS IN WAR.

Last week attention was called to the practical use of wireless telegraphy by the great Atlantic liners—an application which adds much to the safety and comfort of ocean travelers. Now it seems that wireless telegraphy played a most important part in the recent naval battle in the sea of Japan, and that the victory for the one side was contributed to largely by the excellent use which that side made of its wireless apparatus.

While detailed accounts have not yet been published, from a careful reading of those which have been given out it seems that Admiral Togo, while remaining at his naval base with his fleet, was kept constantly informed of the approach of the Russian fleet by means of the wireless apparatus carried by his scouts. In this manner he learned not only the course which they were following, but their position, and thus was enabled to make his attack somewhat in the nature of an ambush. He was able to time his movements so as to attack just when and where he thought best. Although the Russian fleet had some wireless apparatus, it was not in a position to make as good use of it as the Japanese; and although they were no doubt expecting battle, the actual attack must have come somewhat as a surprise.

It seems, however, that Admiral Togo did not confine his use of wireless telegraphy to scouting. The fleets engaged were large, and the line of battle was long. The day was foggy, so that visual signals could not be read far. Admiral Togo's wireless system, however, gave him a means of transmitting orders to any vessel, and thus of fighting a fleet action. Had this not been possible, the battle might have turned into a number of boat-to-boat engagements, with the probability of a greater number of Russian vessels escaping. It will be most interesting to learn later on—as we doubtless shall—just how serviceable the wireless system proved to be during a tremendous battle. The ships must surely have been in such a state of uproar and vibration, and the men under such a strain that a successful use of wireless there might be considered a supreme test of its capabilities.

LIGHTNING PROTECTION.

Two reports have been made recently on the subject of lightning protection. The first gives the results of the lightning research committee, which was organized some years ago by the Royal Institute of British Architects and the Surveyors' Institution. This report deals principally with the protection of buildings. The second report referred to above was presented at the recent meeting of the National Electric Light Association, at Denver, by Mr. Alex Dow. It deals with the protection of electrical systems from lightning. In neither report is there any particularly novel suggestion, nor have the investigations brought to light any new phenomena. Previous recommendations are upheld by the new evidence secured by the members of the committees.

The report of the British research committee is preceded by an introduction prepared by Sir Oliver Lodge, a member of the committee. In this introduction he considers two types of

Digitized by Google

lightning stroke. The first, termed by him the A stroke, is one in which a direct discharge takes place from a charged cloud to the earth. This discharge is not particularly dangerous. To protect buildings from it, lightning rods are useful. The points of the rods may indeed prevent a violent discharge by assisting in equalizing the potentials of the cloud and the earth. Lightning rods, to be effective, must, however, be installed properly. They should offer a path of least resistance for the discharge, yet the resistance of this path must not be too small. If the rod does not form the path of least resistance, the discharge may leave it and find its way to ground through neighboring materials. On the other hand, if the resistance of the rod be too low, the discharge takes place through it too rapidly—almost explosively—and is liable to set up induced or secondary discharges in neighboring conductors. The rod should be carried to the ground with as few bends as possible. Iron is a better material than copper, provided atmospheric conditions are not such as to rust it away too quickly.

The other, or B type of stroke, as it is called, occurs when an uncharged cloud intervenes between the earth and the charged cloud. This intervening cloud acts with the charged cloud as an electrical condenser, and when a discharge takes place between them, the charge upon the upper surface is neutralized, and that on the lower surface suddenly set free, and consequently throws a sudden strain in the dielectric between the cloud and the earth, with the result that if a discharge takes place, it is apt to follow an erratic path. The effect of such strokes is more serious than that of an A stroke, and lightning rods offer but slight protection. The only way to protect the building from such strokes is to surround it by a cage of metal. It is suggested that powder magazines be protected by a complete metallic sheathing; but even a metallic cage does not guarantee a building against lightning.

Lightning will sometimes prefer to find its way to ground through the hot gases of a tall chimney, rather than through the rod provided for it. It is suggested that this might be prevented by raising a number of rods well above the top of the chimney, connecting them to the ground through vertical wires. It is recommended that all metallic parts of a building be connected to good grounds; and although there is no record of damage to tall steel-frame structures, it would be desirable to provide a better earthing connection than that usually obtained through the concrete foundation. The report suggests that the usual method of grounding conductors by means of large plates should be abandoned in favor of a ground obtained through a perforated steel spike driven into moist ground, and filled with granulated charcoal (not coke).

The problem presented to electrical engineers is in some ways even more troublesome than the protection of buildings from lightning, for in addition to providing a path for the discharge to ground, the lightning arrester must prevent the line current from following along the path taken by the lightning. In addition, lightning arresters used on electrical systems are frequently depended upon to protect the system from damage due to an unexpected happening taking place on its own lines. A short-circuit on a transmission line, or a sudden throwing off of a large load, may set up electrical oscillations which will cause an excessive rise of voltage, with danger of breaking down the insulation of the electrical machinery. If the lightning arrester be adjusted so as to allow a discharge to take place if the voltage not only from the lines to the ground, but between the lines themselves, rises above a certain point, it will act as a safeguard. The engineer of a transmission system does not fear a direct stroke of lightning as much as induced or secondary strokes, or excessive potential due to a static charge. A direct stroke will frequently find its way to ground through the poles, rather than pass back to the station over the line. The pole may be shattered, but the system otherwise will be undamaged. A conducting line may, however, be brought to a high potential by unsuspected causes—high winds, dust storms and other atmospheric occurrences—which will throw a dangerous strain upon the electrical machinery. To protect the system from this danger the arresters must provide a path which can be taken by the charge. Such a path is, in general, one of high resistance, and may be formed of a number of small air-gaps, of water jets or carbon rods, or a combination of such devices. In this country the greatest dependence is placed upon an arrester which combines a spark-gap and a conductor of high resistance The gap or gaps are proportioned so as to prevent arcing due to the line potential, but to allow an arc to be established if the voltage rises above a certain limit. Once this has happened and an arc formed, the resistance of the gaps is reduced, since heated air is a better conductor than cold air; and the line voltage will, in general, be sufficient to maintain an arc if means are not provided for breaking it. This may be brought about by blowing out the arc by an electromagnet, or by arranging the path to ground in such a way that, after the arc has been established, the voltage across the spark-gaps falls so low that the arc can not persist.

To protect electrical systems from lightning, it is sufficient, according to Mr. Dow's report, to protect the stations and let the line take care of itself—that is to say, in a transmission line there is need for arresters only at the generating and receiving stations. A distributing system should be protected wherever machinery is installed—that is to say, at every consuming point.

The characteristics demanded of a lightning arrester in Mr. Dow's report are these: it should discharge at a potential slightly higher than that of the system, and the working of the system should not be affected by the discharge; the electrical energy of a static disturbance should be dissipated as rapidly as possible, and these static disturbances prevented from developing high potentials in the electrical machinery. While it is desirable to dissipate static disturbances rapidly, a too rapid discharge might set up secondary disturbances nearly, if not quite, as difficult to handle as the primary discharge; a point which is brought out in the British report. Hence the use of a high resistance connected in the arrester circuit, which tends to prevent oscillations. In lightning protection to-day it is the unexpected which bothers us, as well as the controlling of enormous energies suddenly appearing where they should not be.

Digitized by Google

National Electric Light Association.

Business Session Held at Denver, Col., June 6, 7, 8.

Reported by Telegraph for the Electrical Review.

DENVER, COL., JUNE 6—As early as Saturday the conventionists of the National Electric Light Association began to arrive in Denver, and by the opening of the meeting to-day the hotels, clubs and private houses all over the town were well filled. The first episode was the informal reception held in the drawing room of the Brown Palace Hotel. During the day the ladies were entertained by a coaching trip and luncheon at the Overland Country Club, and in the evening the entire seating capacity of the Elitch vaudeville theatre was taxed.

President Davis called the first meeting to order at the Brown Palace Hotel, at 10.30 A. M. The Hon. Robert W. Speer, mayor, was introduced and delivered a felicitous address of welcome. President Davis then delivered his address as follows:

For the first time in the history of the National Electric Light Association, its annual convention will be held west of the Missouri river, and no more typical city of the West could have been selected than the progressive municipality of Denver, and no more beautiful spot than Colorado Springs.

The choice of our place of meeting was a tribute to the development of the central station industry throughout the West and was intended to bring our western members in closer touch with the work and object of the association and to secure closer personal relations among our members from all sections of the country. The present convention may therefore be termed as somewhat missionary in its object.

The membership of the association generally grows proportionately smaller as we go westward, and it is expected that the Denver-Colorado Springs meeting will result in a large increase in our membership from the West. The state of Colorado is, however, an exception in that an unusually large proportion of the central stations located within its borders are now members of the association.

In this connection it will not be amiss to refer briefly to the work done by the association in recent years. The annual conventions offer the only general opportunity of personal exchange of thought and experience among a large number of central station managers as well as for the presentation of papers and discussions on matters of general interest. The field of the association is far broader than the benefit derived from such personal exchange of individual views and the reading of papers and discussions found therein.

The interest of the central station, considered as an industry, was what has lately received the best work and thought of your association; the vital questions being no longer preeminently those of management or type of plant, but rather those relating to stability and legitimate earning power of the industry.

The one and great menace to the industry is unwise, burdensome and restrictive legislation by the municipality and the state.

The right to tax is the power to destroy. The power to regulate contains the germ of the danger of confiscation, in whole or in part. The regulation of the industry by a commission that has such powers as are vested in the gas and the electric commission of the state of Massachusetts may be proper and satisfactory as safeguarding both the rights of the public and of the investor. But regulation by a commission brought into being by a manufactured public sentiment and having its inception in politics, and not primarily or honestly intended to remedy any admitted public oppression, or to properly regulate the use of the public franchises, can not be fair either to the public or to the investor, and must result in gross injustice to the industry.

The association should not be passive while laws placing the industry under the regulation of the commissions are passed by the several states without making proper suggestions, whereby which laws would be made reasonable and uniform in their provisions. Nor should it permit, without protest, the passage of any laws admittedly unduly restrictive and burdensome. The object should be to have the general laws of the several states relating to the industry conform to some standard, fair both to the public and to the industry.

For one state to grant only very limited term franchises under burdensome restrictions, and for another, and possibly an adjoining state, to grant perpetual franchises without restrictions; for one state to reserve the right to fix and change the rate of charge for service rendered, and for another state to empower any municipality to make any rate it may see fit, and to charge the same when and as it pleases, can not but injuriously affect the stability of the industry from the standpoint of the investing public.

I would, therefore, recommend the appointment of a standing commission on legislation to aid in protecting the interest of our members should occasion arise. The formation of state or sectional associations, whose object shall be to call the attention of interests affected by proposed legislation, and to secure concert of action for mutual protection, should be encouraged, which associations could very advantageously act in conjunction with your association committee on legislation. The good work in this direction already done by existing state or sectional associations has been very much appreciated by the interests benefited. It was my intention to suggest a codification of the laws of the several states relating to the central station industry for the benefit of our members and others interested, but the work has been done in a manner, and is now in book form. Another important question is that of municipal ownership, which, while as yet limited generally to the construction and operation by municipalities of plants for public lighting, is more than likely to result in the general interest to engage in private or commercial lighting, in aid of the public lighting. By way of self-protection the central station should more than live up to the obligation of its franchises, should furnish public light at reasonable prices; and serve the public so well that any agitation started for political or personal ends will not receive the support of a justly indignant public. As the basis of the argument for municipal ownership, that of a reduction in the cost of public lighting to the taxpayer, we should be prepared to answer this claim—as can be done—by the concrete results of the operations of existing municipally overrated plants. It is to be regretted that the League of American Municipalities has not accepted the proposition repeatedly made by the National Electric Light Association to join in a thorough and impartial investigation of the results.

Investigation of the results of the operations of existing electric lighting municipal plants in this country we know, but the public generally do not, shows such results do not justify or support even a part of the claims made by the advocates of municipal ownership. The amendments to the by-laws adopted at the last convention in relation to various classes of members have resulted in a satisfactory addition to our membership. Members of class B are officers or employés of member companies and are now 117 in number members of class C are instructors and teachers of engineering and related sciences and now number thirty-nine; and associate members, class E, are officers or employés of associate member companies and now number sixty-eight. The total membership is now 824, as compared with 583 one year ago.

The Association of Licensed Manufacturers of Incandescent Lamps has appropriated the sum of $10,000 for the pur-

Digitized by Google

pose of effectively co-operating with the central lighting stations of the country for the increased use and, in consequence, sale of incandescent lamps. The plan contemplates its expenditure in two ways: first, to be helpful in stimulating central stations along advertising and new business lines; second, to assume the cost of preparation of an effectual and comprehensive plan of advertising and soliciting which, in consequence, could be furnished by some central bureau or advertising agency at a very low cost. As the plans suggested would be of value to the central station industry, I would recommend that a committee be appointed to work in conjunction with the Association of Licensed Manufacturers of Incandescent Lamps.

Our late president made some very pertinent suggestions as to the labors and difficulties attending the discharge of the duties of the president of your association, and of the value and necessity of having meetings of the executive committee during the interim between conventions, to secure a continuity of the established policy of the association, and to keep in close touch with the needs of our members in all sections of the country. The suggestions made I endorse. The individual policy and efforts of succeeding presidents, no matter how able they may be, can no longer do full justice to the interest of our members, widely scattered as they are. The executive committee must be the connecting link between the work of succeeding presidents. Its members should be selected, so far as possible, to represent geographically the several sections of our country and should meet often enough to place the president in touch with the needs of their localities. Steps should be taken to provide a place and facilities for a library to contain papers, periodicals and publications, issued from time to time, relating to all subjects of interest to the central station industry. The original data collected by several committees and reporters appointed from time to time should be filed in the office of the association, together with all the correspondence on the part of the executive officers of the association and others, relative to the important questions that fall to their lot to deal with. Each president, in turn, is handicapped by finding substantially no record in detail of the work of any of his predecessors, and is therefore at a great disadvantage in attempting to deal with any important question that may overlap the term of more than one president, or may have some relation to events of the past. A committee should be appointed to consider and report on the proper method of grounding secondaries of alternating-current distributing systems, so as to minimize the risk and danger to property and life. The suggestion made by the committee for the investigation of steam turbines, that its work be continued, is endorsed. While not strictly within the objects of the association, it would be well for our members to consider the advisability of consolidating the street railways, gas and electrical companies in any given locality, as not only would the public be better served but the total investment would be more stable and the results unusually satisfactory. During the holding of the Louisiana Purchase Exposition, in 1904, your association, through the kindness of the Association of Edison Illuminating Companies, was granted the use of part of its space at the exposition for the association of our members, and I desire to take this occasion to thank our sister association for the courtesies extended.

At the meeting of the International Electrical Congress, held in September, 1904, at the exposition, your association was ably represented by the gentlemen selected at its Boston meeting. I desire, therefore, to thank Mr. George Ross Green, Professor Frederick A. C. Perrine, and Mr. George N. Eastman for their very able papers and the manner in which they sustained and added to the reputation of the association. But few of us appreciate the tremendous power of the association, the great possibility for good or evil that rests in the direction of its policy and the importance of the interests involved. Our relations to the great public, our customers; to the legislative power to which we are all subjects; to the municipality under whose franchises we operate; to the great manufacturers of apparatus and supplies; to the insurance interest with whom we must always maintain the most intimate relations; and last, but not least, to our stockholders and all others pecuniarily interested in the properties we manage, are the great and vital questions that are now uppermost. It will be for future administrations to deal wisely and conservatively with them.

The president's address was referred to a committee composed of Ferguson, Frueauff, Stetson, Scovil and Carnes. T. C. Martin read the report of the progress committee.

Dr. Louis Bell's report on "The Tantalum Lamp" was read. This was discussed by J. R. Cravath, Arthur Williams, John F. Gilchrist, D. C. Farrand, A. C. Dunham and W. H. Gardiner, Jr., Boston.

All speakers favored this lamp. Mr. Williams said that as an illuminant it is certainly very interesting and promises well for the future, but as there probably have not been more than 100 of these lamps in this country, and they have not been here long enough to be subjected to any kind of commercial test, he did not think it would be practicable to discuss the lamp in any commercial sense. He did not think because of the high price at which the lamp is obtainable that it will be immediately a competitor with the ordinary incandescent lamp. Mr. Gilchrist said the bringing out of this lamp raises the question of selling electricity for illuminating purposes, particularly incandescent lighting, on the lamp-hour basis instead of the kilowatt-hour basis.

Mr. Farrand said they have had two tantalum lamps. The first showed an efficiency of 1.99 watts per candle, which is better than that mentioned by Dr. Bell. That lamp, however, lasted only some twenty odd hours. The second lamp is still burning and shows an efficiency of 1.68 watts per candle. He did not know how long it would continue to burn. The commercial efficiency is a matter which will have to be determined. The theoretical efficiency to very little.

W. H. Gardiner said the unit of illumination in the tantalum lamp shows up approximately on the same basis as its competitor and after comparisons with other lamps thought we should welcome the tantalum lamp.

The paper on "The Paramount Importance of Standard in Preference to Special Machinery," by David Hall, was read.

In discussion, E. F. McCabe said it would be a wise idea for the manufacturers to get together and standardize the machine. What we want is to have machines that are not special except in minor details. H. T. Hartman endorsed Mr. McCabe's point of view.

The paper on "Insulation Testing—Methods and Apparatus," by C. E. Skinner, was presented, but there was no discussion, and the meeting adjourned.

The afternoon session was called to order at 2.30.

Paul MacGahan's paper on "Automatic Synchronizing of Generators and Rotaries" was read. No discussion. Louis E. Bogen's paper was presented, entitled "Notes on Rotary Converters and Motor-Generators for Lighting and Power Systems."

Clarence Renshaw, of Pittsburg, said he differed with Mr. Bogen in regard to sixty-cycle rotaries for voltages of 240 and 500. He also called attention to Mr. Bogen's failure to indicate the ability of a synchronizing machine to affect the voltage of the system by means of changes of load on the synchronized machine. Alex Dow said, that in the question of motor-generators as against rotaries, the distinction is not always made as it should be between the conditions of railway service and the conditions of lighting service. The points of this paper were then discussed in its various technical phases. Mr. Gille concluded the discussion by calling attention to the advantages and the disadvantages of both rotaries and motor-generators as to reliability of service in the case of lightning troubles on transmission lines.

Mr. Wiliams resumed the discussion of the progress committee's report by calling attention to the use at Detroit of exhaust steam for the purpose of evaporating brine and thereby deriving salt. He also referred to the calculations made by Mr. Pearce, a prominent English engineer, on the relative costs of the different artificial illuminants in which the conclusion is reached that the cost per mean candle-power per hour for the arc lamp is 0.66, whereas for the intensified gas lamp the cost rises to 0.79. The references to the use for special purposes of the mercury vapor lamp were commended as well as the use of the Nernst lamp. He called attention to the interesting information that the objections to the use of the osmium lamp at 110 volts have not been overcome; an enquiry was also made, but not answered as to whether osmium

Digitized by Google

lamps were obtainable. The data submitted by J. C. Chamberlain on electric refrigeration were commended as being worthy of special study.

W. C. L. Eglin, of Philadelphia, asked a question relative to the Cooper Hewitt lamp as to how the candle-power is determined, and what is being done toward making a more direct comparison between this and the arc lamp?

Alex Dow, referring to the report stated that the salt works were not growing. It has been money in one's pockets to stay out of the salt business. The reasons are not electrical nor mechanical, but purely financial. In the present peculiar conditions of the salt market they have found good financial reasons for stopping the drilling of salt wells, pending a change in the salt business. There are, however, a number of electrochemical processes, particularly electrometallurgical, which are not necessarily continuous, but which can be run profitably at hours which are not peak-load hours. The discussion of this report was concluded by an extended analysis by Alex Dow on special conditions at the Detroit station.

W. P. Hancock's paper on "The Organization of Working Forces in Large Power-Houses" was presented.

W. B. Jackson said that not only is there a value in keeping the plant neat and clean, but also the moral of the employés would be so much better and they will be so much cleaner on account of the plant being clean in every detail. Mr. Hartman speaking of labor troubles, said his experience is that where men are well paid and well treated the trouble generally comes from the outside. Mr. Hancock said he has not a union man on his payroll. His men are far above the average of men who are in the unions in the same class of service. Mr. Durham said in the last three years they had given their men a six per cent dividend, and there has never been an opening for a union man since.

W. C. L. Eglin presented the report on "Turbines," followed by A. H. Kreusi on "Operating Factors of the Curtis Steam Turbine," on which discussion was postponed until Wednesday morning.

WEDNESDAY SESSION.

DENVER, COL., JUNE 7—President Davis called the meeting to order at 10 A. M. The paper by Clarence Renshaw, on "Series Alternating-Current Motors for Industrial Work," was read. This paper and the one which followed it, being allied, a joint discussion was held on both.

The paper by S. Percy Cole, on "New Type of Single-Phase, Alternating-Current Motor for Elevator Work," was read. The discussion was participated in by Messrs. Renshaw and Eglin. Mr. Cole, in answer to questions, stated that it was the intention of his company to develop this type of motor for hoists and traveling crane service. It is intended to cooperate with manufacturers of traveling cranes and elevators.

Replying to the question as to what cities were changing whole sections from direct to alternating current, he could not name the cities, but it is a fact that in St. Louis there is a section in which only alternating current is used.

Mr. Renshaw said that it seemed to him as if this motor corresponds to a direct-current motor, and is but little better than a shunt motor. Of course, in elevator service a compound motor is desired, but for cranes and hoists a series motor is wanted.

Mr. Cole raised a question as to whether a sixty-cycle motor could be wound for the same voltage as a twenty-five-cycle motor, or for any voltage up to 600. Mr. Renshaw replied that the question is largely one of the size of the commutator bars required. The higher frequency requires a greater number of bars, making a mechanical difficulty in constructing the smaller sizes.

The discussion of the turbine report presented yesterday was taken up. This was participated in by E. F. McCabe, A. H. Kreusi and W. C. L. Eglin.

Replying to a question by Mr. McCabe, as to whether the turbines were being operated by exhaust steam, Mr. Kreusi replied that some were nearly ready. Mr. Eglin said that two sets had been ordered for the Philadelphia Rapid Transit Company.

In the absence of John A. Britton, his paper, "Long-Distance, High-Tension Transmission in California," was read by title, and will be published in the proceedings.

The report by Alex Dow on "Present Methods of Protection from Lightning and Other Static Disturbances" was presented. Mr. Dow recommended that the association appoint a reporter to handle this subject.

C. R. Maunsell asked if any case were known of the puncturing of the lead lining of storage batteries by lightning on railway systems. Mr. Dow replied that, to his knowledge, no case had been reported, but flashing across the battery terminals to ground occurs.

R. F. Hayward described conditions existing on Utah transmission lines up to 40,000 volts. Based on General Electric and Westinghouse data and his own observations, he believed that lightning protection should be special over all lines in the form of lightning conductors. His practice is to ground one or two circuits at each end of the line before thunderstorms.

E. P. Dillon discussed conditions to be met in this connection in Colorado. Further discussion was participated in by Messrs. Hartman, Jackson and Dow.

E. R. Roberts's paper on "The Nernst Lamp, Its Present Performance and Commercial Status," was presented.

M. J. Hazard asked the present price of Nernst lamps for direct currents.

In reply to a question, Mr. Roberts said that the tests on direct-current lamps recently showed favorable results. The company will distribute lamps for commercial tests by various central stations, and the results of these tests will determine whether these lamps will soon be marketed.

Arthur Williams said that he found the Nernst lamp did not materially interfere with the incandescent lamp or the arc lamp, but fills a gap. The Nernst lamp is of high quality, and gives satisfaction where used. The best field is for the three and six-glower lamps. The life is fairly satisfactory, and the lamp is renewed at low cost. The income is about twice the income of a sixteen-candle-power incandescent. The lamp has gained the patronage which would have otherwise gone to the intensified gas burner.

Mr. Durham said that the Nernst lamp had performed an important service in an installation where thirty-five-glower lamps were used. He also gave further interesting data relative to the life and economy of the lamp. The suggestion that the cost of the Nernst lamp be reduced was applauded. The meeting then adjourned until 8 P. M.

This evening the ladies were entertained at a performance in the theatre. The men were entertained at a well-attended smoker.

Evening meeting was called to order at eight o'clock. E. P. Dillon's paper, "Some Investigations of Induction Losses," Wallace S. Clark's paper, "The Choice of an Insulated Cable," and P. D. Wagoner's paper, "Mercury Arc Rectifiers," were read. Mr. Wagoner gave a practical demonstration of this apparatus.

Mr. Scovil presented an amendment to the by-laws, making the retiring presidents members of the executive committee for one year after the expiration of their term. This was referred to a committee composed of Messrs. Doherty, Hartman and Brine.

The reports by Percy Ingalls on "Advertising Methods," on "Sign and Decorative Lighting," by La Rue Vredenburgh, on "Free Signs and Flat Rates," by G. W. Lee, were presented, the discussion being opened by John Craig Hammond, advertising manager, Denver Gas and Electric Company. Many interesting samples of advertising literature were shown, the discussion being taken up by Messrs. Ingalls, Lee, Hewitt, Rawlins, McCabe and Williams.

THURSDAY SESSION.

DENVER, COL., JUNE 8—The meeting called to order at 10 A. M. J. R. Crouse read portions of his paper concerning better cooperation between manufacturers and middlemen. He announced a contribution by the manufacturers of $10,000 to cooperate with central stations for greater use of incandescent lamps.

President Davis thought that later on a committee might be formed to carry on this work as outlined by Mr. Crouse. The discussion on advertising, particularly as relates to small cities, was resumed, Messrs. Watson, Emerick, Sells, Wilcox, Russell, and Gardiner, taking part. This subject was given lengthy analysis, that it might be considered a most important feature of the proceedings.

The report on "Progress in Electric

Digitized by Google

Heating," was presented by James I. Ayer, and discussed by A. L. Selig, California; F. H. Corst, Wisconsin; Julian B. Downey, Wyoming; Arthur Williams, E. F. McCabe, H. W. Hillman and W. H. Blood, Jr.

The Thursday afternoon session was opened by the report by W. H. Blood, Jr., on "District Heating," which was discussed by C. R. Maunsell, H. J. Gille, J. E. Pyle.

The nominating committee, L. A. Ferguson, Paul Doty, Paul Spencer, N. F. Brady, and Samuel Scovil, was appointed.

E. W. Lloyd's report on "Purchased Electric Power in Factories," was read and discussed by E. H. Davis and H. J. Gille. The "Wrinkles" and "Question Box" were presented but not discussed.

ELECTION OF OFFICERS.

The nominating committee made presentations as follows:

President, W. H. Blood, Jr., Seattle, Wash.

First vice-president, Arthur Williams, New York.

Second vice-president, Dudley C. Farrand, New York.

Executive committee, for three years, C. L. Edgar, John Martinson, Frank Frueauff, W. C. L. Eglin.

It was recommended that the executive committee appoint the secretary and treasurer.

Invitations for the next meeting were received from Brooklyn and Buffalo. Brooklyn (Manhattan Beach) will probably be selected.

The executive session listened to reports on "Relation with Kindred Organizations," James I. Ayer, chairman; "Rates and Costs," Charles L. Edgar, chairman; "Municipal Ownership," Arthur Williams; and "Standard Rules," Charles L. Edgar, chairman.

The reports of the secretary and treasurer were read, and after the report of the executive committee the convention, at seven o'clock adjourned. S. H. G.

CONVENTION NOTES.

Manufacturers and Representatives Present—Souvenirs Distributed.

DENVER, COL., JUNE 8—The fine Allis-Chalmers installation at the Denver Gas and Electric plant was inspected by many delegates. This plant was more or less the centre of interest. It contains, among other apparatus, two 1,500-kilowatt, sixty-cycle Bullock direct-connected alternators; four 600-kilowatt, three-phase Bullock belted alternators, and two 400-kilowatt, direct-current belted generators. This is by far the largest generating plant in the West. The Allis-Chalmers representatives at the convention were M. C. Miller, of the executive department, Milwaukee; O. A. Stranahan, power department; C. A. Tupper, department of publicity; George H. Berg, Boston manager; George B. Foster, Chicago manager; Robert J. Glendinning, assistant district manager; R. B. McConney, district manager, Denver; H. L. Woolfenden, electrical department, Denver; J. R. Jeffrey, assistant secretary.

The Bullock Electric Manufacturing Company, the electrical manufacturing department of the Allis-Chalmers Company, was represented by David Hall, assistant chief electrical engineer; Louis E. Bogen, engineer, Bullock company, Cincinnati.

The General Electric Company was represented by General Ervin Hale, manager of the Denver office; G. A. Wooley, superintendent of the Denver office; E. E. Gilbert, lighting department, Schenectady; P. D. Wagoner, sales department, Schenectady; F. G. Vaughan, sales department, Schenectady; W. S. Clark, wire and cable department, Schenectady; A. H. Kreusi, engineering department, Schenectady; H. W. Hillman, sales department, Schenectady; Frank W. Wilcox, assistant manager, incandescent lamp department; F. H. Gale, manager advertising department; A. D. Babson, sales manager, New York; H. C. Hauck, sales manager, Cincinnati; H. J. Dudley, sales department, Philadelphia; J. H. Livesy, sales department, Detroit; J. Scribner, lighting department, Chicago; W. H. Smith, sales department, Minneapolis; C. B. Burleigh, engineering department, Boston; C. B. Mahoffey, engineer, Denver office; A. D. Grouch, Salt Lake City; Otis Turner, Dallas, and H. C. Glaze.

The National Electric Company—Hendrie & Bolthoff Manufacturing and Supply Company, Denver agents; C. O. Poole, sales department, and C. G. Burton, general sales agent.

Fort Wayne Electric Works—J. J. Wood, electric designer and general superintendent; F. S. Hunting, sales manager; A. A. Serva, assistant sales manager; A. L. Searles, manager, Grand Rapids, Mich., office; W. S. Goll, manager, Chicago office.

Baker & Company, Inc., Newark, N. J.—C. O. Baker.

Stanley Instrument Company—F. J. A. Alderson, sales department; A. S. Ochs, sales department; C. R. Spence, sales department.

Pass & Seymour, Syracuse—manager John W. Brooks.

The Switchboard Equipment Company—A. C. Lavidge, sales manager, Pittsburg.

New York Insulated Wire Company—B. K. Sweeney, Denver.

Crocker-Wheeler Company—Lewis W. Ward, Denver; R. E. Miller, W. F. Sullivan and Julian Roe, manager, Chicago office.

Chicago Edison Company—Chicago, Homer Niesz, assistant to second vice-president; John F. Gilchrist, contract agent.

Atlantic Insulated Wire and Cable Company—George F. Porter, New York.

Electric Storage Battery Company—G. H. Atkins, Chicago, manager; Theodore B. Entz, contract agent.

H. W. Johns-Manville Company—James W. Perry, manager; J. W. Hardy, Milwaukee.

Western Electric Company—W. L. Tucker; E. W. Rockfellow and W. F. Hessell.

L. Pearson Company, Boston—W. G. Olson.

The Arnold Company, Chicago—W. L. Arnold, vice-president.

National Carbon Company—N. C. Cotabish, sales manager; J. L. Crider, secretary; J. F. Kerlin, assistant sales manager.

American Circular Loom Company, Chelsea, Mass.—Thomas E. Grier, western manager.

Simplex Electric Heating Company, Boston—James I. Ayer, C. W. Richards.

New York & Ohio Company, Warren, Ohio—W. D. Packard.

Western Chemical Manufacturing Compan, Denver—L. B. Skinner.

Ray D. Lillibridge, New York.

National Battery Company, Buffalo—J. W. Gillette, general sales manager.

Farr Electric Company, Chicago—James M. Gilchrist, manager.

Electric Appliance Company, Chicago—W. W. Low, president.

National Electric Lamp Company, Cleveland—J. Robert Crouse.

Okonite Company, New York—George T. Manson, general superintendent.

Reynolds Electric Flasher Manufacturing Company, Chicago—I. A. Bennett.

Bryan-Marsh Company, Chicago—E. S. Haughton, S. E. Doon.

Osburn Flexible Conduit Company, New York—T. A. Bennett, Chicago, manager.

Buckeye Electric Company, Cleveland—L. P. Sawyer, manager.

Speer Carbon Company, St. Mary's Pa.—J. S. Speer, general manager.

Nernst Lamp Company, Pittsburg—Max Harris, Arthur F. Solomon, D. Matthews, E. R. Roberts.

The exhibit of the Westinghouse Companies adjoined the convention hall. This was very attractive on account of the elaborate decorations. The Westinghouse Electric and Manufacturing Company was one of few large manufacturers to have an exhibit of apparatus, including arc lamps, lightning arresters, meters, transformers, circuit-breakers, small motors, etc. The headquarters of the Westinghouse Companies included a room where refreshments were served. The great Westinghouse banner was suspended from

Digitized by Google

the centre of the dome one hundred feet above make a striking effect.

The Nernst Lamp Company's exhibit of line of lamps was in the Hotel Savoy. E. R. Roberts, of Pittsburg, was in charge.

The Westinghouse Companies delegation consists of the following: from Westinghouse Electric and Manufacturing Company, C. S. Cook, manager of the railway and lighting department; C. B. Humphrey, manager, detail and supply department; G. B. Griffin, assistant manager of the same department; P. Davis, assistant chief engineer; W. C. Webster, assistant to the second vice-president; Mr. Whipple, general lamp agent; P. N. Jones, manager Pittsburg office; L. M. Cargo, manager, Denver district office; C. E. Skinner, Paul McGahan, K. C. Randall and Clarence Renshaw, engineers; Mr. Chase of the New York sales office; W. R. Pickard of the Chicago district office; H. S. Sand, E. C. Means and B. S. Manuel of the Denver district office; from the Nernst company, Max Harris, sales manager, S. Solomon and R. D. Matthews, Pittsburg, managers, E. R. Roberts, Pittsburg; Westinghouse Machine Company, C. C. Shappel, manager, Denver. The arrangements were in charge of J. C. McQuiston, superintendent publishing department, and L. M. Cargo, manager, Denver office.

Dearborn Drug and Chemical Works, Chicago—Fred A. Earls, Robert W. Francis, George R. Carr.

The Phelps Company, Detroit—W. J. Phelps, president, and J. Wiley Phelps, secretary.

Chase-Shawmut Company, Newburyport, Mass.—George A. Grey.

India-Rubber and Gutta-Percha Insulating Company, New York—James B. Olson, manager.

American District Steam Company, Lockport, N. Y.—Charles R. Bishop, secretary and general manager.

The Standard Paint Company, New York—H. C. Eldy, western manager; B. C. Beckman, and Charles Carnshaw, New England manager.

Sangamo Electric Company, Springfield, Ill.—R. C. Lanphier, superintendent.

Moloney Electric Company, St. Louis, Mo.—T. O. Moloney, president.

Phœnix Glass Company, New York—A. H. Patterson and E. H. Fox.

Philadelphia Electric and Manufacturing Company, Philadelphia—C. L. Bundy, manager.

Duncan Electric Manufacturing Company, Lafayette, Ind.—William H. Sinks.

American Electrical Works, Phillipsdale, R. I.—Francis E. Donohue, western agent.

Standard Underground Cable Company—J. R. Wiley, Chicago manager; E. J. Pietzcker, southwestern manager.

Wagner Electric Manufacturing Company, St. Louis—G. Percy Cole, electrical engineer; V. W. Bergenthall, assistant sales manager.

J. S. Codman Company, Boston—Charles Codman, president.

Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass.—Martin J. Insull, third vice-president.

Benjamin Electric Manufacturing Company, Chicago—R. B. Benjamin, vice-president.

American Electrical Supply Company, Chicago—C. Edward Browne, president.

Sawyer-Man Electric Company, New York—Walter Cary, sales manager.

Jeffrey Manufacturing Company, Columbus, Ohio—Frank R. Field.

American Steel and Wire Company—H. J. Woelke, Denver, manager.

Triumph Electric Company, Cincinnati—George A. Stiles.

Pittsburg Reduction Company—John H. Finney, manager.

American Conduit Company, Chicago—A. L. Wetherbury, general manager.

Central Electric Company—J. A. Savage.

Columbia Incandescent Lamp Company, St. Louis, Mo.—J. S. Lehman, manager.

A number of those usually active, socially and otherwise, were regrettably absent. Among these, Charles Blizard, John Dale, A. C. Garrison, H. H. Gearey, C. E. Corregan, Dan Hemingway, C. P. Hill, B. C. Kenyon, H. B. Kirkland were missed. Although Mr. Kirkland was absent, he had provided through his associate, Mr. Grier, two automobiles, for the use of the tired ones. This courtesy was greatly appreciated.

Many unique souvenirs were distributed, among which might be mentiond the following:

National Carbon Company, electric flash lamp. Allis-Chalmers Company, National Electric Company, Central Electric Company, watch fob. Osburn Flexible Conduit Company and Philadelphia Electric Manufacturing Company, scarf pin. Dearborn Drug and Chemical Company, perfume. Phelps Company, "Hylo" cigarettes. India-Rubber and Gutta-Percha Insulating Company, cigar holder.

S. H. G.

RAILWAY MEN'S CONVENTION.

AMERICAN RAILWAY MASTER MECHANICS' JUNE 14 TO 16; MASTER CAR BUILDERS, JUNE 19 TO 21, MANHATTAN BEACH, LONG ISLAND, N. Y.

THE thirty-eighth annual convention of the Railway Master Mechanics' Association will be held at Manhattan Beach, L. I., N. Y., on June 14, 15 and 16, 1905. The thirty-ninth annual convention of the Master Car Builders' Association will also be held at Manhattan Beach on June 19, 20 and 21, 1905. The headquarters of both associations will be at the Oriental Hotel. During the period the two conventions are in session, the hotel will be reserved for the exclusive use of the members and their guests, including the Railway Supply Men's Association.

The following programme has been arranged for the American Railway Master Mechanics' Association:

The opening session will be held on Wednesday, June 14, from 9.30 A. M. to 1.30 P. M. After routine business has been transacted there will be a discussion, from 11 to 11.30 A. M., on the report of the committee on "Proper Loading of Locomotives." From 11.30 A. M. to 12 M. there will be discussion of the report on "Locomotive Tests of the Pennsylvania Railroad Company at St. Louis Exhibition." Lawford H. Fry, of the Baldwin Locomotive Works, will open the discussion on "The Best Known Dimensions for Water Space Around the Fire Box to Produce a Minimum Consumption of Fuel; and Replacement of Fire-Box Sheets, and Reasons for the Same." William Garstang will next open the discussion on "Locomotive Stokers." Following this there will be discussion of a paper by H. H. Vaughan, on "The Value of Superheated Steam for Locomotive Works."

The second session will be held Thursday, June 15, from 9.30 A. M. to 1.30 P. M. There will be discussion of reports on "Locomotive Driving and Truck Axles and Locomotive Forgings," "Shrinkage Allowance for Tires," and "Motive-Power Terminals." Following this there will be a discussion of a paper presented by George M. Basford, on "The Technical Education of Railroad Employés—the Men of the Future." There will also be topical discussions on "High-Speed Steel" and on "Staybolts," followed by a discussion of the report on "Flexible Staybolts."

The closing session will be held Friday, June 16. The reports of the committees on "Water Softening for Locomotive Use," "Service of Locomotives," and "Shop Layouts" will be discussed from 9.30 A M. to 11.30 A. M. Following these discussions C. B. Young will present a paper on "(*a*) Proper Lubrication of Valves when Drifting; (*b*) Relative Set for Piston and Slide Valves." Following Mr. Young's paper, topical discussions will be held on "Relief and Bypass Valves for Locomotives," and "Are Engines with Self-Cleaning Front Ends Satisfactory?" Correspondence and resolutions will be taken up after the topical discussions, followed by the election of officers. After the election of officers, adjournment will be taken.

The present officers of the association are: president, Peter H. Peck, master mechanic, Chicago & Western Indiana Railroad, Chicago, Ill.; treasurer, Angus Sinclair, 136 Liberty street; secretary, Joseph W. Taylor, 390 Old Colony Building, Chicago.

Digitized by Google

The Colorado Springs Electric Company.

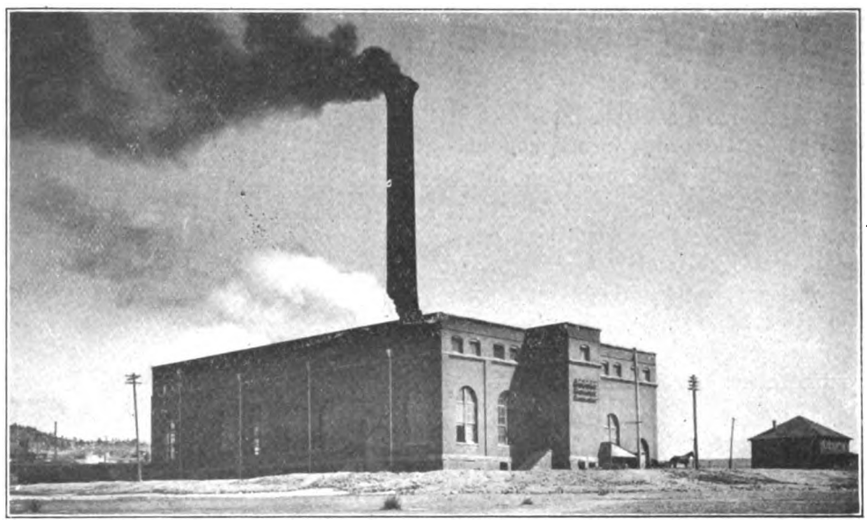
By E. P. Dillon.

THE history of the system now owned and controlled by the Colorado Springs Electric Company makes an interesting story and is characteristic of the substantial growth and development of the West.

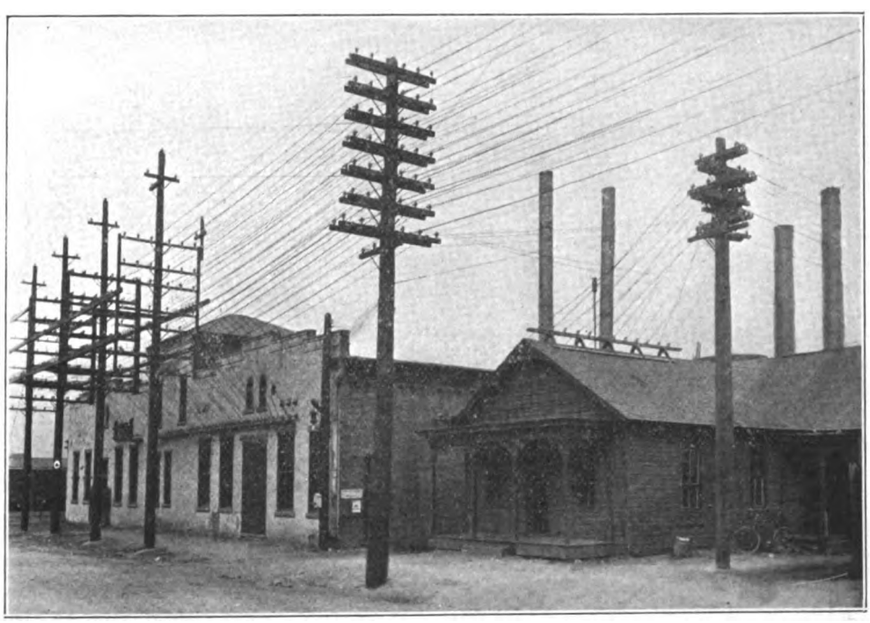
The first central station in Colorado Springs was installed in 1886, and consisted of a fifty-horse-power engine belted to a 600 sixteen-candle-power light Edison generator. This capacity was increased from time to time, being doubled in the second year. In 1899 the plant was moved to the site of the present Colorado Springs substation on Cucharras street.

An important historical note is that the Westinghouse company installed a 1,000-volt alternating-current generator at the new plant. This was the second alternating-current generator to be installed in the United States.

The Colorado Springs Electric Company was organized in 1900 and took over the property of the El Paso Electric Company, and began at once to construct the large steam-generating station at Austin Bluffs. This location was chosen because of the close proximity to extensive lignite coal banks, which are operated by a local coal company. The coal from these mines furnishes a very cheap fuel in the form of slack, or mine-run when the slack does not suffice. The mine is situated about 1,500 feet from the power-house, and the coal is conveyed to the boiler-room conveyer by a two-car gravity surface tram. From here the coal is taken in a conveyer and distributed to the bins in front of the boilers. A good supply of feed water is obtained from a large pipe-line running close to the plant and supplied from a reservoir in the mountains to the north. This feed water is a very fair quality for boiler purposes. A storage reservoir of 500,000 gallons capacity offers an adequate reserve for feed-water purposes, being located adjacent to the plant.



MAIN GENERATING PLANT, AT AUSTIN'S BLUFF, OF THE COLORADO SPRINGS ELECTRIC COMPANY.



SUBSTATION "A," COLORADO SPRINGS ELECTRIC COMPANY.

POWER-HOUSE.

The power-house is of red pressed brick and sandstone trimmings, adequately lighted by large windows. The roof is supported on steel trusses which extend the entire width of the building and are supported near the centre by a brick partition which divides the engine room from the boiler room. The floor of the engine room is supported on steel beams resting on cast-iron bearing-plates in a masonry wall. The engine room is served with a twenty-ton Maris Brothers' hand-power traveling crane which extends the entire width of the room, running the full length of the power-house on sixty-pound T-rails placed on heavy I-beams, which are in turn supported on brick pilasters built up from the building foundation.

The boiler room is sixty feet by 160 feet nine inches, its floor level being nine feet below the floor level of the engine room. The boiler equipment consists of five Aultman-Taylor boilers of the Cahall horizontal sectional water-tube type of 400 horse-power each, set in five batteries; two Babcock & Wilcox water-tube boilers of 500 horse-power each, set in two batteries, thus making a boiler capacity of 3,000 horse-power. The working steam pressure is 160 pounds. The stack, which furnishes natural draught for the boilers, is steel, self-supporting, being 101 feet six inches high above the capstone of the pedestal, and nine feet six inches inside diameter. The pedestal is built of brick and extends from the foundation to a height several feet above the roof of the building. The total height of stack and pedestal is 170 feet. The steam piping is designed on

Digitized by Google

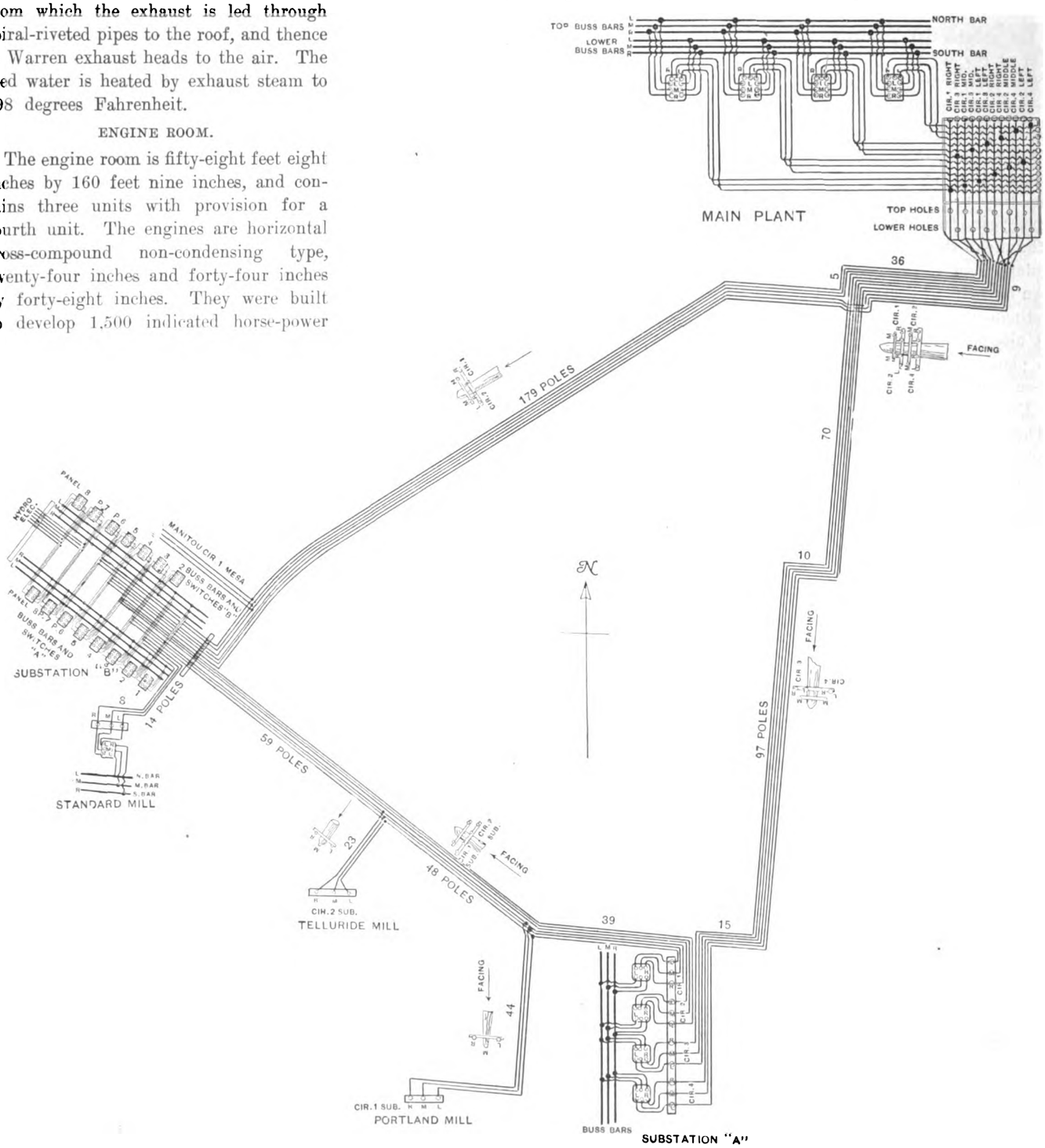
the feeder and main principle and embodies long sweeps between boilers and header and long easy bends to the engines. Between engines and header are separators which serve as steam reservoirs as well as separators. Each engine exhausts into a common cast-iron header, from which the exhaust is led through spiral-riveted pipes to the roof, and thence to Warren exhaust heads to the air. The feed water is heated by exhaust steam to 198 degrees Fahrenheit.

ENGINE ROOM.

The engine room is fifty-eight feet eight inches by 160 feet nine inches, and contains three units with provision for a fourth unit. The engines are horizontal cross-compound non-condensing type, twenty-four inches and forty-four inches by forty-eight inches. They were built to develop 1,500 indicated horse-power when operating at 150 pounds steam pressure and running at ninety revolutions per minute. The engines were built by the International Power Company. Each engine is direct-connected to a General Electric 750-kilowatt, three-phase, 6,600-volt, sixty-cycle revolving field generator. Each unit is equipped with a 70,000-pound flywheel twenty feet in diameter. Experience has shown that these units operate very smoothly in parallel. The two main exciters are General Electric make, having a capacity of fifty kilowatts at 125 volts. They are direct-connected to Ames Iron Works high-speed engine.

The automatic potential regulator installed in this plant gives excellent regulation on the system, notwithstanding that the load is composed chiefly of induction and synchronous motors. To facilitate the operation of the regulator a small motor-generator set was installed to separately excite the shunt-fields of the main exciters. The regulator works on the shunt of the separate exciter. This removes the regulator several steps from the main generator, but practice has demonstrated that the scheme is satisfactory.

The switchboard is of marble and carries sufficient instruments to keep an accurate record of the performance of the



PLAN OF THE DISTRIBUTION SYSTEM OF THE COLORADO SPRINGS ELECTRIC COMPANY.

Digitized by Google

plant. Each unit is given a separate panel, as well as each outgoing circuit. The switches are oil-type, hand-operated, nearly all being three-pole double-throw. The switches, rheostats, instrument transformers, etc., are placed beneath the floor and are hand-operated from switch-point panels. From the switchboard the circuits pass through the lightning arrester room, thence out of the building to the line. The voltage of the line is 6,600 volts, or the voltage of the generators. Each circuit is equipped at the main plant with non-arcing lightning arresters, each leg carrying four 2,000-volt double-pole arresters, placed in a vertical row, and so connected as to give a series multiple path to the ground. This arrangement has proven very satisfactory on this system, and has given much better service than the former method of placing each arrester in a horizontal position and compelling the discharge to take an irregular path to the ground.

THE TRANSMISSION SYSTEM.

The transmission is arranged in the form of a triangle with the main plant, substation "A," Colorado Springs and substation "B," Colorado City, at the angles of the triangle. As will be seen from the map of the system, each pole line carries a double circuit, consisting of three No. 1 copper wires placed sixteen inches centres. The poles are mostly forty feet Oregon white cedar, set on an average 100 feet apart. An inspection of the diagram of the transmission system shows that duplicate service is assured at each of the substations.

SUBSTATION "A."

Substation "A" is located on West Cucharras street, Colorado Springs, and is the original plant of the El Paso Electric Company. This substation is the main distributing point for both commercial and street lighting in Colorado Springs and Colorado City. The voltage is stepped down from 6,600 to 2,300 volts, at which pressure the lighting service is distributed. This transformation is effected through four 375-kilowatt oil water-cooled transformers. The substation also has a twenty-four-inch by forty-inch simple non-condensing Frick-Corliss engine belted to line shaft, and one 100-horse-power Westinghouse engine direct-connected by means of clutches to the line shaft.

The boiler equipment at the substation consists of 1,500 horse-power in water-tube and tubular boilers, with all necessary feed pumps, water heaters, etc. High-pressure steam is maintained throughout the year for service to laundries, hotels, etc., for laundry and cooking purposes. Through the heating season the engine is operated and the exhaust steam is used in connection with the low-pressure heating system in Colorado Springs. The line shaft to which the engine is belted drives a 150-kilowatt bipolar and two seventy-five-kilowatt, multipolar 500-volt generators, and also a 300-kilowatt, three-phase, sixty-cycle, 2,300-volt generator. The 500-volt machines are used for supplying direct-current power service to elevators, motors, etc., within the business district of Colorado Springs. The three-phase

INTERIOR OF ENGINE ROOM, AUSTIN'S BLUFF PLANT, COLORADO SPRINGS ELECTRIC COMPANY.

Digitized by Google

generator is connected in the secondary side of the main transformers and operates either independently or in parallel with the main generating station when running as a generator through the heating season. When the engine is out of commission this alternator is used as a synchronous motor to drive the 500-volt generators above mentioned. The use of this synchronous motor is a considerable help to the system, as it is used partially as a rotary condenser to improve the power-factor of the system.

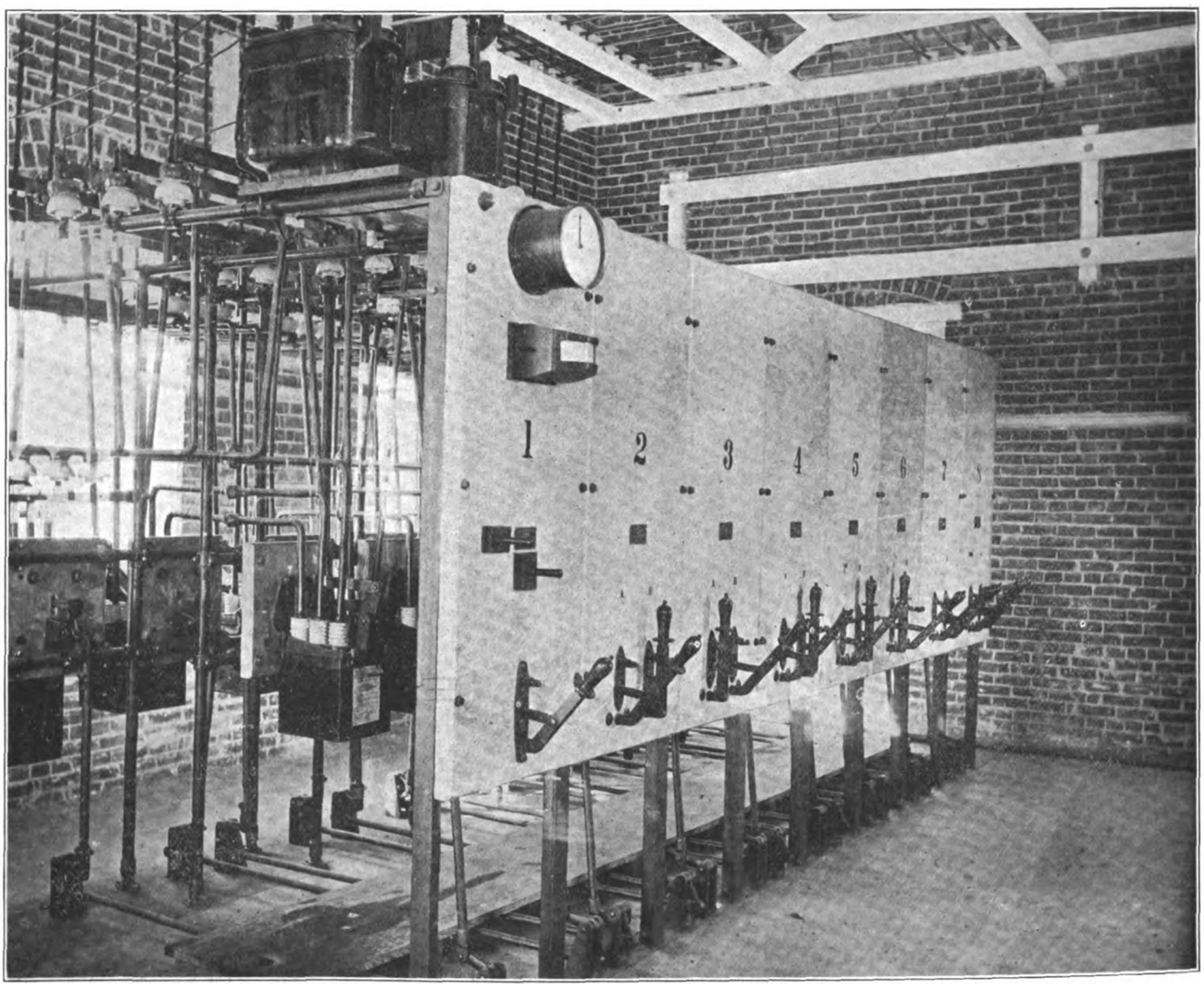
The lighting service is distributed single-phase from the main 2,300-volt bus-bars in fifteen distinct circuits. Each circuit is equipped with a potential regulator, and the regulation is determined by charts which have been established for each circuit by means of tests. The transformers on the distribution are banked in the congested districts, and in outlying districts are so placed that each transformer will serve a moderate area. The distribution system is equipped with lightning arresters, both at the station and at various points on the line.

The arc-lighting system at Colorado Springs and Colorado City consists of six fifty-light tubs, which are supplied from the 6,600-volt bus-bar. These regulators are the 6.6-ampere constant-current regulators.

SUBSTATION "B."

Substation "B," located in Colorado City, between Eighth and Ninth streets, just south of Colorado avenue, is more of a switching station than a distribution station. This substation was installed to take care of four transmission lines meeting at this point, and also to receive the two lines from the Pike's Peak Hydro-electric plant, located at Manitou. This substation contains no transformers except potential transformers, all the lines being at the voltage of the transmission system.

The switchboard at this point consists of an eight-panel marble board, only one of the panels carrying instruments. The bus-bars are arranged in duplicate, and all bus-bars, switches and wiring for the switchboard are carried on a special gas-pipe frame at the rear of the board. Each panel is equipped with two switches, one for each bus, and these switches are interlocking, so that only one switch at a time can be in service on each panel.



SWITCHBOARD, SUBSTATION "B," COLORADO CITY, COLORADO SPRINGS ELECTRIC COMPANY.

The only instruments used in this substation are a voltmeter and a synchronism indicator, to be used in case the bus-bars at this point should be operating on separate plants.

Each line coming into the building is thoroughly equipped with lightning arresters, the arrangement of the lightning

Digitized by Google

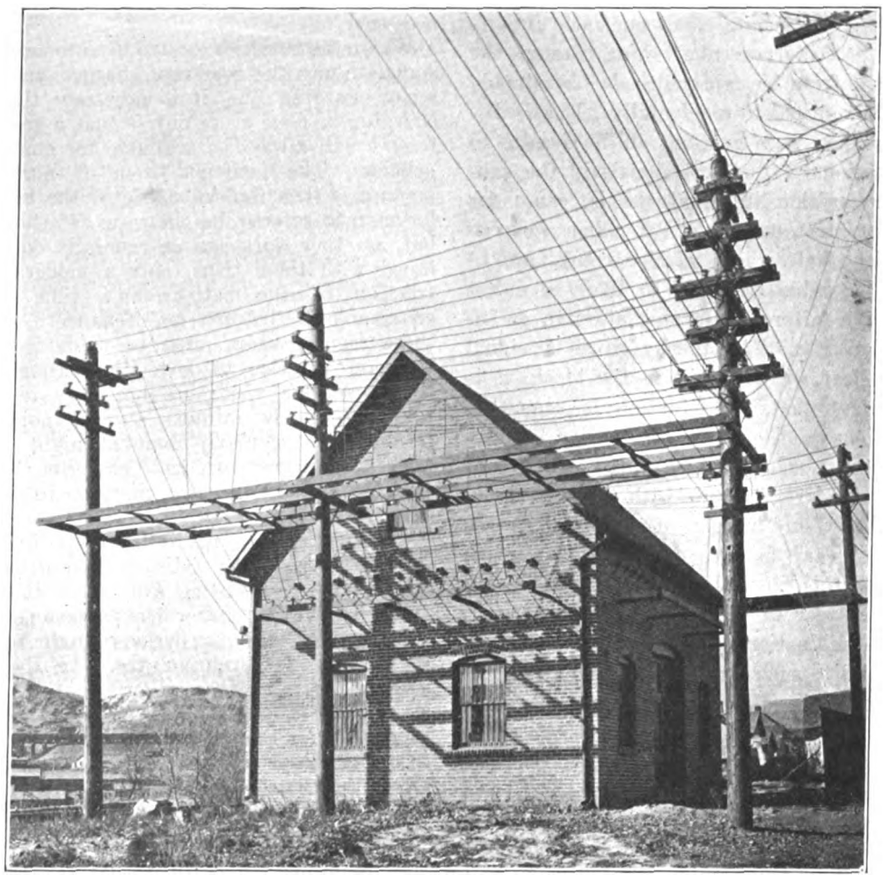
arresters being the same as at the Austin Bluff's plant.

The Standard mill, one of the largest power consumers on the system, is fed from this substation by a single circuit.

The Portland mill, another large reduction mill, has a circuit which branches from the main transmission line close to substation "A," as shown on the map.

The Telluride, which is not now in operation, also has a circuit branching from the main transmission line.

Each of these mills has its own transformer substation, where the voltage is stepped down from the line voltage to 460 volts for motor service. The motors are of both the induction and synchronous three-phase types, and vary in size from five horse-power to 300 horse-power.



EXTERIOR OF SUBSTATION "B," COLORADO CITY, COLORADO SPRINGS ELECTRIC COMPANY.

Each substation at the mills is thoroughly equipped with marble switchboards, oil switches and lightning arresters. The connected capacity in motors at these mills aggregates 4,000 horse-power.

A very accurate record is kept of all power generated, coal consumption and water consumption, along with the incidentals, and all the large power consumers are on meter basis.

INSTALLATION AND MAINTENANCE OF STORAGE BATTERY FOR TRACK CIRCUITS.[1]

BY C. C. ANTHONY.

The storage battery is particularly well adapted to meet the conditions of the track circuit as here outlined. The electromotive force of a single cell is comparatively high, much higher than that of other batteries commonly used on track circuits, and is fairly constant; for, although the range between maximum electromotive force at full charge and the minimum at discharge is wide, the actual variation on discharge in regular service is very moderate. At the same time the internal resistance is so low that it is necessary to use artificial resistance which has the advantage that it can be adjusted to the requirements as exactly as may be convenient and is free from variation.

A further advantage is that one storage battery can be used to supply track circuits and other circuits at the same time; the internal resistance is so small that variations of the current in one circuit cause no noticeable changes in the difference of potential at the battery terminals and consequently no fluctuations of the current in any other circuit. Finally, the storage battery is not seriously affected by very low temperatures and, for the low rates of discharge common on track-circuit signal work, does not require underground or otherwise protected shelters.

The cells can be placed above ground in a suitable cast-iron base of a signal post or in a case or box between the bracing in the leg of a signal bridge. If the battery is charged in place care should be taken to provide ventilation so that the fumes will be carried off and to protect thoroughly any ironwork near the battery; partitions separating the battery from instrument compartments should also be impervious to the fumes.

Where the method of alternate charging and discharging is employed, that is, if duplicate sets of battery are installed and one cell of a pair is charged while the other is supplying current, a simple double-throw multiple switch is used for each pair of cells. When this switch is in one position the two terminals of one cell are connected to the charging circuit and those of the other to the circuit to be supplied, and *vice versa*. If cells at a number of points are charged in series on a special charging circuit, an additional double-throw switch is needed for each pair of cells, by which the charging line may be connected as a loop to the "charging" switch previously mentioned, or disconnected and cut through.

It is a tradition of the track circuit that both the relay and battery should be located as near as practicable to the point of connection to the rails so that the wire resistance between them and the track will be very small. This rule has no application to storage battery, however. Since resistance must be introduced between the battery and track part of this resistance may just as well be in the connecting wires as in coils made specially for the purpose. The battery can therefore be located at a considerable distance from the end of the circuit on the track, if there is any advantage in doing so, and the artificial battery resistance can be reduced by an amount equal to that of the long leads.

The resistances are simple coils of any convenient form; the chief requisite is that the wire and the surface be large enough so that the current flowing when the track is short-circuited will not cause overheating. Where the same battery is used to supply other circuits it may be

[1] Abstract of paper presented before the Railway Signal Association in New York, May 23, 1905.

Digitized by Google

an advantage to provide the resistance coils with iron cores so that they will act as choke coils to prevent the passage, between the track and other circuits, of discharges due to lightning.

It is usual, in this double use of the battery, to insert two resistances on each track circuit, one in connection with each pole of the battery, so that neither side of the other circuits connected with that battery will be grounded on the track. There is a good deal of doubt in the mind of the writer as to whether there is any advantage in this arrangement; it is a question whether it is not better to have one side of the signal circuits grounded so that an accidental ground on the other side may show itself by cutting out a signal before worse trouble is caused by a combination of grounds on that side of the circuit in which the circuit-breaking devices are connected.

It is practically necessary to settle upon one resistance and use it on all circuits of the same general character. For a single cell of storage battery electromotive force about two volts, a resistance of two ohms is found to be satisfactory with relays adjusted to pick up with 0.015 watt. Where the batteries are used for signal and track circuits two coils of one ohm each are put in. The current taken on short-circuit of the track is of course about one ampere.

Supplying two or more track circuits from the same single-cell battery, especially the long circuits used with automatic block signals, has not proved altogether satisfactory in practice. The principal trouble has, however, been caused by the stray currents in the earth, coming from electric roads. Where two track circuits are practically in connection with each other through the small resistances used with one cell of storage battery, these currents are likely to cause disturbances that would not occur if the circuits were entirely separate. It may therefore be laid down as a general rule that each long track circuit should be insulated on both rails at both ends and should have its own source of current.

The same battery used for a track circuit may, without any practical disadvantage, supply current to insulated signal circuits, although it is safer if these do not extend to any great distance and are not connected to a general common return wire, as perplexing troubles due to grounds at distant points may thus be avoided.

For the actual work of installing the cells the first and last word is, follow the directions. Cells rated at eighty ampere-hours, normal charging rate ten amperes, are quite satisfactory for single track circuits or for one track circuit and one or two signal circuits in connection with it. The chief difficulty, where the method of series charging is used, is to furnish the normal charging current for the initial charge. The current is likely to be limited by the resistance of the charging line to a point below the normal charging current for the battery so that, even though only a few cells are charged at a time, it may not be possible to send that amount of current through them.

The disturbing effect on track circuits of the stray currents flowing through the earth from electric railroads has already been referred to incidentally. If this disturbance were confined in its results to occasional failures of signals in the danger position it might not be cause for very great concern. But when we consider that, where such currents are of considerable strength, so likely a defect as the failure of the insulation in an insulating rail joint may cause a signal to clear with a train in the block, it is evident that the situation is somewhat serious; and as the area covered by electric railroads increases and the volume of return current grows with the increase in number and weight of cars, the danger of "clear" failures of automatic signals from this cause is undoubtedly increasing from year to year. Alternating current, in combination with relays adapted to respond to such current only and to be unaffected by direct current, has of course already been used to a limited extent for track circuits on electrically operated roads; and, unless operation of electric roads by alternating current should have a very rapid introduction, it seems not unlikely that the use of alternating current as a protective measure on the track circuits of steam roads may become urgent in the next few years.

With the alternating current used on the track circuits, one advantage of the storage battery, that of furnishing for a reasonable time a local source of current unaffected by accidents to the power line or generator, would of course be lost, and all efforts would have to be devoted to placing the lines and generating plants practically beyond the possibility of any prolonged failure. The line is the most serious problem, but it is safe to say that, under the pressure of necessity, by thoroughly substantial construction it could be made reliable; although it might be necessary to place it in conduit under or near the surface of the ground. However, the considerations need not as yet withdraw all attention from the storage battery.

The maintenance of the storage battery, to whatever use it is put, is well covered by the directions of the makers. It naturally happens, however, that some differences of method develop in different localities. The conditions on automatic block signal circuits are very favorable for the battery. The cells are chosen of such size and are so handled as to maintain a good reserve capacity against a breakdown of the power line; consequently they are worked at a low rate and are never, in regular service, carried anywhere near full discharge. As a result it is rare that any defect develops and very frequent inspections and elaborate tests seem hardly necessary.

Where the batteries located at automatic signals along the road are charged on a series charging line, it is necessary that charging be done every day so that a good reserve will always be available for emergencies. The principal item of maintenance is then the daily trip of the batteryman to reverse the charging switches; but, as other work can be generally combined with these trips, only a moderate fraction of the batteryman's time is chargeable to battery maintenance. As these regular visits must be made it is common practice to have the batteries tested at each visit; the necessary tests take only a few minutes at each point. Charging is regularly done at night so that the inspecting and changing of switches is done while the charging line is dead.

On the Pennsylvania railroad one hundred and forty-two cells in one group have been in service an average of three and a half years. Other groups have been working for various periods from two years down to seven months. In these 990 cells, with an average service of about a year and a half, six new elements have been used for renewals, three broken jars have been replaced, and four carboys of electrolyte and a small quantity of distilled water have been used on account of evaporation. Part of these cells are of eighty-ampere-hour capacity and part 160-ampere-hour.

Automobiles and Electric Cars for Lima, Peru.

A. L. M. Gottschalk, United States consul at Callao, Peru, states that the Empresa del Tranvia Urbano de Lima (Lima Horse Car Company) will receive proposals from the United States for the material which it intends to purchase in order to transform its present line into an electric trolley road. The company will need some forty-five cars, with a seating capacity of forty persons each. These are to be run by overhead trolleys. It will also purchase wires, rails, transformers, rotaries, etc. American exporters of these classes of goods should address Señor D. Joaquin Godoy, Gerente, Empresa del Tranvia Urbano, Lima, Peru, sending plans and proposals, and not English catalogues merely.

Digitized by Google

THE CHOICE OF AN INSULATED CABLE.[1]

BY WALLACE S. CLARK.

Every plant generating electric current uses insulated cables—in many cases only for station wiring; in others for its entire distributing system. The company that buys twenty-five or more miles of cable each year can and does devote a liberal allowance of engineering skill to the selection of the best and most economical types. There are a very large number of plants of moderate size that, with the growth of their business and the increasing tendency to substitute underground for overhead construction, are compelled to increase continually their investment in this line. Some of the points covered in this paper will, I hope, be of value to those responsible for the success of such plants.

The size of the conductor is determined by well-known methods, therefore it is only necessary to emphasize some points usually overlooked. There are two distinct conditions of service. One where the amount of current is not subject to any probable increase, such as instrument, generator and transformer leads; the second comprising all lines outside of the station that may be subjected to increasing loads due to the growth of business.

For the first class, ampere (current-carrying) capacity, or mechanical strength in the case of small apparatus, is the determining factor. The current-carrying capacities given in the National Electric Code for rubber insulation are a fairly safe guide and the current densities given should not be exceeded.

For the second class of conductors, the cost of power at the switchboard, the load-factor of the line, the limits of loss in transmission for satisfactory regulation of potential and operation of consuming device, the heating of the cable in short lines, the probable increase in load with time and the interest charge on the cable investment are the principal factors in settling the size of conductor to be used. The Thomson law, so-called—that the most economical arrangement is where the cost of the power wasted and the interest charge on the cable investment is a minimum—is the basis of many formulæ elaborated in different books.

Having determined the size of conductor required on theoretical grounds, consideration should be given one or two very practical points. First, do not use for underground construction cables so small as to be mechanically weak. I have in mind a station with a 6,600-volt distribution where the cables ran from three-conductor No. 0000 to three-conductor No. 6 in size; the No. 6 constituting the smallest part of the installation and giving more trouble than the entire remainder of the system.

Second, if you use a duct system, keep in mind the fact that the cost of duct per foot is independent of the size of the cable in the duct, and select the size of conductors so that the cables will utilize a reasonable proportion of the duct area. Two No. 8 arc-light cables, single-conductor, in a three-inch duct, costing from twenty cents to forty cents per duct-foot, is evidently uneconomical. The standard three-inch duct will take cables of the following sizes, insulated for different voltages: any voltage under 1,500, single-conductor cables up to 2,000,000 circular mils; concentric two-conductor cables up to 1,000,000 circular mils; three-conductor cables up to 500,000 circular mils.

For 3,000 volts, single conductors up to 1,500,000 circular mils; concentric up to 750,000 circular mils; three-conductor up to 400,000 circular mils.

For 6,600-volt lines, which are practically all three-phase, the limit is found at three-conductor, 250,000-circular-mil cable; 12,000-volt lines, the limit is found at three-conductor No. 0000 cable; on 24,000-volt lines at about 100,000-circular-mil cable. It is assumed, of course, that the three-conductor cables are run on delta-connected circuits, and have the same wall of insulation between conductors and ground as between the conductors themselves. If the three-phase circuit is run Y-connected with neutral grounded, then the outer jacket of the three-phase cable can be made considerably less in thickness and larger cables be installed in the standard three-inch duct.

Fig. 2 gives some curves showing the variation in cost per 1,000 circular mils of copper contained in the cable for different sizes of cables and different working electromotive force. It will be noted that the lack of economy in the use of small conductors is most marked in the 15,000-volt class, where changing the size from No. 8 to No. 6 wire increases the cost less than four per cent, while the conductivity is increased fifty-eight per cent. Or, taking the larger sizes and going from No. 1 to No. 0, the cost is increased eight per cent and the conductivity twenty-six per cent.

These figures and curves are based on varnished cambric cable, as this type of insulation is roughly midway in price between good rubber cable and good paper cable. With paper insulation the comparison would be less favorable to the larger conductors, while with rubber insulation the use of the larger conductors would show much greater economy.

There is another point especially noticeable in the use of potentials above 5,000 volts, and that is that the safe working pressure for a given thickness of insulation is less in the very small sizes of conductor. Or, to put this in another way, where the thickness of insulation exceeds twice the diameter of the copper core in high-potential cables with homogeneous insulation, we are not able to get the full advantage of the insulating wall, since the fall in potential, or potential gradient, is undoubtedly higher in the layer of insulation immediately adjoining the copper than it is half way between the copper and the outside of the cable; this concentration of pressure tending to break down first the inner layers of the insulation and finally puncturing the entire insulating wall. In short, it is easier to make a 500,000-circular-mil cable for 10,000 volts working pressure than to insulate a No. 14 wire for the same purpose.

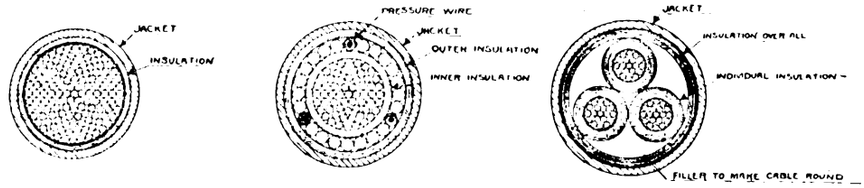


FIG. 1.—THREE CABLE SECTIONS.

The next point to be covered is whether single or multiple-conductor cables should be used. For station wiring single conductors in separate ducts, or runways, might safely be taken as the best modern practice. Maximum safety and reliability, and simplicity of arrangement, appear to have settled this question pretty definitely. For outside lines the service will largely decide. Direct-current railway feeders are normally single conductor.

When ducts are high in cost and the load on one feeder is not heavy enough to require a cable utilizing most of the duct space, two feeders may be combined,

[1] Read before the National Electric Light Association at its twenty-eighth convention, held at Denver-Colorado Springs, Col., June 6-11, 1905.

Digitized by Google

as long as their course is parallel, in a concentric type of cable if it is desirable to preserve their identities to the switchboard. If it is not important to run the cable as separate feeders back to the switchboard, we may bunch two or more cables by means of a junction box into a single large cable which will run back to the generating plant; as, for instance, three 500,000-circular-mil cables might be multiplied and a 1,500,000-circular-mil cable run back to the station. This cable is readily installed in a standard three-inch duct, and there would be a saving in first cost of cable, a saving in duct investment and in switchboard.

For low-tension mains on the three-wire system, either three single-conductor cables or one three-conductor cable can be used. The three-conductor cable is slightly cheaper in first cost but not nearly as convenient for making taps to customers. Theoretically, with alternating currents there is a slight advantage in the use of the three-conductor cable. For low-tension feeders, which usually exceed 250,000 circular mils in size, the concentric type of cable should be used for maximum duct economy. Smaller than 250,000-circular-mil cables may be run as a flat twin conductor, and this type of conductor is always advisable for alternating-current feeders with manhole transformers. It should be noted here that it is a modern practice, and one to be commended, in running a three-wire system to ground the neutral and run the feeders simply as two-wire feeders, providing a tree or trunk neutral to which the different points of distribution are connected and which runs back by means of a very heavy cable to the station.

The common practice in arc circuits is to use single-conductor cable. Where a number of circuits are in parallel for any distance an excellent plan is to combine them into a multiple-conductor cable. This saves in first cost, in cost of installation, and in cost of ducts. If a number of small leaded cables are run in one duct, which is necessary in order to keep the duct investment reasonable for the arc circuits, one cable burning out in a duct is very likely to injure the others. Further, the cables are liable to mutual injury when being installed, and it is quite difficult to draw out one cable without damaging the others. These are defects that may be avoided if a multiple-conductor cable is used.

Single-phase two-wire lines not exceeding No. 0000 size should be run as twin conductors unless numerous taps are made.

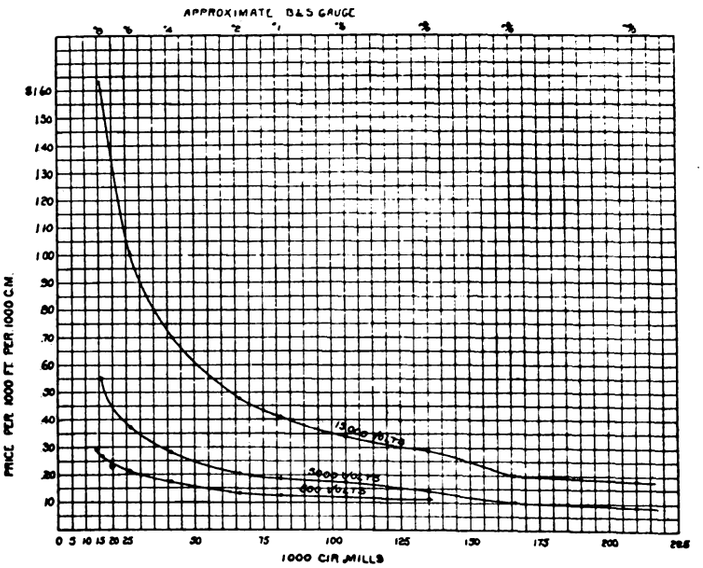


FIG. 2.—VARIATION IN COST PER 1,000 CIRCULAR MILS OF COPPER FOR DIFFERENT SIZES OF CABLES AND DIFFERENT ELECTROMOTIVE FORCE.

in which case the greater convenience in making joints may justify the use of the single-conductor cable. The concentric type of cable for single-phase work is losing favor in England and on the Continent and has never been in favor in this country. The most serious objection is that in a large network of concentric cable on single-phase or three-phase alternating circuits, great care is required in switching, since the outer conductor has a very much higher electrostatic capacity to earth than the inner conductor, giving rise to surging of the voltage and current and to burn-outs. For three-phase work, three-conductor cables, and for two-phase (quarter-phase) four-conductor cables are required, both on economic and engineering grounds.

Types of Insulating Material for Different Services: (*a*) Station Wiring—I believe the majority of engineers who have had experience in central-station construction now consider that cables without metallic sheaths are better than leaded or other metal-sheath cables for this class of work. The lead sheaths are generally grounded, and must be grounded in a high-tension system to prevent the accumulation of static charge. These grounded lead sheaths offer the arc from any conductor to earth in their neighborhood a ready inducement to spread and cause trouble on adjoining cables. The lead sheath on circuits exceeding 5,000 volts, and on all voltages if the cable is paper or fibrous insulation, must terminate in an end bell or pothead to prevent the breakdown of the cable at the terminus of the lead sheath. This end bell in addition serves as a seal to prevent the absorption of moisture in the case of paper or similar cable.

Cables for tensions not exceeding 750 volts that can be run in dry non-metallic ducts without pocket, where water may collect, or on suitable incombustible insulators—porcelain, glass, slate shelves, concrete, etc.—require insulation only to prevent shocks to operatives and short-circuits due to mechanical causes, such as a workman dropping a wrench or bar across two bare conductors. An excellent type of cable for this work is one insulated with varnished cambric tapes and asbestos (asbestos being on the outside), finished with a flame-proof braid. Such a cable can be operated continuously at the boiling point of water without injury. The varnished cambric, being enclosed in asbestos, does not introduce any additional fire risk, as do weatherproof or rubber cables. The rate of deterioration is less than with other types and the cost low. The first use of this type on a large scale was in the Harrison street station of the Chicago Edison Company in 1893. Since then they have been largely used in station practice and have never given any trouble; they have in one or two cases come through fires practically uninjured.

For pressures of 1,000 volts and upward we must use rubber cables of good quality, or some satisfactory substitute. Such cables, unless protected by individual fireproof runways, should be protected on the outside by an asbestos jacket. This jacket will prevent fire following along the cable or bunch of cables; it also acts as a protection, to a considerable extent, from the destructive action of an arc from an adjoining conductor.

If rubber insulation is used it should be of good quality, and such cables can not be cheaply made, owing to the present extremely high price of the better grades

Digitized by Google

of crude material. Rubber cables should not be operated at temperatures exceeding 125 degrees Fahrenheit if reasonable long life is expected of the insulation. Lower operating temperatures are most desirable, as they will do much to prolong the life of the insulating wall. Higher temperatures cause very rapid deterioration of the insulation. In England, and to a less extent on the Continent, various patented compounds, made usually from oils and bitumens, have been tried, and with fair success, on low-tension work, and where they are not subjected to any high degree of heat. These cables are not adapted to the high temperatures that prevail during summer in most stations, nor will they give satisfaction when run at the high-current densities common in this country. The best that can be said of these insulations is they are more or less successful imitations of vulcanized rubber and generally have all the faults of rubber insulation more or less exaggerated.

You are all no doubt familiar with the large use of oil varnish films in the insulation of electrical apparatus such as transformers, generators, motors, etc., usually used in combination with some woven fabric to give mechanical support to the film. Six years ago, after extended experience with this type of insulation, the company with which I am connected became convinced of the value of the insulation for cable work, especially on cables of large size or for very high voltages. The insulation developed consists briefly of cloth tapes especially treated and coated on both sides with multiple films of varnish. These tapes are applied to the cable, and between the tapes is a thin film of plastic insulating material which does not dry or become hard. The function of this plastic layer is to increase the flexibility of the cable by allowing the tapes to slide one upon another when the cable is bent. Cables thus insulated are tested and finished the same as rubber-insulated cables with braid, lead or any other desirable finish.

This type of insulation has all the good qualities of paper cables. It will withstand as high temperatures; it is more flexible; has a considerably higher dielectric strength; and finally, most important of all, does not absorb moisture and can be used in interior work without a lead jacket. The varnish and cambric insulation, which we will speak of as V. C. for the sake of brevity, will not decentralize or deteriorate under temperatures destructive to rubber insulation. Mineral oil will not rot it. So far as data are obtainable, its rate of deterioration is less than that of vulcanized rubber of the best quality under like conditions. Its dielectric strength is fully equal to that of rubber insulation. The method of manufacture is one ensuring a homogeneous insulation of uniform dielectric strength—a point extremely difficult of attainment in rubber-insulated cables for high voltages. This type of insulation, I believe, is especially suitable for station wiring in the higher potentials and larger sizes of cables. It lacks only one quality to make it approach very closely the ideal—it is not in itself fireproof; neither is rubber, nor paper. Like rubber-insulated conductors, it may be flame-proofed with asbestos on the outside, or, in fact, with any available material that can be used over the other insulations. It has not as yet been applied to very small conductors for potentials below 1,000 volts; for these rubber is at present the best available insulation. For small conductors for high tension an inner wall of rubber and an outer wall of varnished cambric make an extremely effective cable and one much cheaper than cable built entirely of rubber.

Passing to conductors outside of the stations, these may be roughly divided into transmission lines practically always operated at potentials of 4,000 volts or more and running to substations. The second class of cables comprises the distributing systems with feeders seldom exceeding 3,000 volts and mains to which customers are directly connected operating at 500 volts or less. Circuits outside of the station using insulated cables are practically all underground. There are a few cases where high-tension leaded cables are run on pole lines supported by a steel cable similar to telephone practice, but this may be regarded as a temporary expedient.

Underground construction in this country consists almost entirely of lead-jacketed cables in conduits, the most permanent type of duct being thoroughly vitrified tile. For installations where electrolysis can be guarded against, or is not to be feared, paper-insulated lead cables give thoroughly satisfactory service when carefully installed. Where severe electrolysis is counted on or where the ducts are filled with water for considerable lengths of time varnished cambric or rubber leaded cables should be used to ensure against interruptions of service.

There are some successful installations of rubber cables, not lead-sheathed, in operation. It is, however, questionable if this is the best practice, since the ultimate life of the leaded cables will, I believe, be sufficiently extended to warrant the extra cost of the lead jacket.

Services to customers are installed in short lengths, although amounting to a considerable proportion of the cost of an underground system, and are most convenient when insulated with a material not requiring special sealing of the ends to protect against the absorption of moisture, and it is a common practice to use rubber-insulated cables for this purpose. We believe varnished cambric to be equally well suited to the requirements.

Where subaqueous lines are called for various constructions are possible. With narrow, shallow streams or canals the line of conduits may be dropped with deep manholes and the ducts carried underneath the bed of the stream. This usually necessitates draining the ducts toward one manhole and providing a small pump to keep the manhole clear of water seeping in. Wide shallow streams can have a trench dredged or dug across them and cables with band steel armor laid in the trench which will usually be rapidly filled with silt. For deeper streams or wider streams armored submarine cable is required. A method used with success in some cases is to lay a cast-iron water main with specially bolted ball and socket joints along the bottom of the river and to draw an unarmored leaded cable through it. Tunnels can, of course, be used, but except for a very heavy line containing a number of cables this construction is extremely expensive, and it is cheaper to install one or more spare cables which can be switched into service in case of accident to one of the operating cables. It is perhaps well to mention here that where a submarine cable or underground cable is inserted in a pole line of any length adequate lightning protection should exist at each end of the cable.

There is one type of cable largely used in England, and almost universally in continental Europe, of which we do not avail ourselves as much as we should for underground work. This is the so-called band iron armored cable. Leaded cable is wrapped with tarred jute, over this with two overlapping steel tapes, each from one-thirty-second to one-sixteenth inch thick. The outer tape covers the butt joint in the inner tape and is protected against corrosion on the outside by an additional jacket of compounded jute. Such cables buried directly in the earth have been giving first-class service in some cases for twenty years. They are in use for pressures from 250 up to 15,000 volts.

Digitized by Google

and lines of even higher potentials have been installed, but for too short a time to be cited.

There are many cross streets where only a distributing main of, say, three No. 0000 conductors is required. A single duct with small manholes every seventy-five feet for service distribution will cost at least fifty cents per duct-foot, including service manholes and omitting all paving charges. Single No. 0000 cables suitable for this use can be armored for approximately eight cents per foot, or twenty-four cents for three cables, showing a direct saving of sixteen cents per foot of three-wire main, allowing ten cents for trenching. If smaller sizes of conductor were used in the comparison the saving of the armored cable over the duct would be largely increased, since the duct charge is fixed, while the cost of armoring is approximately proportional to the size of the cable. With such constructions services can be installed at any point, the joint being protected by cast-iron T-boxes. Such cables are usually installed inside of the curb lines, saving the expense of disturbing expensive pavement. Cables thus installed can run into manholes belonging to the conduit system at either end of the block and be then worked in with the regular distributing system. For service to buildings set back from the street, for an underground system connecting a group of buildings of a permanent character such as a college with fine grounds, where overhead lines are an eyesore, and for complete systems in small cities where the conduit system is too expensive, this type of cable represents a neglected opportunity, I believe, to American engineers.

PROPER REQUIREMENTS AS TO TEST PRESSURES.

Before it is shipped from the maker's factory every cable should be tested with an electromotive force higher than the maximum working pressure. If possible, a similar test should be made after the cable is installed and jointed. As to the relation which these test pressures should bear to the working pressure, the duration of the tests, etc., there exists considerable diversity of opinion. For a good many years the writer has advocated two and one-half times the working pressure for thirty minutes to an hour as a factory test and twice the working pressure for the same length of time after the cable is installed. Cables tested under these requirements have given no indication in practice that the margin of safety was not ample. Some engineers, desiring a higher factor of safety on important and large installations, specify a factory test of three times the working pressure and a test installed of two and one-half times. Any requirement more severe than this represents a questionable investment on the part of the purchaser. It is especially undesirable to make very high potential tests for very short periods of time, since the cable may be decidedly weakened by such treatment, although it does withstand the high-potential test for the brief period specified. In short, the words "breakdown test" should not appear in cable specifications, in the writer's opinion. Boilers are tested to see if they are safe for a given working pressure, but such test is not usually referred to as a bursting test. Cable tests should be considered on the same basis. They are not to show the ultimate strength of the cable, but to show that the cable is safe and satisfactory cable for the purpose for which it is intended.

It should, of course, be understood that the above refers to cables for 2,000-volt circuits or over, since in lower voltages the necessary mechanical requirements frequently call for a wall of insulation sufficient for a 3,000-volt test or even a 5,000-volt test on cables which are to operate at 250 volts. A variation in tests called for by some engineers, which is a very good one, in my opinion, is to test the cable for one hour at two and one-half times the working pressure and at the end of that period to raise the pressure to three times the working pressure for one minute.

Paper cables are not generally tested at more than 2,300 volts for each one-thirty-second inch of wall; rubber cables at 2,500 volts for each one-thirty-second inch of wall; varnished-cambric cables we are enabled to test with 2,800 volts for each one-thirty-second inch of wall. These figures apply, of course, to the ordinary commercial cables as made to-day. They can be exceeded on specially made cables of all types. The size of the cable has a considerable bearing on the pressure test, and the figures above represent the practice on cables running from No. 6 and larger, for working pressures from 2,000 to 20,000 volts.

In concluding this paper I would strongly advise any central-station man who contemplates underground construction to procure a copy of Louis A. Ferguson's paper, read at St. Louis last year at the Electrical Congress, on underground construction, as it contains a mine of valuable information, which, so far as I know, has nowhere else been published.

It is to be regretted that more time and thought have not been given in the past to the selection of the proper types of cable for given uses, as the subject is one which, on account of both its commercial and engineering importance, deserves careful study.

HIGH-SPEED, LONG-DISTANCE ELECTRIC TRACTION.

LECTURE AT THE NEW YORK ELECTRICAL SOCIETY.

The 251st meeting of the New York Electrical Society was held May 24. Mr. Charles A. Mudge, formerly chief engineer of the railway department of the Allgemeine Electricitäts Gesellschaft, Berlin, who took part in the tests on the famous Berlin-Zossen road, lectured on "High-Speed, Long-Distance Electric Traction." Mr. Mudge stated briefly the conditions existing in high-speed traction about six years ago, when the plans for these extraordinary experiments were formulated by Messrs. Ratherau and Schweiger. Continuing, he said, in part:

"As is generally known, these tests were made under the direction of a company organized for the special purpose, and known as the 'Studiengesellschaft für Elektrische Schnellbahnen.'

"The objects of the tests were to make a study of many of the heretofore incompletely, and in some cases, wholly unknown factors entering into electric traction at speeds never before attempted, such as collecting current at high voltages, traction and air resistances, best design of trolleys, motors, transformers, brake gears and trucks, the power required to run at high speeds, the details entering into the construction of the permanent way, and the collection of other data in order to calculate costs of future installations.

"The track selected for the experiments parallels the main line running south from Berlin toward Dresden, and is used by the Ministry of War for giving instruction to the railway corps of the army. The car barn was located five miles from Berlin, at Marionfelde, where the tests were started toward Zossen, fourteen and one-half miles distant, over a track having only two decided curves, of one and one-fourth miles in radius each. The first one occurred three and one-eighth miles from the car barn, the second, seven miles further on, leaving four and three-eighths miles to Zossen. This practically divided the line into three parts—four miles at each end for acceleration, and seven miles for running in the middle—with almost no grades; conditions about ideal for the tests contemplated.

"Power was supplied from a central station seven miles distant, to a cable-house along the line a little over one-half a mile from the car barn, where it was connected directly to the trolley wires

Digitized by Google

through automatic circuit-interrupting devices.

"The apparatus installed in the Allgemeine car differed quite materially from that installed in the Siemens & Halske car, and my remarks will refer only to the apparatus used in the Allgemeine car.

"The car body was sixty-nine feet long and nine and one-fourth feet wide, and was divided into three compartments by a so-called machine room, twelve feet long in the middle, which contained the starting rheostat and high-potential switches, and was not allowed to be occupied while current was on. The other two compartments were utilized for measuring instruments and for passengers, and were connected by a narrow passage through the machine room.

"On either side of the machine room underneath the car floor the transformers were fastened. The six-wheel trucks were spaced forty-three feet seven and five-eighths inches from centres, and the forty-nine and three-sixteenths-inch wheels had a base of six feet three inches, which was increased later to eight feet two and one-half inches.

"Three-phase current was used, and the highest recorded voltage in the car during any test was 14,150. The current collectors were of the sliding bow form, six in number, and placed in groups of three on each end of the car, two bows working in parallel on each plane.

"The weight of the complete car with fifty passengers was 100 tons (2,000 pounds to the ton), which was increased four tons in the last year of the tests by alterations necessary to accommodate the new trucks and by balancing weights.

"The first year, September, October and November, 1901, was what might be termed a 'try-out' period. The entire installation, with the exception of the permanent way, being new, it was necessarily handled with greater caution than it would have been if the apparatus had been of a more standardized construction. Before the car was taken from the works all apparatus was thoroughly tested, and for this purpose a stationary bed plate, having four run wheels, was arranged under each truck, the wheels on the bed plate having profiles similar to rails, and made wide enough for brake straps of dynamometers.

"After all apparatus had been given as thorough a shop test as possible, the car was hauled approximately 500 miles by a steam locomotive in order to loosen it up. After this many different runs were made, the maximum speed attained during this year's test being 100 miles per hour.

"The second year of the tests, September, October and November, 1902, was occupied mainly in determining the train resistance at different speeds, in measuring the power required for different loads and speeds, in determining the losses to the transmission line, in collecting the necessary braking data for computing the coefficients of friction for different speeds, and in determining the alterations necessary to be made in the car and the permanent way, to allow us to run up to 125 miles per hour.

"These tests were conducted up to a speed of only seventy-five miles per hour, as the observations of the previous year showed that the permanent way would not stand much higher speeds. To determine the train resistance as well as the energy absorbed in running the car a distance of four miles, starting at the car barn, was very carefully measured, and all curves, grades and levels were absolutely fixed. This made it possible to correct the observed data so accurately that the recorded results in this year's report are of the greatest value.

"The brake tests made in this year were not as satisfactory as those in the following year, on account of the complicated brake rigging used, which did not allow of easy adjustment, and which I will not therefore attempt to analyze.

"Suffice to say, that the maximum retardation of two miles per hour per second was recorded at seventy miles per hour, with a total brake pressure equal to 155 per cent of the weight of the car. At the conclusion of the tests this year it was found necessary to build new trucks with a two-foot longer wheel base, and to support the car body on the truck frame at some distance from the centre pin. Also to flexibly support the centre pin in the truck, thereby allowing the car body to have a movement of about one inch on each side of the truck centre independent of it, and in a line at right angles to the track. In order to observe the action of the springs and their connecting levers, it was decided to place them on the outside of the frame of the truck. The tests this year were of value in showing what alterations in the car and permanent way were necessary in order to be able to run at higher speeds.

"Data of very great value were secured on the much discussed question of air resistance, and although the formula may not be straightened out to suit everybody, we know positively that if we run our car, for instance, fifty miles per hour we can expect a maximum air pressure of about seven pounds per square foot at the front of it; and if we double the speed we will get four times this pressure, and if we triple the speed we will run into trouble and get nine times this pressure. If we shape the nose of our car properly we will be able to reduce these figures ten per cent. Also if we run our 100-ton car fifty miles per hour on a level track without paying much attention how the front of it is shaped, it will take about 150 horse-power. When we double the speed it will take six times this amount of power; but if we attempt to triple the speed, *i. e.*, to run at 150 miles per hour, we would have to supply about eighteen times the amount of power it takes to run at fifty miles per hour.

"As had been anticipated, the new truck used this year, with its greater wheel base, worked much more satisfactorily than the old one. The feeling that the car body was being carried along by something that knew its business came to all who took part in the tests, and the sense of security when running at high speeds around curves was a comfortable one.

"That was due not only to better designed trucks, and the manner in which the car body was supported on them, but also to the excellent service given by the new eighty-two and one-half-pound rails, the closer-spaced ties, and the more substantial ballast. At the very outset of the tests considerable difference was noticed in the behavior of the car when running above or below 100 miles per hour. At about this speed the car seemed to take on a swinging lateral motion, which at times became so pronounced that it endangered the overhead work, and created a feeling of insecurity in the passengers.

"The cause of this was found to be the unsymmetrical disposition of the motors and transformers on the car. This was ascertained by taking the weight of the car under each wheel, which showed a maximum variation of one and one-half tons in some cases.

"This was counteracted by placing weights along the floor of the car, four and one-half feet from its centre line at each truck, after which no further vibration was noticed, even up to the highest speeds, and the car ran as smoothly as our Pullmans.

"The working of the trolleys was satisfactory after they had been properly adjusted, but it was evident that a more substantial construction would have to be adopted on installations where schedule speeds must be adhered to.

"The enormous brake pressures needed at high speeds to give a comparatively low retardation, show very plainly that our familiar friend, the coefficient of friction, is not going to help us in the same proportion that he is doing at present; but if he

Digitized by Google

doesn't electrical means will most likely help us out. For instance, it was found to take about seven-eighths of a mile to stop the car when running 110 miles per hour, the initial brake pressure being 150 per cent of the weight of the car. If we had some means of keeping the retardation constant, we could have stopped the car in three-fourths of a mile by using the same pressures. Under the most favorable conditions the car could not have been stopped in less than one-half mile when running at 110 miles per hour, which would require a retardation of three and one-fourth mile per hour per second, which is about the limit of braking with this type of braking apparatus. The pre-eminent value of the braking system employed lay in the fact that it never failed in its operation during all the tests made, and the feeling of security which its absolute reliability inspired.

"Basing our ideas upon some of the observations and experiences gained in these tests, we would make use of the following points in approaching a similar problem:

"(1) Keep the car body as near the rails as possible.

"(2) Arrange all heavy pieces of apparatus so that their centres of gravity lie in the centre of the car, or symmetrically placed to it, and as near the earth as possible.

"(3) All apparatus mounted above the car floor should be as light as their design will permit.

"(4) Make the overhead trolley contact above the car, in preference to the side of the car.

"(5) Support the motors flexibly on the axles of the trucks.

"(6) Give the front end of the car a wedge shape.

"(7) Support the car body on the truck frame at some distance from the centre bolt, and allow it a flexibility in a line at right angles to the track, independent of the truck.

"(8) Make the total wheel base of the truck of ample dimensions, and not less than twenty per cent of the length of the car.

"(9) Build the road as straight as possible, and where more than one track is used make them further apart than our present practice would suggest.

"(10) On curves, make the approaches of the elevated side of the track longer than usual.

"If it were possible to have the wheels along the sides of our cars and the rails between the floor and roof lines, we should have very comfortable traveling. Any condition approaching this, as by keeping the car body near the rails, would share in the benefits thus derived.

"A German engineer of considerable prominence has advocated lowering the floor of the car between the trucks, in order to make it ride steadier, utilizing the space above the trucks for second and third-class passengers, or for freight and baggage. Although this might be too radical a change in designs of our standard practice, and would not harmonize as well with conditions here as with those abroad, it would undoubtedly give good results. That all apparatus should be symmetrically mounted in relation to the centre line of the car was very evident as we approached the 100-mile-per-hour figure. Our motors were mounted slightly out of the centre line of the truck, and it was found necessary to use 275 pounds per motor to counteract this.

"The transformers, which weighed three and one-half tons each, were mounted on either side of the centre line of the car body just behind each truck; and a line connecting their centres of gravity did not coincide either with the transverse or the longitudinal centre line of the car. This gave rise to a torsional movement which produced a dangerous swinging of the car when running above the speed referred to, which was overcome by placing weights of about one ton each on the side opposite to that to which the transformer was mounted. The fact was thus confirmed that heavy pieces of apparatus should be mounted in the centre lines of the cars for high-speed service, as they run smoothly only when their weight is equally distributed upon the wheels.

"All apparatus above the car floor should be light. This applies particularly to the trolley construction. If the trolley for high-speed work is to be of a light construction, which is the tendency of most designs abroad, particular attention must be given to the form of the exposed surfaces, on account of the high air pressure, and means must be applied to counteract it. When the current is collected at the side of the car, as in these experiments, any slight swaying of the car is at once felt by the trolley, and the higher the current collectors are placed from the ground the greater is this disturbance. Also the trolley wires as placed in these tests were very sensitive to cross winds, and even to the slight pressure of the sliding bow against them, necessitating spacing the supporting poles closer together than they were originally placed, and stretching the wires themselves with very high tensions.

"If the motors are direct-connected to the axles, a part at least, of their weight should be flexibly connected to it. Motors of this power—250-horse-power normal rating—run into weight, and, both on account of the permanent way and the truck, as much of their weight as is possible should be flexibly supported on the axles. This flexibility need not be great, and can be through the medium of heavy springs. There is a certain oscillation given to all the parts on a car moving at such high speeds, and it often occurs, through the unevenness of the road-bed, of slight inequalities in the rails, or the motion of the car itself, that a certain oscillation of a heavy piece of apparatus will be met out of step. For instance, the motor will be going down just as a part of the rail is coming up and a severe blow will be the result. A little flexibility of these parts will greatly reduce the force of this blow. At speeds over 100 miles per hour it very often seems as if the rolling friction were taking a rest, and that we were actually floating for short distances, after which we notice very distinctly that gravity has not forsaken us, and we can almost hear the rails groan under their extra burden.

"It is at such times that the flexibility of the apparatus is mostly needed; not so much when we pass over rail joints or frogs, as the car doesn't take much notice of them and is far beyond before their effects could be felt; but just at those moments when the apparatus seems to be furthest out of synchronism with the car.

"Since it is impossible to build an absolutely level and straight track, we can help conditions very much, as well as increase the comfort of passengers, by having heavy pieces of apparatus flexibly supported in the car.

"Giving the car a wedge-shaped construction may not be possible when using the vestibuled type with multiple unit control, and no definite end relation, in which case it may be advisable to have a portable wedge-shaped engineer's cab on wheels, capable of being quickly attached to the front of the car in making up the train.

"We found that it was a very good thing to hold the car body firmly to the truck frame at points equally distant from the centre pin, also to allow it a movement independent of the truck, parallel with the axles. The trucks take curves much more quickly than the heavy car body, which requires a certain amount of time to swing it out of its straight line path, and should not be attempted too rapidly.

"It should not receive a blow to turn its nose in the new direction, but a gradually increasing pressure until it is turned out of its former course. This was very

Digitized by Google

well accomplished by the centre pin bearing being mounted flexibly in the truck. The pin was held in its middle position by one and one-half tons pressure, and could be moved out of this position for one and three-sixteenths inches to its furthest limit, by the addition of about two and three-quarters tons pressure. This had the effect of swinging the car body more gradually into the direction taken by the trucks, and the shock was considerably less than that experienced with the trucks used in the first year's tests.

"If we build our roads with few curves, we might as well take full advantage of the fact, and make our wheel base long. The thirty per cent increase of base in the truck used in the last year's tests was a noticeable improvement over that used in the previous tests. With a greater distance between wheels we have a better chance to equalize the weights upon the axles, since the lever arms and springs between them may be made longer and consequently more sensitive and easier to adjust. In three-axle trucks the motors will most likely always be mounted on the outside axles, making it necessary to carry a greater percentage of the weight of the car body on the middle axle, than is carried on the outside ones.

"As this weight fluctuates considerably this fact must not be overlooked in designing the equalizing lever arms of the truck, as otherwise the load will be unequally distributed on the axles and possibly disturb the smooth running of the car.

"In passing stations at 125 miles per hour it was not possible to recognize persons standing upon the platforms, and only those at a distance of fifty feet and over could be approximately identified. On dark and rainy days it was quite impossible to read signals at this speed, except when of large dimensions or of very pronounced color.

"This would suggest placing the signals in the car itself, operated electrically, either by direct contact or through inductive means. Such a system was tried at Zossen and worked perfectly, even at the highest speeeds.

"An insulated piece of angle iron was placed alongside of the rail, it and the rail constituting two poles of an electric circuit. As the car passed over this section contact was made with the angle iron by a brush which led current through a magnet in the car, releasing a spring and allowing a disc to fall in front of the motorman, the circuit being completed through the wheel.

"A system on similar lines could easily be arranged to ring different bells, or to operate different colored discs in the engineer's cab, thus relieving him of the strain upon the eyes caused by passing so many objects which naturally distract his attention.

"In all the runs, of which over 300 were made, no difficulties were met with, or even suggested, that the skill of the engineer did not or could not overcome, and this great triumph, in a branch of industry which has done more than any other to lift the human race to a higher degree of intelligence, should serve as a stimulus to us, who are anxious to have trains in regular service running at this, the highest speed ever attained by any device used for human transportation, 131 miles an hour."

DISCUSSION.

Mr. Sprague—It seems to me that there are two questions suggested by the Zossen experiments:

(1) To what extent will the commercial possibilities warrant speeds anything like those attained?

(2) Assuming that for long distances alternating current be used, shall it be by the polyphase method as at Zossen, or in a single-phase development?

One thing must strike everyone who has followed Mr. Mudge's most interesting description, and that is the extraordinary difficulties which had to be met, and the great increase of powers as the speed approached the higher marks. My own impression is, taking into account all the practical conditions surrounding trunk-line construction and operation, a maximum speed of about one hundred miles an hour is all we can reasonably, for a time, at least, try to reach. Not that cars can not be operated at higher speeds; but the difficulties which must always stand in the way when we take into account all the essentials of trunk-line operation, seem as yet to hardly warrant the commercial use of such speeds. This is a feeling which I have had for a number of years, and I believe it is one which is generally shared by both electrical engineers and steam road operators whenever they have fully studied the matter.

These conclusions, of course, do not vitiate or belittle in any sense the importance of the experiments which have been made, because, in order to operate even at 100 miles an hour as a maximum it is desirable to make trials at much higher speeds, not only to develop weaknesses of apparatus, but to clearly indicate the practical working difficulties and limitations which confront the engineer.

Mr. Mailloux—It seems to me that these tests prove all that was intended. In regard to the selection of systems when it comes to traveling over fifty miles an hour electrically, while it seems as though we should use some alternating system, I am not prepared to say which should be used. The single-phase has not yet been developed to sizes which will do what the large polyphase motors can do. Before we can authoritatively say what would be the best method, further experimentation will be required. I do not think that that point will be reached immediately. The experiments now being made on the New York Central and Pennsylvania roads will give us some valuable data. I am not prepared to say, and I don't think any person is, that they will bring about any real general solution. They are, in reality, what mathematicians term "particular solution." We have something to learn before the electrification of steam roads in general is an accomplished fact. We shall have to proceed gently. I do not wish to be understood as being pessimistic; I believe it is going to come; but by evolution rather than by revolution; not to-morrow, or in ten days, nor, possibly, in ten years. I believe there will still be steam locomotives twenty-five years from now.

Mr. Sprague—I quite agree with the general statements which have been so clearly made by Mr. Mailloux. We are not on the eve of the general conversion of steam-operated roads. It is interesting to note that some of the difficulties met with on the Zossen line at high speeds were encountered in the earlier tests on this locomotive. Notwithstanding the fact that it had leading trucks, there was a distinct "noseing," caused by lateral sway, which was periodic, *i. e.*, corresponding to the length of the rails, and resulting in some displacement at thirty feet intervals. It was thought, at one time, that possibly the low centre of gravity was the cause of this; but this, apparently, did not prove to be the case, for, by using side springs, and subsequently, in addition, friction plates, to retard the free action between the body of the locomotive and its pilot trucks, this "noseing" was made to entirely disappear, even when traveling at the rate of eighty-two miles an hour. Had the potential been raised I have no doubt that speeds of between ninety and 100 miles an hour could have been easily made.

Speaking, however, of the general problem, we must bear in mind that what is being done in New York relates to congested terminal operation, and there are many local conditions which have dictated the use of electricity without necessarily putting it on all points on a directly competitive basis with steam operation. One

Digitized by Google

of the earliest applications of electrical operation in miscellaneous roads is likely to be due to the recognition of the fact that in many cases the concentration of grades and electrical operation, in whole or in part, at such grades, may prove cheaper than the making of costly detours. In such cases, both continuous and alternating-current motors can be used, and which shall be the better is a matter to be decided by local conditions. In spite of the admirable work which has been done abroad with the polyphase system, and granted its possible desirability in certain special cases, I can not but feel that, speaking generally, the multiplicity of conductors will stand as a bar to any general application to trunk-line service, and that the later developments in single-phase operation, offer, on the whole, more promise of final adoption, where alternating currents are used.

Mr. Shepard—We have a locomotive in operation at East Pittsburg, upon a specially equipped track, about four miles long. We last week put this locomotive in operation, pulling a fifty-car freight train, for the benefit of the visiting members of the International Railway Congress. This locomotive is designed for the heaviest work. Its weight is 135 tons, its capacity 1,600 horse-power, the maximum drawbar pull being 80,000 pounds. This has been registered on the tests already made. The overhead construction is the catenary type and the voltage in use is 6,600. The control of this is by induction regulator. This is quite the ideal control for such service. The tests demonstrate fully the practicability of the single-phase motor of this capacity. The results were fully up to expectations. The tests seem to show that this type of locomotive will find its field in heavy service where concentrated powers are required, as, for instance, on pusher grades, which under steam service are most expensive to operate. In order to secure concentrated power with electrical operation the track conditions need be no more severe than for comparatively light steam locomotives—this by reason of the facility for distribution of the motive power over different axles. I agree with Mr. Mailloux and Mr. Sprague that the adoption of electricity on steam railroads will be gradual; at first, in such special applications as this locomotive is fitted to meet, and such terminal propositions as local conditions determine; and, ultimately, the expansion of these installations will be quite readily accomplished where the high-voltage single-phase system is used.

Transportation Arrangements, Convention of American Institute of Electrical Engineers.

For those attending the convention of the American Institute of Electrical Engineers at Asheville, N. C., tickets will be issued at all the principal stations and ticket offices of the Trunk Line Passenger Association, the Central Passenger Association, the Southeastern Passenger Association, and the New England Passenger Association, on the certificate plan, which allows the holders of such certificates to purchase tickets from Asheville to original starting point, at one-third the regular fare, provided there are at least one hundred certificates presented.

Tickets at full fare for the going journey may be obtained three days (exclusive of Sunday) prior to the meeting, and also during the first three days of the meeting. The scheduled dates of the meeting are from June 19 to 23; consequently, tickets may be obtained not earlier than June 15, nor later than June 21. The outgoing tickets are good on any train which carries passengers to Asheville.

Persons attending the meeting should be sure to make application for their certificate when purchasing ticket for Asheville. Should certificates not be available at the office where application is made, a ticket should be purchased to the nearest station where such certificates are issued, and a ticket to Asheville, together with the certificate, obtained there.

Immediately after arrival at Asheville, persons attending the convention should present their tickets to be viséed at the Secretary's headquarters in the Battery Park Hotel. A fee of 25 cents will be charged by the railroad agent for each certificate endorsed by him.

It should be noted that members must return to the starting point; otherwise there will be no reduction in the fare. No claim for refund will be entertained by the railway companies on account of holders of certificates returning to original starting point, before the requisite number of one hundred certificates is in the hands of the special agent of the railways.

Return tickets at the reduced rate of fare are valid for three entire days after the Convention adjourns, not including Sunday; that is on any through train leaving Asheville before midnight on June 27.

SPECIAL ARRANGEMENTS.

Arrangements from New York—All Rail.—Members starting from New York should leave via Pennsylvania Railroad, Cortlandt or Desbrosses street ferry at 4.30 p. m., West 23d street ferry at 4.25 p. m., Saturday, June 17. If a sufficient number warrants a special train from Washington to Asheville, Saturday night, June 17, it will be provided; if not, extra cars will be attached to the regular train leaving New York at the time mentioned above, Washington at 10.45 p. m., and arriving at Asheville Sunday afternoon, June 18.

Members who wish to leave New York for Asheville Saturday, June 17, or to board the train at Philadelphia, Baltimore, Washington or any other point en route, should communicate with Mr. F. C. Bates, Chairman of the Committee on Transportation and Arrangements, 44 Broad street, New York, immediately, in order that proper provision for special train or extra cars can be made.

Tickets will be sold via Old Dominion Steamship Co., New York to Norfolk, thence via Southern Railway to Asheville on the certificate plan at the following rates: going fare, $18.95; return fare, $10.15; both including meals and berth on steamer.

Old Dominion steamers leave Pier 26, North River, New York, at 3 p. m., daily, except Sunday, and arrive at Norfolk about 11 a. m. the following day. The Southern Railway runs through sleeping cars, leaving Norfolk 7.30 p. m., and arriving at Asheville at 1.40 p. m. the following day.

Members wishing to travel via Old Dominion Steamship Co., should make application for accommodation immediately, direct to Old Dominion Steamship Co., Traffic Dept., 81 Beach St., New York city.

Merchants' and Miners' Steamship Co. from Boston.—Boston members can reach Norfolk by Merchants' and Miners' Line; round trip, including meals and berth, $22.00.

Tickets via Southern Railway Co., from Norfolk to Asheville, can be purchased on the certificate plan as explained above.

Chicago, St. Louis, etc.—Members who wish to start from Chicago, St. Louis, etc., should apply for additional information to Mr. John H. Finney, member of Local Committee, National Bank of Commerce Building, St. Louis, Mo.

The hotel rates at the Battery Park Hotel and at the Manor range from $3.50 per day for single rooms without bath to $4.50 per day for a single room with bath. For double rooms the rate per person is about $1.00 less in each case. Rates at Margo Terrace are $2.50 per day.

All the above rates are on the American plan. Each member must arrange for his own hotel accommodations, and early application is desirable.

Digitized by Google

Electrical Notes from Europe.

By Our Special Correspondent.

LYONS is to have an additional supply of current from two different sources. The first of these is a large hydraulic station at Moutiers, and the second consists of a plant on the Romanche river at Gavet. This current is needed for operating some of the new traction lines and to provide for the increase of traffic on the old ones. The Moutiers plant is of special interest, as it is one of the few in Europe which will be operated on the direct-current series system at high voltage. It is to be equipped on the Thury system, like the St. Maurice-Lausanne plant, which attracted so much attention. The line is 110 miles long and is the longest in Europe. A tension of 57,000 volts will be used. This is much higher than the St. Maurice, which has only 22,000 volts, and the line is but thirty-five miles long. Thury direct-current machines to the amount of 5,000 horse-power will be placed in the Moutiers station, using four pairs of double dynamos. The 110-mile line from Moutiers to Lyons will consist of two bare copper wires for the overhead part. Where it enters the city there will be two underground cables, well-armored and insulated so as to take 50,000 volts. At Lyons it is proposed to erect a substation containing five double motor-and-dynamo groups, in which the current will be changed to low voltage for the tramways. The high-voltage direct-current system is no longer an experiment, as the Thury system is now working in several large transmission plants. The second plant which is to supply current for Lyons is operated on the three-phase system, with an overload line ninety miles long. The Romanche river affords a 200-foot fall, and it is expected to utilize some 10,000 horse-power. At Gavet there will be three turbo-alternators of 1,700 kilowatts each. They will furnish current at 4,000 volts, running at 380 revolutions per minute. Schneider & Company, the well-known French metallurgical firm of Creusot, will supply the outfit. At Lyons, the substation is to have five rotary converter groups of 600 kilowatts each. When it is finally completed, the new Lyons system will be one of the most extensive in Europe.

Recent experience with motor-boats in France and elsewhere in Europe shows that the magneto which is used for the motor ignition is a great cause of trouble. Thus, at the races which were held in the bay at Monaco, the boats shipped water even in a light sea, and as the magneto was not protected it soon became useless. This not only causes the boat to stop, but as it can no longer be steered, it is liable to turn broadside to the waves and be overturned. As the magneto is to play such an important part in the motor-boat question, it seems only rational that some attention should be paid in the future to having it well enclosed and constructed so that it will give a minimum number of accidents from this cause.

The question of having a better telephone system continues to be agitated in Paris. At present the defects are many and the subscribers have been complaining for a long time past, both as to the working of the instruments and also the way the service is carried out. Some time ago a subscribers' league was formed, composed of many influential persons, in order to defend their interests. This agitation now seems to have borne fruit, for we hear that M. Berard, the secretary of posts and telegraphs, has formed a technical commission which is to examine the different propositions relating to telephone matters, especially as regards the transformation of the existing system. This commission is to meet shortly. It will be occupied with the modifications which have already been undertaken for improving the operation of the lines, as well as the new propositions which have been presented to it. So that there is some hope that in future Paris will have a telephone system which is at least as complete as that of the other large cities of Europe.

The cantons of Schwytz and Zürich in Switzerland are taking measures to secure a supply of current from hydraulic plants and distribute it throughout the region. The city of Zürich expects to thus have an important increase of current, and this is needed to provide for the increase in the lighting and tramways. The two cantons have now made an agreement as to the best method of proceeding. The first plant which will be used for the purpose is located on the Sihl river in the canton of Schwytz. Here it is proposed to build a dam some ninety feet high and 350 feet long across the stream. This will form a large lake in the valley through which the stream flows, and it will have an area of two square miles and a capacity of ninety-six million cubic metres. It will empty into the lake of Zürich, with a difference of level equal to 480 metres. This will afford some 20,000 horse-power, or if the supply is only used for ten hours, it will be increased to 45,000 horse-power. This will be amply sufficient for the present needs.

A new electric process of treating peat is to be used by a large company which has been lately formed in Switzerland. A plant is to be erected at Berne or nearby, in which the peat, as it comes from the bogs, is to be put through an electrolytic process. The method, which is operated by the Osmon company, has been patented recently. The company is said to be capitalized at $400,000. This is only one of the electrolytic methods of treating peat which are now being operated in Europe, as several inventors have brought out different processes. After the treatment, the peat is compressed into briquettes and forms a good combustible.

An exhibition of acetylene apparatus is to be held at Paris under the auspices of the Union of Carbide Manufacturers. It is intended to bring out the merits of new apparatus, so as to be able to select those which show the best qualities of reliability, economy, good workmanship, etc. The society is to examine all the apparatus carefully and will make out a report in which it recommends the best ones. Such a recommendation will, of course, be of great benefit to the inventors. The examination is to be made by a committee of influential scientists and the jury will be composed of delegates of the different industrial syndicates which are interested in the acetylene question.

The new Bourgeat system of electric line poles is attracting some attention. It has been recently used in Switzerland. The poles are built of wood combined with cement. A wood pole or rod forms the core. In it are fixed angled or double spikes and upon them is wound a sheet of wire gauze of large mesh, thus leaving a space between the wrapping and the wood. A cement layer some two inches thick is put over the gauze, and this is found to make a solid pole which is not easily acted upon by the weather. It lasts as well as an iron pole and costs only half as much. A line over thirty miles long

Digitized by Google

has been erected with the new poles. At present the cross-arms are fixed to the pole by curved iron pieces which are bolted so as to embrace the pole. Later on, it is proposed to make the cross-arms also of cement construction. At Zürich the municipality is trying the new system on a circular line in which the poles are spaced some forty-five feet apart. These poles measure 315 millimetres in diameter at the base and 200 at the top, and are twelve metres long. They have 1.6 metres planted in the ground. They showed a very high resistance to the breaking strains applied at the top. The maximum bending was sixteen centimetres.

Among the new turbine stations we may mention the plant which has lately been erected at Caffaro. This plant is one of the large ones of northern Italy. It lies in the province of Brescia, near the Austrian frontier. The town of Brescia receives current for light and motors over a line thirty miles in length. A high tension of 40,000 volts is used on this line, and no difficulty is found in operating under these conditions. The hydraulic station is equipped with alternators of 1,850 kilowatts and the total output of the plant is near 10,000 kilowatts. Besides the main substation at Brescia there is a second one which has machines of 2,400 kilowatts for supplying direct current to electrochemical works.

At Naples a project is on foot for obtaining current from the Volturno, a stream in the neighborhood. It is proposed to erect a hydraulic station which will furnish upward of 2,000 horse-power. The water will be brought from the intake canal by three steel penstocks having a capacity of 270 cubic feet per second. It is estimated that the hydraulic work and the station will cost some $800,000. From the station an overhead line is to run to Naples, working at 45,000 volts. In the city there will be a large substation for transforming the current. The expense of building the line and substation is figured at $750,000. The total cost of the project will thus be near $1,600,000.

It is stated that the hot-wire principle has been applied to a mirror galvanometer by M. Schmidt, a German scientist. He can thus measure alternating current of very high frequency and with considerable accuracy. The instrument he now uses is an adaptation of the usual hot-wire galvanometer, except that he removes the index needle from the pulley over which the wire passes, and instead fixes a small mirror on it, so that a very slight movement of the wire is shown. Of course great care must be taken in making the readings with such an instrument. He finds that to have its work constant, the maximum current must be applied to it for several minutes before using. One form of instrument with fine wire measures currents from 0.1 to 0.2 ampere. It is heated up for two hours previous to taking the readings, and the latter are found very constant. The difference between any two readings is not more than three-tenths of one per cent. Without the preliminary heating the difference is greater.

Professor Wedding seems to prove in some recent experiments that the blackening of lamp bulbs has not as much effect in cutting down the light as might be expected. He took some lamps that had been running for 14,000 hours and were very much blackened. The candle-power had fallen from sixteen to five candle-power. Upon opening the lamps and replacing the bulbs by new ones he found that they still gave about the same low candle-power. It would seem, therefore, that the lowering of the light is due to the burned-out filament and not to the blackening. While the experiment requires some care to carry out, it is one which can be easily verified, and therefore there does not seem to be much doubt as to the above results.

That the new steam turbines are capable of running for a long time without wearing out has been shown very well at the Donnersmark mine in Silesia. A Brown-Boveri-Parsons turbine had been in operation for two years, with an actual run of 17,200 hours. On the twenty-fourth of April it was taken apart and showed no trace of wear, either in the bearings or the vanes of the wheel. This speaks very well for the performance of these machines. The present wheel must have made over three billion revolutions during the two years' working.

One of the largest arc searchlights in Europe is now in construction for the Russian government by the Siemens-Schuckert Company. It has an arc lamp which takes about 200 amperes and furnishes 310 million candle-power. A parabolic mirror of silvered glass is used here, measuring over six feet in diameter. The carbons of the arc are 4.9 and 3.5 centimetres in diameter. The Heligoland searchlights, which have been reckoned as among the most powerful, give only thirty million candle-power, taking thirty-five amperes, while the mirror is thirty inches in diameter.

According to the opinion of L. Vogt it is a mistake to take account only of the hardness of water when considering the matter of boiler corrosion. Other substances in the water are just as hurtful. After purifying the water by the present methods there usually remains a large quantity of sulphate of soda in the water, and this becomes more and more concentrated as time goes on. The sulphate is found to attack the boiler considerably. Nitrates and chlorides are also found in the water, and these are even more corrosive than the sulphate. Worst of all is chloride of magnesia. We must therefore keep the concentration down below the limits where the salts attack the iron. Seeing that the water is not mixed uniformly in the boiler, the concentration is apt to occur where the evaporation is greatest, or at the points of greatest heat in the boiler. These points are attacked before the others. He recommends emptying the boiler once a week, and washing it thoroughly every two months so as to avoid the accumulation of soluble salts.

The Allgemeine Electric Company has gone somewhat extensively into the manufacture of standard types of lifting magnets for handling iron in various forms. These have been found very convenient in connection with cranes. For short and heavy pieces of metal they employ a magnet of round section, while they adopt an oval section for picking up the longer pieces, such as bars, etc. For plate iron another form is used, and it will take plates up to two inches thick. Another type for lifting rails has movable pole-pieces. It takes some three kilowatts and will lift a six-ton rail. In some of the other forms, the magnet weighs 900 pounds for lifting a weight of two tons or more.

The new electric traction system of Genoa is no doubt one of the most complete in Europe. It runs within the city and to the different suburbs. The rolling stock consists of forty-five-place cars and a second type containing twenty-four places. Both of them use a thirty-horse-power motor with single reduction. The air-brakes work on all four wheels. The heaviest grades on the lines are eight per cent. A 500-volt overhead line is employed. The system now uses about 200 motor-cars and thirty trailers.

C. L. DURAND.

Paris, May 23.

Digitized by Google

The Faraday Society.

The fourteenth ordinary meeting of the Faraday Society was held on Thursday, May 18, 1905, at the Institution of Electrical Engineers, London, England, Dr. F. Mollwo Perkin, treasurer, being in the chair.

Dr. T. Martin Lowry read a paper entitled "An Application to Electrolytes of the Hydrate Theory of Solutions."

The object of the paper is to consider the possibility of extending the hydrate theory to electrolytes in such a way as to take account of the observations which form the experimental basis of the theory of electrolytic dissociation. The hydrate theory postulates that an aqueous salt solution consists of a mixture of hydrates in equilibrium with the solvent and with one another. But it must be supposed that even in solution there is a limit to the possibility of hydrate formation, so that ultimately a stage will be reached at which the molecule as such will be unable to combine with any further quantity of water. The ionization of an aqueous electrolyte consists essentially in a further process of hydration whereby the fully hydrated molecule combines with an additional quantity of water to form two or more hydrated ions. The hydration of the ions is thus conceived to be the primary cause of the ionization of aqueous electrolytes. It is believed that this extension of the hydrate theory to the phenomena of electrolysis may help to remove the fundamental difficulty of Arrhenius's theory, namely, the absence of a motive for electrolytic dissociation.

The evidence in support of the hydrate theory of ionization is summarized as follows:

(1) The theory is in accord with the fact that the best "ionizing" solvents are those which are themselves most highly associated. While Arrhenius laid special stress on dissociation as the characteristic feature of the process of ionization, the hydrate theory emphasizes an association of solvent and solute which is the primary cause of the separation of the ions. Such an association with the solute may be expected to occur most readily in the case of solvents composed of molecules having a high coefficient of association.

(2) Complete ionization is possible only in presence of a very large excess of water, that is, under exactly those conditions which are most favorable to the formation of complex hydrates.

(3) The influence of temperature on ionization is also in accord with the view that the process is essentially one of association with the solvent.

(4) Evidence in favor of the hydrate theory of ionization is afforded by a consideration of the mobilities of the different ions in aqueous solutions. In the following table of ionic mobilities.

Li	Na	K	Rb	Cs
33.44	43.55	64.67	67.6	68.2

the larger atoms yield the more mobile ions; the lithium ion (at weight seven) moves through the solution only half as rapidly as the rubidium ion (at weight eighty-five) or the cæsium ion (at weight 133). Such a result strongly supports the view that in aqueous solutions the ions are present in the form of complex hydrates.

(5) The mobility of the hydroxl ion is more than double as great as that of any other anion; while that of the hydrogen ion is nearly five times as great as that of any other kathion. The peculiar properties of these two ions are most readily explained by supposing that they are either anhydrous or are combined with a smaller proportion of water than any of the other ions. Confirmation of this view is afforded by at least two independent considerations:

(*i*) The affinity of water molecules for the ions H and OH must be relatively slight, since otherwise liquid water, like fused salt or caustic soda, would be a good electrolyte.

(*ii*) Whereas nearly all sodium and potassium salts are good conductors, the acids from which they are derived are often exceedingly poor conductors.

(6) Independent evidence in favor of the hydrate theory of ionization is to be found in a consideration of the freezing points of dilute aqueous solutions. At extreme dilutions the molecular depression of the freezing point reached a maximum value corresponding very closely with that required by the theory of electrolytic dissociation. In less dilute solutions, however, values are obtained which can not be accounted for in terms of this theory as originally propounded, but which are explicable if, as the hydrate-theory assumes, part of the solvent is removed as far as freezing point lowering is concerned.

(7) The theory of electrolytic dissociation owes much of its acceptability to the readiness with which it lends itself to exact mathematical treatment. The whole theory can indeed be summed up in the well-known equation

$$K = m\,a\,(u + v).$$

The essential constants of the hydrate theory are, however, quite as simple as those of Arrhenius's theory. For any given solution the chief constants are :(1) the total hydration H of the solution, which expresses the total number of molecules of water present per molecule of salt. (2) The coefficient of combination B, which expresses the fraction of the total quantity of water that is actually combined with the salt to form hydrates. (3) The product of these two quantities will give the average composition of the hydrates in solution; this may be termed the "molecular hydration" of the solution and may be represented by the symbol h. Thus $h = B\,H$ may be regarded as the fundamental equation of the hydrate theory.

Jones and Getman and Biltz have attempted to determine the molecular hydration of dissolved salts. Assuming that the abnormally great molecular depressions of the freezing point of salt solutions of moderate concentration were due to a combination of solvent and solute, Jones and Getman were able to compute the amount of solvent water remaining in the solution by comparing the observed molecular depression with that calculated from the coefficient of ionization of the solution.

The author, after correcting the figures —in which two serious flaws were made— calculated by Jones and Getman, shows that the corrected values point to a regular increase of molecular hydration as the dilution increases, and are, therefore, in accord with the view that ionization involves an increase, and not a decrease, in the hydration of the solute.

(8) The theory may easily be extended to non-aqueous electrolytes in which ionization may again be attributed to the superior combining power of the ions as compared with the molecules of the dissolved salt.

(9) In the case of autolytic salts, which became conductors when fused, it is known that polymerization is an essential characteristic of these, hence it is only necessary to suppose that the complex molecules of these are associated with the ions. Evidence of the formation of complex ions has recently been obtained in the case of fused salts by Lorenz and Fausti, who have shown that, in fused mixtures of lead chloride with sodium and potassium chlorides, the transport values prove that the lead is present in the form of a complex anion which travels in the opposite direction to the current. Their experiments afford direct evidence of the

Digitized by Google

presence in the fused salt of positive and negative ionic complexes.

Conduction in mixtures of solid oxides, such as the Nernst filament, is doubtless electrolytic in character. Like glass, this filament has the composition of an electrolyte, but behaves as an insulator until the temperature has been raised sufficiently to permit ionic migration to take place. Temperature-conductivity curves for filaments of very various compositions have been plotted by Reynolds, and are very similar in form to those for glass, or for overcooled, concentrated, aqueous solutions of calcium chloride or sulphuric acid. An even more striking resemblance is to be seen between the family of curves given by Reynolds for the conductivity of mixtures of ZrO_2 and Y_2O_3 at 900 degrees, 1,000 degrees, 1,100 degrees, 1,200 degrees, and 1,300 degrees centigrade and the isothermal conductivity concentration curves for mixtures of sodium hydroxide and water at 0 degrees, eighteen degrees, fifty degrees, and 100 degrees centigrade. The appearance of the two series of curves is such as to warrant the conclusion that the mechanism of conduction is essentially the same in the two cases.

Mr. H. D. Law pointed out that molecular mobilities were often largely influenced by the undissociated molecules; an ion might wander more quickly through its own molecule than through another. He thought that the experimental evidence on which the hydration was based was as yet somewhat slender.

Dr. C. H. Desch hoped that Dr. Lowry would develop the theory on the mathematical side. The unsymmetrical pulls, due to electric attractions, on an atom in a solution might be sufficient to cause an interchange of ions, and so explain how conduction occurs in solutions.

Mr. W. R. Bousfield (communicated) showed that the experimental investigation of the relation between hydration and ionization could be approached along three conveying lines: firstly, on the assumption of a rectilinear relationship between freezing point depression and concentration; secondly, on the assumption that the amount of contraction per gramme of solute, in aqueous solutions, is a measure of the combination between solvent and solute; and thirdly, by a consideration of the variations of ionic sizes with temperature and concentration based on the application of Stokes's theorem on the movement of small sphere in a viscous fluid. The results of these three lines of investigation indicated the generalization, pointed to by Dr. Lowry, that the amount of combination of solvent with solute increased progressively and continuously with increasing dilution. With regard to the conductivity of water, he inclined to the opinion that the H and OH ions were not entirely anhydrous, but were combined with a smaller proportion of water than any of the other ions, and that the conductivity of water depended upon a volatile organic impurity.

Dr. F. G. Donnan (communicated) drew attention to the work of Werner, who first showed how it was possible to bridge over the gap between the "hydrate" and the "ionization" theories.

Mr. G. T. Beilby, referring to the author's views on solid conduction, said that recent observations of his seemed to prove that the impact of electrons (*e.g.*, β rays) was able to produce electrolysis—ionization—in solid crystals, such as calcspar.

International Electrical Exhibition.

From present indications the coming International Electrical Exhibition, to be held in the Mechanics' Building, Boston, Mass., July 15 to 22, will be the most important event of its kind on record. The manager, Chester I. Campbell, has already been notified that thirty-nine states will send delegates to the fifth annual convention of the National Association of Electrical Contractors, which will be held at the same time and place. A large and efficient reception committee will extend welcome and entertainment.

The entire building, comprising 83,000 square feet of floor space, will be occupied. The exhibition, it is expected, will cover the widest range possible of apparatus relating in any manner to electricity. It will include many of the latest achievements of electrical science. In addition to the great number of still exhibits, a large part of the apparatus will be in active operation.

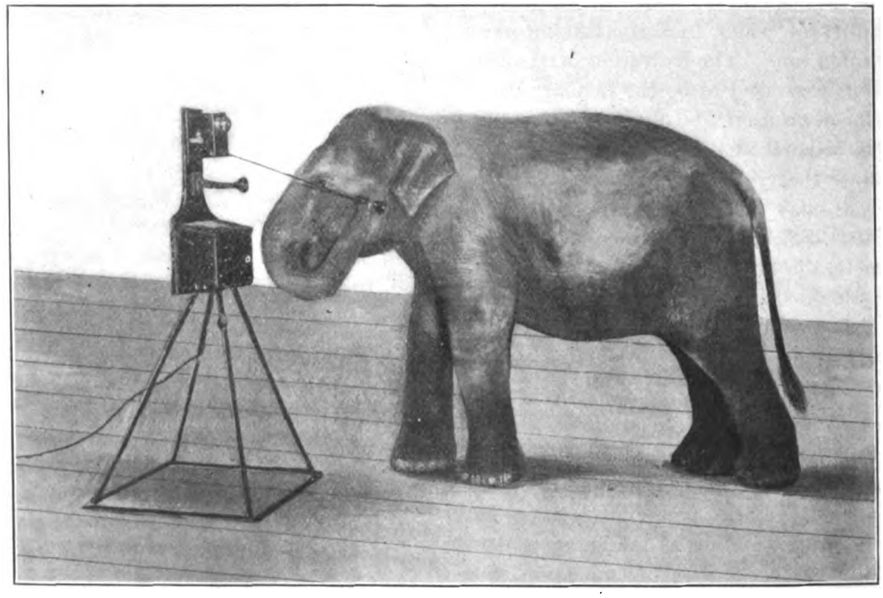
A Communicative Elephant.

The possible extent of the application of the telephone by its use in calling a dog which recognizes his master's voice has recently obtained an unexpected reenforcement at the New York Hippodrome, where one of the elephants gravely steps out from the herd where he has been performing various stunts with his associates, and walks up to a telephone, turns the crank, takes the receiver from the hook and holds it to his ear, only to hand it up again and petulantly sway his trunk because the line is busy.

In a moment, a second attempt again finds a busy line and the disappointment is evident by his stepping backward and vigorously slapping his trunk from side to side with considerable anger.

The third attempt obtains a satisfactory connection and the joyous squeals at the transmitter indicate that promises of sugar or other pleasant communications are received over the telephone.

The elephant is the only tool-using animal in that it uses branches of trees to brush off insects, and also will naturally pry with a beam in a manner indicating a comprehension of the principle of the lever.



A COMMUNICATIVE ELEPHANT.

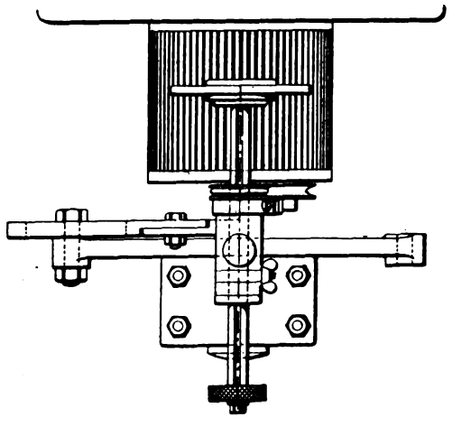
The finder of a stray dog, telephoned to the owner fifteen miles away, by reason of the name on the collar, and the owner told the finder to hold the receiver down so that the dog could hear the call.

The dog capered in delight at hearing its master's voice, and then showed its own mental limitations in its evident resolve to rescue the master from the confinement of the receiver by craunching the fragile rubber shell with his teeth.

Digitized by Google

Electrical Patents.

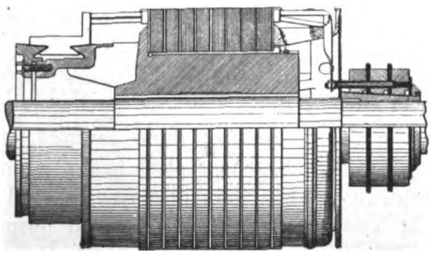
A machine for grinding commutators of dynamos or motors has been devised and patented by William H. Jordan, of Brooklyn, N. Y., and a three-fourths interest in this patent has been assigned to John F. Jordan, George A. Jordan, and Christopher C. Jordan, of the same place (789,917, May 16, 1905). The inventor's object is to produce a device for grinding the commutators of motors or dynamos



MACHINE FOR GRINDING COMMUTATORS.

when such become worn, without dismantling the dynamo or motor. It is also the object to produce a device which may be readily applied to dynamos or motors of different sizes and designs, also a device which may be accurately adjusted in the relation to the commutator. A grinding-disc is provided which is supported by an adjustable shaft. Means are employed for adjusting the shaft. Bearings are provided for the shaft and a support for the bearings. The bearings are adjusted in relation to the support by means of an eccentric, and means are also provided for adjusting the support in relation to the work. The eccentric is secured to the support by suitable means.

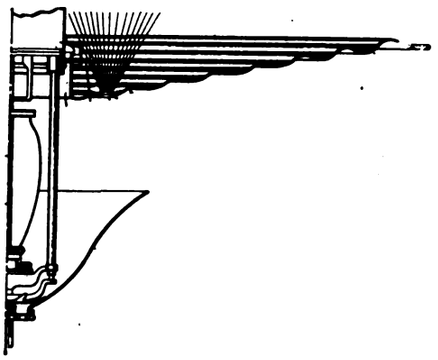
An alternating-current machine is the invention of Charles W. Johnson, of Nor-



ALTERNATING-CURRENT MACHINE.

wood, Ohio, and has been assigned by him by mesne assignments to the Bullock Electric Company, of Ohio (790,368, May 23, 1905). The invention relates to the rotating element of alternating-current machines, and particularly to connecting the windings to collector rings, and is applicable to the rotors of induction motors, to rotary converters, and to other machines in which the winding of the rotary element is connected to slip rings. The object of the invention is to provide a suitable support for the end connections of the windings and to produce a simple and compact arrangement of the connecting leads. By the present invention, the end connections of the windings are supported upon an end-head and the connections to the slip rings pass through the end-head toward the axis of the machine. In this manner a very direct connection is obtained, giving a simple construction, and the connections are enclosed and well protected by the end-head. In the embodiment of the invention, a core is provided and windings therefor. An end-head supports the end connections, the end-head having pockets covered by insulating material. Leads pass through a part only of the pockets. Blocks are fitted in the pockets through which the leads pass, and other blocks serve to guide the leads and collector rings to which the leads are connected.

Walter D'A. Ryan, of Lynn, Mass., has devised and patented an improvement in reflectors, which patent he has assigned to the General Electric Company, of New



REFLECTOR.

York (790,399, May 23, 1905). The object of the invention is the provision of improved means by which a proper distribution of the light emanating from a source can be obtained. The invention is more particularly intended to be used in conjunction with such a source of light as an arc lamp. The reflector has a circular outline and is formed with a ridge or corrugation on its reflecting surface which extends in spiral turns from the centre of the reflector outward, the amplitude of the corrugation increasing along the ridge from the centre outward. Dispersing lenses are located in apertures formed for the purpose in the reflector.

Nominations for Officers of the New York Electrical Society—New Members Elected.

At the meeting of the New York Electrical Society, held on May 24, the nominating committee made the following announcement:

For president, N. S. Barstow.

For vice-presidents: Albert F. Ganz, Louis B. Marks, N. S. Rugg, H. G. Stott, Putnam A. Bates, Max Loewenthal.

For secretary, George H. Gray.

For treasurer, H. A. Sinclair.

The following new members were elected:

Timothy Donovan, 243 East Thirty-eighth street, New York city; George W. Elliott, 114 Liberty street, New York city; Joseph J. Bigelow, 170 West Broadway, New York city; Clement F. Street, 836 Farragut street, Pittsburg, Pa.; F. H. Shepard, 11 Pine street, New York city; A. S. McAllister, 114 Liberty street, New York city; Thomas A. Nathans, 30 Gold street, New York city.

The Convention of the Street Railway Association of the State of New York.

The annual convention of the Street Railway Association of the State of New York will be held at the Fort William Henry Hotel, Lake George, N. Y., June 27 and 28. In addition to the question box, conducted by Mr. C. F. Fairchild, Jr., the following papers will be presented:

"Types of Interurban Cars," by J. N. Shannahan, Gloversville.

"Municipal Ownership," by W. J. Clark, Schenectady.

"Medical Examination of Employés," by Dr. F. H. Peck, Utica.

"Publicity," by J. H. White, Boston Elevated Railway.

The following committee has been appointed to have charge of the exhibition of the supply men: F. V. Green, Westinghouse Traction Brake Company; H. C. Evans, Lorain Steel Company; Henry N. Ransom, and B. H. Nostrand, Jr., Peekskill Lighting and Railway Company, Peekskill, N. Y., chairman.

Wireless Telegraphy Experiments at Purdue University.

Purdue University, located at Lafayette, Ind., is about to institute a series of experiments on the transmission of messages to railroad trains by means of wireless telegraphy. A number of railroads are in plain view for a long distance from the electrical engineering building. These roads include the Wabash, Big Four, and Monon. The various roads will place wireless telegraph instruments on a number of their trains and experiments will be conducted from the university. One experiment will be the placing of a receiver in the locomotive cab, enabling the engineer to take his orders from the train despatcher without bringing his train to a stop.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Discharge of Electrically Charged Electrolytic Surfaces by Light.

Lenard has shown that the discharge of negatively charged metallic surfaces by violet light, as discovered by Hertz, may be attributed to cathode rays at least, if the experiment is conducted in a vacuum, and the action of light on a surface surrounded by air is not essentially different. This led Lenard to say that the cathode rays given out from the illuminated surface are absorbed by the surrounding gas, and thus the discharge is dissipated. Recently Bose has shown that cathode rays are given off by electrolytic surfaces when contained in an exhausted tube if the vapor pressure of the electrolyte be sufficiently low. He conducted experiments on the following substances: the Nernst lamp glowers, concentrated sulphuric acid, concentrated phosphoric acid, a solution of sodium nitrate in water and concentrated solutions of the alkalies and calcium chloride. Herr C. Schaefer concluded from these experiments that charged electrolytic surfaces would show the same phenomena as metallic surfaces and would be discharged by ultra-violet light. To test his conclusion experimentally, he arranged an electrolyte in a glass tube, made contact at the bottom by means of mercury, and charged it negatively by means of a battery. An electroscope was connected to the electrolyte, and an arc lamp arranged so as to illuminate the surface of the electrolyte. By means of a quartz lens the violet rays were cut off or allowed to fall on the surface, as desired. The experiment showed that the light had no discharging effect. Electrolytes were then prepared and colored with different materials, still with only negative results. To explain this failure, the author compares our ideas of electrolytic and metallic conduction. In the latter, transport of electricity is accomplished by free negative electrons comparatively massless, and by positively charged atoms or ions. Electrolytic conduction is brought about by positive and negatively charged ions, that is to say, electrons associated with mass. The effect of ultra-violet light is to set free the electrons in a metal. As yet we know of no method of separating from an ion its electron and leaving a neutral atom, and hence there is no discharging effect of ultra-violet light on electrolytes. If a method of doing this were found, it is believed that ultra-violet light will show the same discharge action with charged electrolytic surfaces.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), May* 1.

Magnetic and Electric Properties of Various Kinds of Sheet Steel and Steel Castings.

A brief account is here given of a research carried out by Messrs. Gunnar Dillner and A. F. Enström, holders of Carnegie research scholarships, into the magnetic and electric properties of various kinds of steel. The researches were conducted at the testing institution of the Royal Technical University of Stockholm. Samples of commercial steel sheet and steel castings were obtained from ten Swedish iron works, and later a number of samples were prepared having specific chemical constitutions. The cast samples were accurately turned to standard size, and tested in the du Bois magnetic balance, the samples being turned spherically on the ends. The sheet samples were made of strips punched with the aid of a cutting machine specially constructed for the purpose. These strips were slightly ground to remove the greater part of the scale, and they were tested by a magnetometer. The electrical resistance was measured in the steel bars, but not in the strips, owing to the difficulty met in determining the area of the strips. It was found that an increase of carbon implies a corresponding increase in the coercive force, and also of the hysteresis energy loss. The increase of the coercive force and the hysteresis coefficient have been found to follow a straight line within the range of a carbon percentage of one-half per cent. A small amount of carbon is favorable in sheets used in armature cores and transformers. As regards the cast steel, there should be no inconvenience involved in the increase of the carbon percentage, so far as is shown by the present researches. With the very high percentage met with in the cast steel employed, values of the maximum induction and of the permeability at the induction usual in field poles can not be considered as quite satisfactory. On the other hand, the hysteresis properties of cast steel are comparatively unimportant. A high percentage of carbon produces an increase in the electrical resistance which is advantageous. An increase of silicon is accompanied by a noticeable increase of the coercive force and of the hysteresis energy loss, while the maximum induction does not seem to be influenced to any great extent. The hysteresis loss is thus increased by the presence of the silicon, a disadvantage outweighing the corresponding gain in electrical resistance. Any addition of silicon ought to be avoided in the case of sheet steel. It is of little importance in cast steel, since it does not noticeably affect the permeability, remanence and maximum induction, although increasing the resistance. The addition of aluminum noticeably reduces the hysteresis loss, at the same time increasing the electric resistance. An addition of aluminum, however, reduces the maximum induction and the permeability for ordinary saturation values. The general conclusion is that an addition of aluminum improves sheet material which is used for constructing dynamos. As regards cast steel, it is disadvantageous, since it affects the magnetic properties too much. When both aluminum and silicon are present, the influence of the former on the permeability and maximum induction seems to be neutralized by the addition of silicon. The results of the research are in agreement with Le Chatelier's theory that the electrical resistance is proportionate to the number of atoms present, and to Benediks's formula for calculating it. The cast-steel rods were examined before and after annealing. As a rule, the annealing improves the magnetic properties in general, more especially the hysteresis loss. No annealing tests were made on the sheet material, but samples were selected from the centre and from the borders of the plates, and compared. Samples from the edges have a greater maximum induction than those from the centre, while the coercive force and hysteresis loss of the centre samples are about ten per cent greater than that of the edge. The samples of Swedish soft steel sent in were produced by different methods. Comparing these samples, it appears that Bessemer steel has a lower magnetic quality than open-hearth steel; that steel prepared by the basic open-hearth process is preferable to that prepared by the acid open-hearth process, and that the former is scarcely inferior to Lancashire iron. It is thought that the poorer quality of the Bessemer material is due to the gases dissolved in the metal. In

Digitized by Google

general, basic steel does not contain such large quantities of silicon and manganese as acid steel, and at the same time it is possible to get a lower percentage of carbon in the first-mentioned metal. Microscopical researches on the samples show that a high percentage of silicon in steel causes the cementite to be transformed partly into graphite. In steel with a high content of aluminum, the carbon is expelled from the interior of the grains, and is accumulated at the edges of the grains in a sorbitic state.—*Abstracted from the Electrician (London), May 19.*

The Hydroelectric Installation of Trubigo, Lombardy, Italy

Some years ago the Societa Lombarda per Distribuzione di Energia Elettrica erected a large hydroelectric station at Vizzola on the Ticino river. The output of this station was 14,000 horse-power, but the demands upon the station grew so that the company was forced to increase the plant to 19,000 horse-power. In spite of this increase it has been found necessary to provide for still greater demands, so that the company has built a new power station at Trubigo. This has been completed, and operates in parallel with the older plant. It is here described by Signor Enrico Bignami. Like the first plant, the new installation is operated by a bypass from the river Ticino. The new canal is 5,590 metres long, and makes available a head of 8.2 metres, which, at the rate of flow permitted by the terms of the concession—this being sixty-two cubic metres per second—makes available a total of 6,800 horse-power, or about 5,400 horse-power at the turbine shafts. The water is controlled by means of a dam and ten intake sluices. The power-station buildings are situated at the end of the canal on the left bank of the river. They consist of two parts, the first facing the upper canal, and in direct communication with the forebay formed at the end of the canal. This building contains the turbines, each of which is fixed at the bottom of a separate basin open to the sky. In the second building, which adjoins the first, is the electrical machinery. There is here one large room, forty metres long by ten metres wide and twelve metres high, and a number of smaller offices. As it is necessary to maintain a constant head of water in the spillway canal, the water from this canal being used for irrigation purposes and controlled by means of gates, three spillways have been provided, which bypass water around the turbine pits. These spillways are controlled by a gate operated automatically by an electrical device, itself controlled by slight variations of level in the spillway. The generating plant consists of five three-phase alternators directly coupled to the horizontal shafts of the turbines. They are rated at 1,500 horse-power and 1,320 kilowatts, 11,000 volts, fifty cycles per second. Four of these machines are normally in operation, one being reserved. Two exciter groups are provided, each consisting of a 100-horse-power generator driven by a horizontal turbine. From this station power is transmitted over three lines and distributed mostly in the area served as well from the Vizzola station. The greater portion of it is consumed in the Legnano district.—*Abstracted from the Electrical Review (London), May 19.*

Schmitt Accumulators.

The Schmitt accumulator, here described by M. T. Pausert, differs most from other storage batteries in the method of preparing the active material. A mixture of pulverized oxides of lead, sulphuric acid and glycerine is formed, which is distributed in layers about ten millimetres thick over discs of sheet iron. The layers thus prepared are then placed in a compression cylinder and subjected to a pressure of 700 kilogrammes per square centimetre. The plates of active material thus formed are dried. They are very dense, slightly porous, and are as hard as ordinary cement. These plates are crushed and sifted so as to give grains irregular in shape, but having an approximately constant weight. To form an electrode, the material thus prepared is packed tightly in boxes, the box forming the negative electrode being completely filled; that forming the positive electrode not being quite filled. The current is led in through strips of antimonious lead. The shape of the elements depends upon the service for which they are intended. For traction purposes a square box of some non-conducting material, such as hard rubber or celluloid, is used, the conductor lead being formed of two long lead strips, each bent longitudinally so as to form a right angle, with the apexes welded together to form an x. This terminal is then given a quarter twist at the centre. The active material is packed tightly around it. Circulation is secured by means of perforations in the lead terminal and in the containing-case. The stationary type of electrode is formed in a rectangular, but narrow, box. The terminal of this case consists of a number of parallel strips of lead running horizontally through the active material, and attached to a stout terminal at one end. The advantages claimed for this accumulator are the good conductivity secured, the freedom from buckling, and free circulation of the electrolyte. A cell consisting of seventeen positive and eighteen negative tubes, the positive tubes weighing altogether 4.76 kilogrammes, and the negative tubes 4.68 kilogrammes, is 17.8 centimetres long, 11.3 centimetres wide, and twenty-two centimetres high. The total weight is fourteen kilogrammes. This cell is rated at 300 ampere-hours for a ten-hour discharge, or 220 ampere-hours for a four-hour discharge.—*Translated and abstracted from La Revue Électrique (Paris), May 15.*

The Question of the Gas Turbine.

An answer to the question "why not a gas turbine" is here given by Professor Sidney E. Reeve. The author first shows why the steam turbine promises to displace the reciprocating engine, and then points out that the same conditions do not obtain in gas-engine practice. The prime problem of steam-engine design, from the days of James Watts, has been to reduce or prevent cylinder condensation. On the other hand, in a gas engine there is no condensation; and on account of the high temperature, we are forced to cool the cylinder rather than heat it. The steam turbine has made possible a desirable increase in rotative speed, but to employ high-temperature, high-pressure gases efficiently directly in a steam turbine will call for speeds far too great. Nevertheless, Professor Reeve believes that the development of a gas turbine is a desirable thing. As to the practicability of the gas turbine, two phases of the development must be considered. The author shows that the cycles commonly used in reciprocating gas engines can not be applied to the turbine. If the gases are admitted directly into the turbine, the temperature is too high. If expended simply in a nozzle the velocity is too great. To get around these difficulties the gases may be mixed with steam. Thus not only will the temperature be reduced, but the weight of the fluid will be increased, and hence the velocity of exit under any pressure decreased. This process would overcome not only the thermodynamic, but the mechanical difficulties. The conclusion is reached that the gas turbine is a machine immediately practicable both thermodynamically and mechanically, with the sole exception of the question of the best method of forcing the fuel and air into the generator.—*Abstracted from the Engineering Magazine (New York), June.*

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Fort Wayne Prepayment Wattmeters.

The reason for the failure of many prepayment wattmeter designs lies in the fact that the prepayment mechanism has required too great a torque for its operation and affected the light load registration of the meter. The Fort Wayne Electric Works, Fort Wayne, Ind., is now placing upon the market a prepayment wattmeter which requires such an extremely low torque for the operation of its prepayment mechanism that the smallest amount of energy which will cause the meter to run will operate the device perfectly.

The new prepayment mechanism is compact in form and neat in appearance. It has been applied to the popular type K induction integrating wattmeter which has met with such success in the past as

FIG. 1.—TYPE K, FORT WAYNE PREPAYMENT WATTMETER.

well as to the new "Wood" type W meter which has recently been described in these columns.

Fig. 1 is an outside view of the type K prepayment wattmeter, while Fig. 2 shows the same mechanism applied to the type W meter.

These meters are at present designed to operate with a dime and may be credited with two dollars' worth of energy at one time. The capacity of the money box is ten dollars. The Fort Wayne Electric Works will soon place upon the market, however, a meter whose operating coin will be the quarter, as considerable demand has already been made for such a meter. This meter may be credited with five dollars' worth of energy at one time and has a total capacity of twelve dollars in quarters.

Upon inserting a coin into the slot at the top of the meter the former acts as a key, locking the crediting device to the knob, so that one-half turn of the latter credits the coin upon the dial and deposits same in the money box. This operation is accomplished as follows:

Upon the further end of the crediting spindle is a pinion which engages an intermediate gear. This intermediate gear also engages the inside annular gear of the escapement mechanism. The coin acting as a key in rotating the above pinion causes the intermediate gear to roll about the pinion as an axis. This forces the numbered dial ahead under the tension of a flat-coiled spring. Thus power for the debiting operation is stored up in the spring. This operation of crediting may be repeated until the dial at the top of the meter shows twenty dimes credited.

After the coin has once been inserted and the knob turned, it is locked within the meter and can only be obtained by opening the money box. It is only by turning the knob one-half revolution that the consumer can obtain credit for his payment. After twenty dimes have been credited the slot is closed, preventing the insertion of another coin until a dime's worth of energy has been used.

The same operation that credits the first coin in the meter causes the circuit to be closed by means of a cam on the crediting drum. This cam operates a lever-arm which in turn engages the switch-bar and closes both circuits under the tension of a coiled spring. Fig. 3 shows the details of this switch.

After the amount of energy purchased has been used, and the drum, in debiting the coins, has returned to its initial position, the same cam releases the spring and causes the switch to open.

The only connection between the prepayment device and the recording train of the wattmeter is a pinion upon the former which engages a gear in the latter. In the operation of debiting every revolution of this pinion causes a stop to be removed from the gear train in the prepayment device by means of a cam mounted upon the pinion shaft. The gear train thus released is free to revolve. This

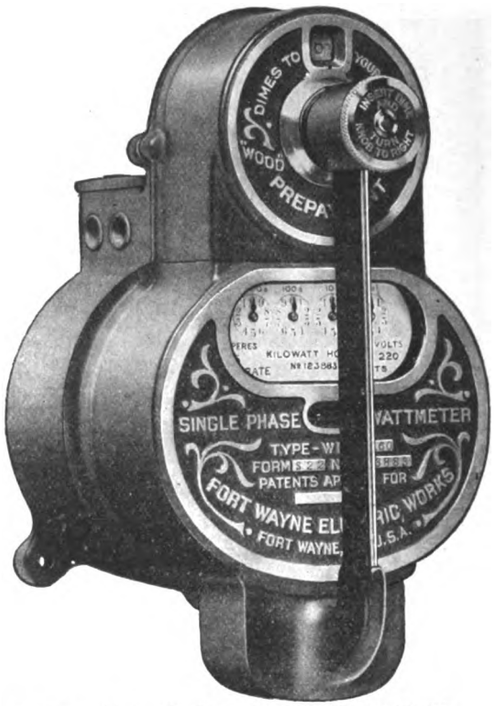


FIG. 2.—TYPE W, FORT WAYNE PREPAYMENT WATTMETER.

train consists of three gears and three pinions; one of the latter, however, simply operates a retarding fan (see Fig. 4).

In debiting, the intermediate gear in rolling about the centre stud under tension of the coiled spring carries with it the internal annular gear and causes the whole escapement motion of the prepayment device to operate, providing the latter be unlocked by one rotation of the small pinion as explained above.

The ratio of gears in the escapement train is fixed at such a value that when the dial has moved sufficiently to allow the next lower number to appear thereon, a pin upon the periphery of one of the large gears acts as a cam forcing a stop-lever into such a position that the latter immediately engages a pin on one of the lower gears and stops the whole mechanism. Thus it will be seen that for every revolution of the small pinion which engages the wattmeter recording train, one number is subtracted on the dial and the switch cam is brought just so much nearer

Digitized by Google

to the position in which it operates the switch and opens the circuit.

One of the valuable features of this prepayment meter is its ability to both credit money and debit energy at the same time. It is possible to accomplish this operation for the reason that the only connection between the crediting stud and the debiting escapement motion is an intermediate gear whose axis is not fixed.

In crediting, the intermediate gear rolls about one central pinion; in debiting, the annular gear together with the intermediate gear rolls about the central pinion. Thus when both operations take place at one time the pinion and the annular gear turn in opposite directions at equal speeds, causing the intermediate gear to simply revolve upon its own axis without changing the numbers on the dial in any way. Although the debiting device is usually locked during the crediting operation, it will be seen that the value of the meter is greatly increased by its ability to perform both operations simultaneously when such an occasion arises.

The money box of this meter has been designed with the idea of making it as nearly tamper proof as possible, for it is not possible to gain access to the lock without first breaking an auxiliary seal. When the lock is reached it is found to be of the concealed Yale type which can not be picked, and can be opened only

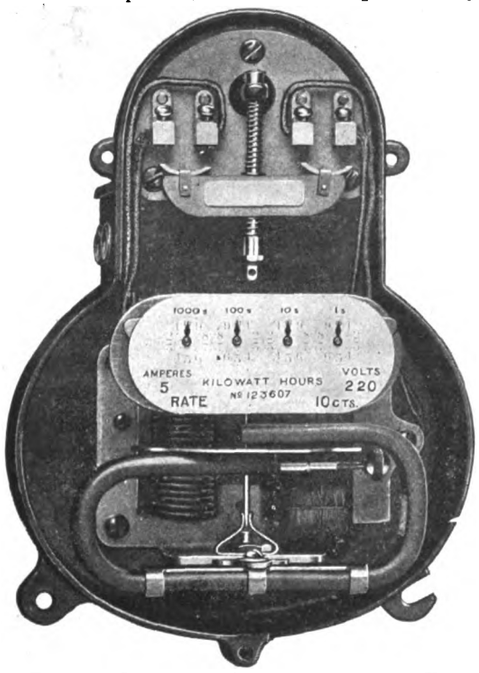


FIG. 3.—INTERIOR ARRANGEMENT OF FORT WAYNE PREPAYMENT WATTMETERS.

by one special key in the possession of employés. This operation of removing the box, however, can be accomplished without interfering with the meter in any way.

The flexibility of this meter will at once attract the interest of the central station manager. It can be readily adjusted for any rate up to twenty per cent per kilowatt-hour and its principle of combining the time switch with the integrating wattmeter will gain for itself

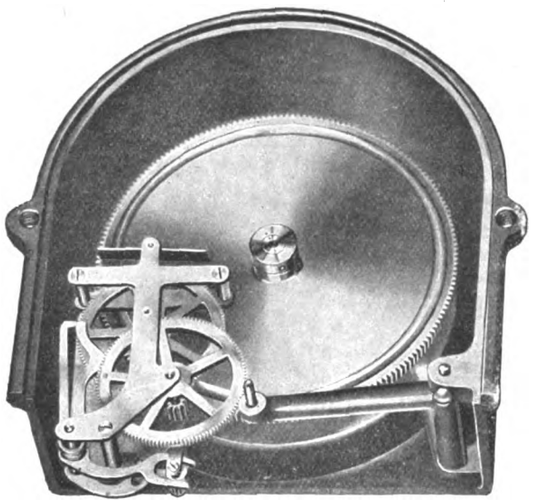


FIG. 4.—DEBITING APPARATUS FORT WAYNE PREPAYMENT WATTMETERS.

an entirely new field of service, especially in sign lighting.

In short, this meter will satisfy a long-felt want among a widely varying class of consumers. The central station will be protected by its use and the consumer will feel better satisfied. It is the ideal installation for the consumer using small amounts of power and in addition it will reduce the amount of bookkeeping and fault-finding to a minimum.

The booklet "Notes on Prepayment Wattmeters" recently published by the Fort Wayne Electric Works clearly sets forth the advantages of this meter, while bulletin No. 1063 and bulletin No. 1066 explain its operation more in detail. These publications will be forwarded upon application.

Orders for the Westinghouse Draft Gear.

The Westinghouse Air-Brake Company has just received orders from the Baltimore & Ohio Railroad system for the equipment of 10,000 of its cars with Westinghouse friction draft-gear apparatus. This will now make a total of 25,000 cars on this system equipped with the friction draft-gear device.

It is interesting to relate in this connection that the Pennsylvania system has now a total of 70,000 cars equipped with this same device.

One of the features of the tests shown the visiting members of the International Railway Congress when they were at East Pittsburg during the month of May was the efficacy of this apparatus to save wear and tear on rolling stock.

Richmond Electric Company's Induction Motors.

The Richmond Electric Company, Richmond, Va., is introducing an induction motor for which it claims a number of valuable features. In designing the motor the company has followed largely European practice, and has produced a motor which is stated to be extremely satisfactory in hard service and of high efficiency. By the use of special sheet steel of high quality, and extremely thin, the hysteresis loss in the motor stators has been reduced to a minimum. The heat losses of the stators are kept down by means of low-resistance windings.

The rotors are designed with heavy imbedded copper bars, and the secondary resistance is in the end rings, where ample ventilation prevents high temperatures. The general appearance of the motor is shown in Fig. 1, and the motor with rotor removed is shown in Fig. 2. The rotor itself is illustrated in Fig. 3.

The bearings are made of aluminum bronze, split, and are ring-oiled. Very large oil chambers provided with overflow and drain plug give ample oil storage capacity, and a system that will require the least possible attention. The heads are held on by four cap screws, and can be readily turned so as to suit the motor for floor, wall or ceiling use.

The motor is equipped with malleable iron skids, so that the skids can be safely lag-screwed or bolted to the ceiling tim-

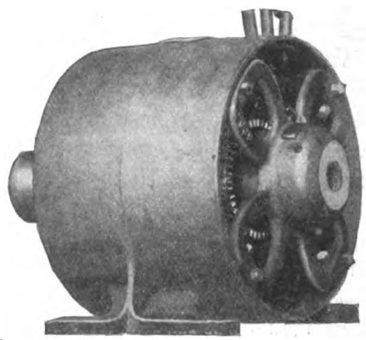


FIG. 1.—RICHMOND ELECTRIC COMPANY'S INDUCTION MOTORS.

bers, and the motor swung from the skids without danger, thus giving belt-tightening adjustment when used on the ceiling as well as on the floor. The shaft is extended on both ends so that, if desired, the motor can drive from either or both sides.

The smaller-sized motors are run at a speed of about 1,700 revolutions per minute; the larger sizes, at 1,150 revolutions. For slow speeds the maker recom-

Digitized by Google

mends a back-geared motor. For variable speeds a motor is provided which has two cone pulleys on either end of the shaft, thus giving four speeds with one belt.

The motors are built in standard sizes of one, two, three, five, seven and one-half, ten, fifteen and twenty horse-power,

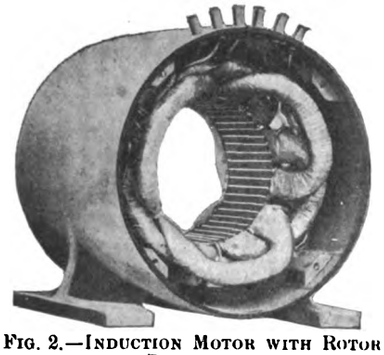


FIG. 2.—INDUCTION MOTOR WITH ROTOR REMOVED.

in all phases, cycles and voltages. The speed is not affected by the number of phases or the voltage. It is controlled by the cycles under which the motor is to operate. At sixty cycles the motors under ten horse-power run at about 1,700 revolutions per minute, and the larger

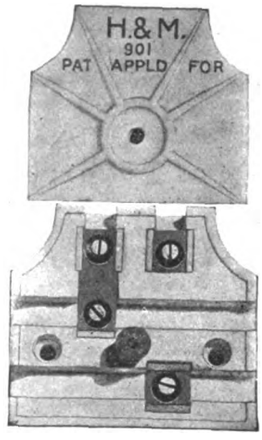
FIG. 3.—ROTOR OF RICHMOND INDUCTION MOTOR.

sizes at about 1,120. At forty cycles all sizes of motors run at about 1,120 revolutions per minute. At thirty cycles the smaller motors run at 1,720 revolutions per minute, and the larger sizes at 850.

A New Type of Moulding Branch Block.

The Elm City Engineering Company, New Haven, Ct., has brought out a new type of moulding branch block which is designed to overcome the disadvantages in making joints and taps in connection with wood-moulding work. In the ordinary method of wiring with moulding the main line of moulding can not be completed until all branch wires are spliced and soldered. With the use of the block shown in the accompanying illustration it is possible to complete the main line at once. It is usually necessary, when making branches or splices in the main line in moulding, to cut the grooves away in order to accommodate the increased size of wire. By the use of the block this is not necessary, and soldered joints are also done away with.

The wires connect under substantial screw heads, and all connecting parts are of sufficient strength and proportions to carry the current intended. It is impossible for contact parts to work loose, as they fit into the recessed parts of the porcelain. The porcelain cap covers the block, and is held in place by a knurled thumb-nut. The block, when in place, presents

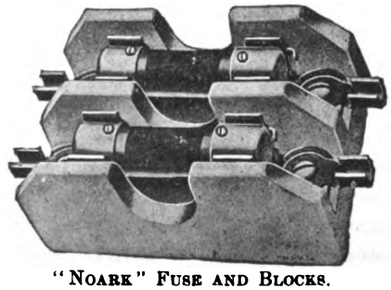


MOULDING BRANCH BLOCK.

a pleasing and, at the same time, a thoroughly safe way of making a branch. The company makes five styles, including two-wire main to double two-wire branch, and three-wire main and single and double two-wire branch. There are also three-wire mains to single and double three-wire branch.

Exhibit of the H. W. Johns-Manville Company.

The H. W. Johns-Manville Company is making an attractive exhibit at the Denver convention of the National Electric Light Association. The company is displaying a large board showing blocks, fuses and fittings of the "Noark" standard type. In addition there is a board consisting of blocks, fuses and fittings of



"NOARK" FUSE AND BLOCKS.

the National Electric Code standard, and a full line of the latest and most modern service and subway boxes.

The construction of the enclosed "Noark" fuses is such that there is no arcing even under conditions of a dead short-circuit. There is therefore no danger of the fuse setting fire to any of the surroundings or injuring the fittings to which it is connected. The fuse strip, which is enclosed in an outer tube, is made of a special grade of metal peculiarly adapted to the purpose. This is surrounded by a powder which protects it from currents of air and other disturbing influences. This powder, after the fuse has blown, immediately takes up the gases generated by the fusing of the metal, thus making the fuse safe under all conditions. A full line of the H. W. Johns-Manville strain insulators is also shown.

Mr. J. W. Perry, general manager of the electrical department, together with the Denver representatives, Hendrie & Bolthoff Manufacturing and Supply Company, is in charge of the exhibit.

A New Type of Dynamotor.

The dynamotor illustrated herewith has been placed on the market by the New England Motor Company, Lowell, Mass. This is a peculiarly handy machine for charging storage batteries or for such other purposes as may require the transformation of direct currents from one voltage to another. The machine is of the cradle type, the armature being

DYNAMOTOR FOR X-RAY OUTFIT.

mounted in a yoke or cradle entirely independent of the field frame. The armature may therefore be removed without disturbing the bearings. Owing to this peculiarity of construction the machine can be assembled for support whether on the floor, from the wall, or from the ceiling. The machine possesses the advantage that it is impossible for the bearings to get out of alignment when changing from one form of support to another.

The machine illustrated herewith was designed for the operation of a large X-ray outfit, and is intended to deliver thirty amperes at 110 volts on the low-pressure or secondary side, using a pressure of 220 volts on the primary.

The New England Motor Company manufactures a complete line of these dynamotors, and is finding a considerable demand for them for charging automobiles, running X-ray outfits, etc.

Digitized by Google

A Modern Hydraulic Elevator Plant.

The accompanying illustrations show portions of the power plant of the John Taylor Dry Goods Company, Kansas City, Mo., and show the three Worthington three-stage motor-driven turbine pumps operating the hydraulic elevator system in this company's store. The power plant of the store contains three generators, two of seventy-five kilowatts and one of 160 kilowatts, each direct-connected to a tandem-compound high-speed engine. These generating units supply power to motors for various services in the building. Power is distributed for electrically operating feed pumps, elevator pumps, a ventilating fan, an ice machine, circulating pumps, and other apparatus.

A notable and interesting feature of this plant is the battery of three high-pressure turbine pumps, shown in Fig. 1. Two machines, each of 300 gallons per minute capacity, are driven by forty-five-horse-power, 220-volt motors. The third pump has a capacity of 500 gallons per minute and is driven by a 220-volt motor of seventy horse-power. These machines maintain a pressure of 140 pounds in the system. Their motors are controlled by standard Cutler-Hammer automatic controlling apparatus, which is mounted on panels and assembled uniformly with the panels of the main switchboard. A portion of this board is shown in Fig. 2. The three pumps supply the water required for the complete hydraulic system, to which all the elevators of the store are connected.

The arrangement of piping for this system is unique and has proved to be the most highly satisfactory in service. There is one pressure main from the discharge openings of the pumps which runs through the whole building, past each of the elevator machines. This pressure main is connected to two compression tanks, one in each end of the building. These two tanks are set at the same level and carry their water lines at the same height. The connection for each elevator machine is taken from the main at a convenient point. There is a return main, paralleling the pressure main, into which each elevator machine discharges, and this return main is connected to each of two open, or "surge," tanks located near the compression tanks. These tanks are connected to the suctions of the pumps. With a suitable arrangement for removing entrained air from the suction line, the operation of the system is perfect.

During the hours of light load, one of the 300-gallon units operating at normal capacity will carry the service. During the hours of heavier service the 500-gallon pump will take care of the load, and during the hours of maximum load either of the 300-gallon machines, together with the 500-gallon one, will carry the load.

The floor space available for this installation was only 160 feet square. A compact outfit was necessary, as this installation is two floors below the ground in a subbasement in which there are many building columns and other obstructions, and where a very limited space was allowed to the engineers for the mechanical equipment. Noiseless operation also was essential in view of the location in a department store. The motor-driven turbine pump was chosen as the one which would best fulfil these conditions.

The nature of the turbine pump is such that a control device is not required except from considerations of economy. The pumps will automatically cease to discharge when the maximum pressure of the system is reached, and the current consumption of their motors will fall to that required to merely rotate the mass of water in the impeller chambers. When the pressure is reduced discharge begins and the current increases proportionately to the amount of pumping done. Consequently, the pumps will operate entirely automatically without any special controlling apparatus, which is greatly in their favor, but the addition of the Cutler-Hammer controlling mechanism is considered a step toward greater economy.

Attention is called to the details of the installation of these pumps. The discharge from each pump is conducted through a special enlarging cast-iron return bend and inverted nested check valve into a conduit under the floor, where it is connected to the pressure main of the hydraulic elevator system. The suction main is also laid in a carefully planned conduit, and the suction of each pump is provided with a separate gate valve, as shown in Fig. 1.

The foundations are of concrete, so formed as to provide ample space for the piping connections and suitable connections to the mains laid in the concrete conduits under the floors. These conduits are accessible through cover-lid sections, carrying on them the tile flooring uniform with the rest of the engine-room floor, and readily removable, uncovering all parts of the piping for inspection.

This plant was designed in all its details and its construction superintended by the engineering office of W. K. Palmer, 718 Dwight Building, Kansas City, Mo.

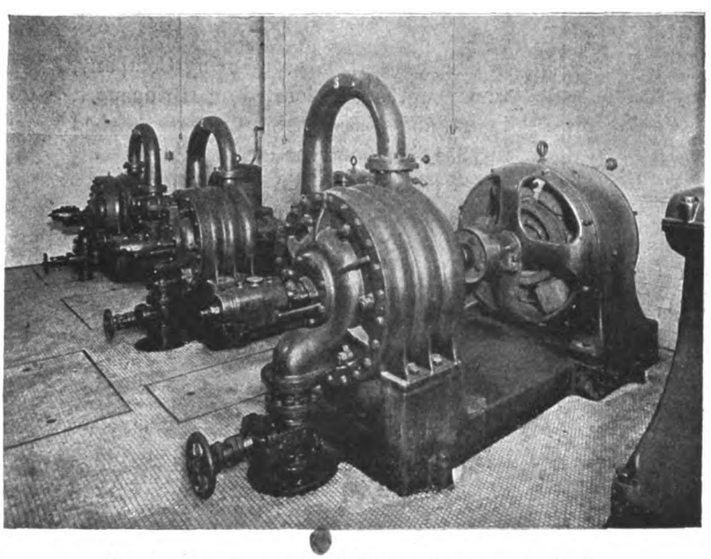


FIG. 1.—BATTERY OF HIGH-PRESSURE TURBINE PUMPS.

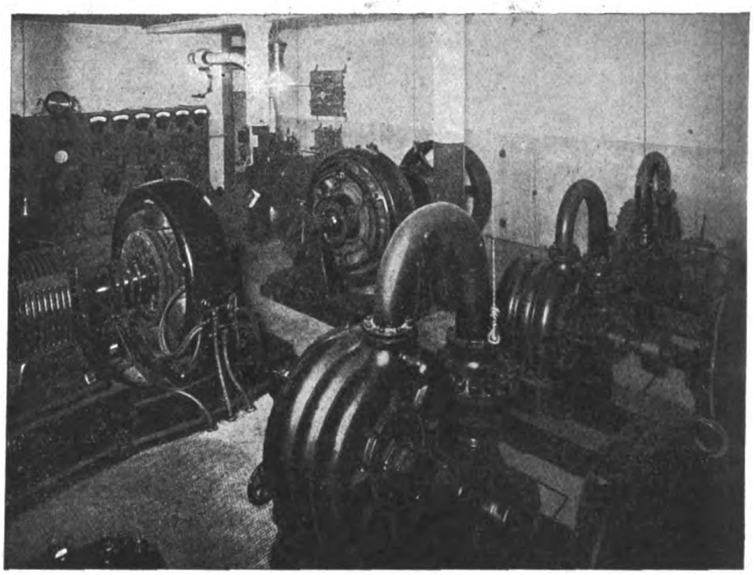
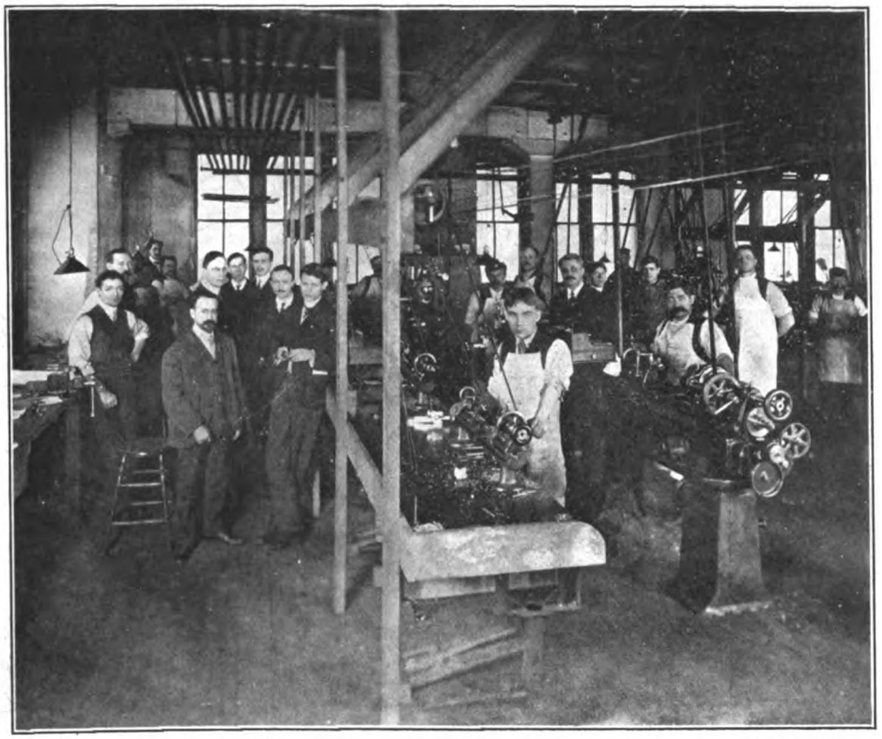


FIG. 2.—BATTERY OF HIGH-PRESSURE TURBINE PUMPS, SHOWING SWITCHBOARD.

Digitized by Google

Milo G. Kellogg's Present Plans and Work.

During the past year Milo G. Kellogg has gathered about him some of the foremost telephone engineers, inventors and patent experts, who were formerly in his employ in the Kellogg Switchboard and Supply Company. These men have been working industriously, developing several new lines of telephone apparatus. Mr. Kellogg's interest in the Kellogg Switchboard and Supply Company, as is well known, was sold out by his attorneys during a severe illness which caused him to retire temporarily from business and seek recuperation in the West. Mr. Kellogg has instituted proceedings to regain this interest. It is in order that there will be no deterioration in the Kellogg apparatus, and that he may thoroughly reinstate himself in the telephone manufacturing business, that this experimental and engineering corps has been established. The experimental shop has been in operation on the third floor of the Electrical Building, Jackson Boulevard, Chicago, Ill., for some time. The apparatus which Mr. Kellogg is developing, it is said, will show marked improvements in telephone apparatus construction. His efforts, up to the present time, have been directed especially to multiple switchboards, semi-automatic switchboard systems, full-automatic switchboard systems, and long-distance transmission apparatus.



EXPERIMENTAL AND ENGINEERING CORPS OF MILO G. KELLOGG.

Incorporation of Manning, Maxwell & Moore.

An important event in the machinery trade was the incorporation, on May 31, of Manning, Maxwell & Moore, Incorporated, composed of the well-known house of Manning, Maxwell & Moore and its allied manufacturing companies, The Shaw Electric Crane Company, The Ashcroft Manufacturing Company, The Consolidated Safety Valve Company, The Hayden & Derby Manufacturing Company, The Hancock Inspirator Company and the United Injector Company.

The corporation was formed under the laws of the state of New Jersey, having a paid-up capital of five million dollars. There is but one kind of stock, known as common, non-assessable.

The officers of the new concern are: Charles A. Moore, president; John N. Derby, vice-president; Martin Luscomb, vice-president; Stephen B. Aller, vice-president; Colby M. Chester, Jr., treasurer; J. H. Blue, assistant treasurer; Charles Arthur Moore, Jr., secretary, and Merle S. Clayton, assistant secretary.

There is to be a board of fifteen directors, among which are some prominent New York business men. The present directors are: Charles A. Moore, John N. Derby, Charles A. Moore, Jr., Colby M. Chester, Jr., J. Rogers Maxwell, Edmund C. Converse, Martin Luscomb, Stephen B. Aller, Alfred Brotherhood, Robert A. Bole, John G. Emery, Jr., James B. Brady, P. M. Brotherhood and A. J. Babcock.

Business will be carried on at the home office of Manning, Maxwell & Moore, at 85, 87 and 89 Liberty street, New York, and through its branch offices in Boston, Philadelphia, Chicago, Cleveland, Pittsburg and St. Louis.

The firm of Manning, Maxwell & Moore was established in 1881, composed of Henry S. Manning, Eugene L. Maxwell and Charles A. Moore. Mr. Maxwell died about ten years ago, and Mr. Moore recently purchased Mr. Manning's entire interest in the business.

The firm was remarkably successful from its inception. Of the several manufacturing companies involved in this consolidation, The Shaw Electric Crane Company, with works at Muskegon, Mich., is the manufacturer of the well-known Shaw electric traveling crane. The exhibit of this company received the grand prize at the Louisiana Purchase Exposition.

The Ashcroft Manufacturing Company, whose works are located at Bridgeport, Conn., and whose business was established in 1851, is among the largest manufacturers of steam gauges in the world. In addition to steam and pressure gauges, the company manufactures the celebrated Tabor steam engine indicator, the Edison recording gauge and an extensive line of pipe-fitters' tools. This company was awarded a grand prize at the St. Louis Exposition.

The Consolidated Safety Valve Company, whose works are also located in Bridgeport, makes the famous "Consolidated" safety valve, which is made under the original Richardson patents, and was the first successful "pop" safety valve ever produced.

The factory of the Hancock Inspirator Company is located in Boston, Mass. This business, established in 1876, consists of the manufacture of the Hancock inspirators for the feeding of locomotive, marine, stationary and portable boilers. Over 300,000 of these instruments are in daily use. This company also manufactures Hancock globe, angle, 60-degree and cross valves, and is making a complete line of locomotive trimmings.

The business of The Hayden & Derby Manufacturing Company was established in 1888, and has a factory in Boston devoted to the manufacture of "Metropolitan" injectors, of which there are over 150,000 in use. The company also makes the "H-D" ejectors and other jet apparatus.

The Consolidated Safety Valve Company, The Hancock Inspirator Company and The Hayden & Derby Manufacturing Company, all received gold medal awards for their exhibits at the St. Louis Exposition.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MORTGAGE OF THE BUFFALO & NIAGARA FALLS ELECTRIC LIGHT AND POWER COMPANY—The Buffalo & Niagara Falls Electric Light and Power Company has given a mortgage to the Buffalo Loan, Trust and Safe Deposit Company for $2,500,000. The company contemplates extensive improvements, and has recently increased its capital stock.

LOCATION FOR POWER PLANT IN INDIANA—The Indiana Hydraulic Company announces that it will build a power plant at the mouth of Sugar creek, about twenty miles north of Terre Haute, Ind. The point on the creek at which the dam will be constructed is known as "Turkey Run," and it is figured that a minimum of 1,000 horse-power and a maximum of 2,000 horse-power can be obtained.

TRANSFER OF ELECTRIC COMPANY IN JAMAICA, WEST INDIES—It has been announced that the West India Electric Company, of Montreal, Quebec, has purchased the entire plant and business of the Jamaica Electric Light and Power Company, of Jamaica, West Indies. The price paid was about $80,000. The Canadian company now controls the entire electric traction and lighting interests in Kingston and Lower St. Andrew.

WORK COMMENCED ON LARGE POWER PLANT—Ground has been broken for the power plant of the Shasta Power Company, Shasta County, Cal. The Shasta Power Company has a franchise from the county, and will take water from the head of Hat creek at the base of Mount Lassen, and convey it twenty-five miles to the site of the power plant on Bear creek. The power plant will generate 3,000 horse-power, which will be transmitted at a voltage of 30,000. The company expects to complete the plant by the first of January.

NEW POWER PLANT IN MEXICO—The Toluca Electric Light and Power Company will develop a water-power concession on the Rio Verde river at Temascatepec. There is a total of about 8,000 horse-power available, but only 3,000 will be utilized at present. The chief engineer, R. J. M. Danley, has filed the final papers providing for the development of the water power, and work will be commenced at once. It is expected that the plant will be in operation by the end of the present year. The power will be distributed to the mining interests in the Temascatepec and Sultepec districts.

MAINE POWER PROJECT FINANCED—Farson, Leach & Company, of New York city, have financed the development of the Bodwell Water Power Company's property at Oldtown and Milford, Me. The company proposes to build a dam and power-house, and to generate from 6,000 to 8,000 horse-power, in addition to the present development. The company has contracted to deliver over 6,000 horse-power of the present development to various manufacturing companies nearby. The power company owns a large amount of land at Oldtown and Milford, which is suitable for factory sites.

LARGE POWER PLANT TO BE ERECTED IN CANADA—Arrangements have been made for a power plant at Upper Bonnington Falls, British Columbia. The plant, when completed, will generate 24,000 horse-power, and cost $1,000,000. This is in addition to the plant now established at the Lower Bonnington Falls, which generates 4,000 horse-power. The plant is intended to supply power to Grand Forks, Phœnix and Greenwood. William M. Doull is president of the company, and L. A. Campbell, general manager of the West Kootenay (British Columbia) Light and Power Company, has charge of the arrangements.

MERGER OF TROLLEY CAR MANUFACTURING COMPANIES—Plans are under way whereby the companies engaged in the manufacture of steel railway cars throughout the country will be merged. Options have been secured on the Laconia Car Company, of Boston, Mass., and Laconia, N. H.; the J. G. Brill Company, Philadelphia, Pa., Elizabeth, N. J., St. Louis, Mo., and Cleveland, Ohio; the St. Louis Car Company, St. Louis, Mo.; the Mason Manufacturing Company, Springfield, Mass.; the Bradley Car Company, Worcester, Mass., and the Jewett Car Company, Newark, Ohio. The plans contemplate a single corporation with a capital of $50,000,000.

ELECTRIFICATION OF THE PHILADELPHIA & READING RAILWAY—It is announced that the Philadelphia & Reading Railway will operate its local suburban trains by electricity for a distance of ten miles out of Philadelphia. This is to be done in connection with the elevation of the railroad company's tracks in Ninth street. When the tracks are elevated and the trains operated electrically, it is planned to build stations at short distances throughout the city, and give a service similar to that maintained on the elevated lines in New York. Vice-President Voorhees stated that the plans did not contemplate the operation of the fast express trains by any other motive power than steam, but that all suburban trains would be operated electrically.

SALE OF NEW YORK & LONG ISLAND TRACTION COMPANY—The New York & Long Island Traction Company has sold its entire plant to Sanderson & Porter, electric railroad contractors, of New York city. The New York & Long Island Traction Company controls thirty-four miles of line, extending from Mineola to Hempstead and from Hempstead to Jamaica. Another line runs from Hempstead to Freeport and from Freeport to Rockville Centre, Valley Stream and South Jamaica to the Brooklyn line. The capital stock is $1,000,000, and its bonded indebtedness is $500,000. The first section of the road was opened in 1902, and the last extension was completed about six weeks ago. The price paid for the road by the new owners is $1,450,000.

DEVELOPMENT OF THE TENNESSEE RIVER TO SUPPLY ELECTRIC POWER—Arrangements have been completed to incorporate the Chattanooga-Tennessee River Electric Power Company, under the laws of the state of Tennessee, with a capital of $3,000,000. The company proposes to begin work within sixty days upon the erection of a power plant at the "suck" on the Tennessee river, twelve miles from Chattanooga. The plant will have a minimum capacity of 30,000 horse-power, making the plant second only to Niagara. The total amount of current which can be produced is estimated at about 60,000 horse-power. The cost of the dam and lock will be $1,180,000, and the cost of the gates for the lock, $150,000. The power plant is to be located on the east side of the river. The building will be 60 by 300 feet, and fifty-seven feet high. The power will be furnished by thirty-six turbines. Applications have already been made by factories in Chattanooga for the use of 4,000 horse-power when the plant is completed. The financial arrangements have been in charge of C. E. James and J. C. Guild, and the construction work will probably be under the charge of Major Newcomber, the government engineer. It is proposed to have the plant in operation within twelve months.

AUTOMOBILE NOTES.

THE HAROLD E. THOMAS CHALLENGE CUP—The Automobile Club of America has accepted the custody of a challenge cup, donated by Harold E. Thomas, to be competed for by the Automobile Club of America and the Chicago Automobile Club, and which is to be the private property of the club winning three successive races for it.

A DANGEROUS CORNER IN SCARBOROUGH-ON-THE-HUDSON—A prominent citizen of Scarborough-on-the-Hudson has appealed to the Automobile Club of America to call the attention of all automobilists to the exceedingly dangerous corner on Broadway (Albany Post Road) in Scarborough, in front of the Presbyterian Church, where the Briarcliff road and the road to the Scarborough Railroad station intersect Broadway. The approach to Broadway is masked on the one hand by a high brick wall, and the road is down-grade, and on the other hand by a sharp curve. Several serious accidents have narrowly been averted at this point. Automobilists are requested to observe the warning signs upon their approach to this point.

Digitized by Google

ELECTRIC RAILWAYS.

NEW MARTINSVILLE, W. VA.—At a special election a franchise was granted to the Wetzel & Tayler Street Railway Company.

EVANSVILLE, IND.—A preliminary survey for the proposed Evansville & Mount Vernon Traction line will be made immediately. At Mount Vernon it is said that the road will be in operation between the two points in twelve months.

LOS ANGELES, CAL.—The $25,000 to be placed at the disposal of the Huntington Electric Railway Company has been subscribed. The corporation is under contract to begin extending its line to Sierra Madre within thirty days after the sum is ready.

PITTSBURG, PA.—The Shenango Traction Company is seeking a right of way through Sharpsville, Pa. The franchise is limited to seventy years. The company agrees to pay a cash bonus of $1,000 and three per cent of the gross receipts after eight years.

GREENSBURG, PA.—The council of Mount Pleasant has granted a franchise to the Uniontown & Monongahela Electric Railway Company, a constituent concern of the West Penn Railways Company. It is stated that a new line to Greensburg, connecting Hecla and Youngwood, will be built.

KANSAS CITY, MO.—The Metropolitan car barn and power plant building at Eighteenth and Olive streets is to be remodeled at a cost of $20,000. The car storage capacity of the building will be increased about twenty-five per cent. An automatic sprinkling system for protection against fire may be installed.

MONROE, LA.—At a meeting of the city council the contract for the construction and equipment of the proposed electric street railway was formally awarded to the Western Electrical Construction Company, of St. Louis, for the sum of $100,000. The work is to commence at once and be completed within six months.

JACKSON, MICH.—The council of the village of Howell has granted a franchise through the streets of the village to James and Charles Van Keuren and others for an electric line from Lansing to Detroit. The village of Brighton has also granted a franchise to the same men. The franchise calls for beginning work in eight months.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Company is about to purchase eighteen new cars at a cost of about $5,000 each. The cars are to be ordered at once, and must be delivered by October 1. The company will spend between $180,000 and $200,000 in improvements this summer. These improvements include the extension and double-tracking of a number of lines.

COLUMBUS, OHIO—The Columbus, Johnstown & New Albany Railway Company has given a mortgage to the Columbus Savings Bank and Trust Company for $450,000. The company intends paying off indebtedness and completing the line. The mortgage is to secure twenty-year gold bonds. At the same time the company canceled a $200,000 mortgage held by the Cleveland Trust Company.

NORRISTOWN, PA.—The Lansdale & Norristown trolley line, including all the property, buildings, terminal facilities and property, steam and power plant, engines, boilers, dynamos, generators, cars, ties, motors, power and car houses, overhead construction, branches, switches, rights of way, franchises and all other property real and personal, was sold at public auction on May 25 to General W. E. Doster, counsel for the Lehigh Valley National Bank, of Bethlehem, for $150,000.

WATERLOO, IOWA—The Greenville & Newnan Railway Company, with headquarters at Savannah, has been granted a charter. The company proposes to build a line of railway through Coweta and Meriwether counties, extending from Greenville, in the last-named county, to Newnan, in Coweta County, the line to be approximately thirty miles in length. The incorporators are J. F. Hanson and S. R. Jacques, of Macon; H. C. Cunningham, T. M. Cunningham, Jr., T. S. Moise, W. A. Winburn, Alexander R. Lawton, H. W. Johnson, J. T. Johnson and H. M. Steele, of Chatham County.

ROCHESTER, N. Y.—Offices have been established in Rochester by the Rochester & Southern Electric Company, which has yet to be incorporated, and which has been formed for the purpose of building an electric railway between Rochester and Elmira, with several branch lines. A company to be known as the Rochester & Southern Construction Company is to be incorporated with a capital of $100,000 to build the road, which is to be 120 miles long, and for which ninety per cent of the necessary consents for right of way are said to have been obtained. The power-house will probably be placed at Wayland.

OBITUARY NOTICE.

MR. EDWARD A. LESLIE, general manager of the Kings County Electric Light and Power Company, died on Monday, June 5, at his home, 262 Hancock street, Brooklyn, N. Y. Mr. Leslie suffered from pneumonia and pleurisy, and made a brave struggle against this complication, aided by every human agency possible. He was a man remarkable in many ways, and his loss will be keenly felt, not alone by his family and business associates, but he will be mourned by a host of friends and acquaintances who held him in high esteem. Mr. Leslie was born in Harrisburg, Pa., in 1849. He entered work in the telegraph service as messenger boy for the Illinois & Mississippi Telegraph Company at Freeport, Ill. Acquiring the art of telegraphy he was made manager of the office at Lena, Ill., and like most of the operators of that period, was used to supply vacancies in various places, until he finally found the way to New York city and entered the employ of the Western Union Telegraph Company. There he became manager of the cable department, the service of which he conducted with acknowledged fidelity and ability. In 1882 Mr. Leslie was appointed superintendent of the Mutual Union Telegraph Company, with headquarters at Washington, D. C., and in the year following accepted the appointment as assistant general superintendent of the Postal Telegraph Company. In 1884 he received the appointment of superintendent of the National Telegraph Company, which was a part of the Baltimore & Ohio system, and at the same time he was appointed superintendent of the eastern division of the Baltimore & Ohio Company, comprising the eastern states and portions of New York, New Jersey, Pennsylvania and Delaware. On October 1, 1885, in token of his ability and devotion, Mr. Leslie was appointed general superintendent of the eastern division with headquarters in New York. After a short period with a storage battery company he entered the employ of the Consolidated Telegraph and Electrical Subway Company, and in 1888 was made manager of the Manhattan Electric Light Company, afterwards consolidated with the Edison Electric Company, remaining with them until 1901, when he became the general manager of the Kings County Electric Light and Power Company, on Pearl street, Brooklyn. In that position he showed remarkable executive ability from the first, and formed friendships which have been strong and lasting. Mr. Leslie was a valued member of the Crescent Athletic, the Hamilton and the Brooklyn Whist clubs, in the latter of which he was vice-president. He was also a member of Grant Post, G. A. R., having entered the army as a drummer boy of sixteen years, at the beginning of the Civil War. He participated in the siege of Mobile in 1865, as a member of Company E of the Forty-sixth Regiment of Illinois Infantry Volunteers. He was also a popular member of the Masonic fraternity and belonged to Anglo-Saxon Lodge No. 137, F. and A. M., and to Kismet Temple, A. A. O. N. M. S. He leaves a widow who was a Miss M. E. Morley, and two children, Edward, Jr., and Miss Florence M. Leslie.

Photo by Dampf.
MR. E. A. LESLIE.

Digitized by Google

ELECTRIC LIGHTING.

WHITTIER, CAL.—The Edison Electric Company will double the capacity of its plant.

LEWISTOWN, MONT.—It is announced that John L. Bright will build a new electric light plant at Livingston.

JANESVILLE, WIS.—The Janesville Electric Company has been awarded a five-year contract for lighting the city.

TALLAPOOSA, GA.—Messrs. Gelder & Black have been granted a fifteen-year franchise to erect an electric light plant.

LOGAN, UTAH—The city will install a second unit at the municipal lighting plant. Work is to be completed by September 1.

PADUCAH, KY.—The Paducah Gas and Electric Company has been sold to James C. Utterback. The price paid is stated to be $135,000.

TRUCKEE, CAL.—The plant of the Truckee Electric Light and Power Company was totally destroyed by fire on May 29. The loss is about $40,000.

JOHNSON, VT.—Johnson has voted to secure the Ithiel falls, and to equip them so as to provide electric power. The estimated expense is $12,000.

GREENVILLE, MISS.—The Delta Electric Light, Power and Manufacturing Company has assumed control of the Greenville Light and Car Company.

FREDERICKSBURG, VA.—The city has voted not to sell the municipal electric light plant and franchise. The proposition was defeated by a majority of 314.

POTSDAM, N. Y.—The village trustees will offer for sale $40,000 worth of bonds. The proceeds are to be used to establish and maintain an electric light plant.

DETROIT, MICH.—The village waterworks and electric light plant at Trenton were destroyed by fire on May 27. The loss is $30,000, partially covered by insurance.

HOUSTON, TEX.—The electric light plant at Houston Heights will be renovated and put in operation by O. M. Carter. A quantity of new machinery will be added to the equipment.

PRAIRIE GROVE, ARK.—An electric light plant is soon to be established at Prairie Grove, and the streets are to be lighted with electricity. Clem Cummings has the matter in charge.

MORGANFIELD, KY.—T. W. Gilbert, of Chicago, has purchased the electric light plant for $6,000. The new owner proposes to install a 3,000-light generator, and a 200-horse-power engine.

CLARKSBORO, N. J.—It is proposed to install an electric plant to light the towns of Jefferson, Mount Royde, Clarksboro and Mickleton. A mill at Boody's pond will be converted for the station.

NEW CASTLE, COL.—The Henry Electrical Corporation, of Denver, has purchased the Peter Kinney electric light plant at New Castle, and will remodel it. New machinery will be installed.

LEBANON, N. H.—The Lebanon Electric Light Company has purchased the Chancellor water privilege on the Mascoma river. There is a twenty-two-foot head and about 200 horse-power is available.

WALLA WALLA, WASH.—The Northwestern Gas and Electric Company has secured the franchise for a street railway system from E. S. Isaacs. Construction will begin as soon as the material can be obtained.

LAWRENCE, KAN.—The Lawrence Electric Light Company has been reorganized, with Irving Hill as president and R. C. Johnston as secretary and manager. The company proposes to purchase new engines and dynamos and to enlarge the plant to three times its present capacity.

STAMFORD, VT.—The Stamford Heat and Power Company has organized with the following directors: John Tudor and Charles D. Houghton, of Stamford; C. H. Cutting, H. T. Cady, E. A. Richardson, J. D. Hunter and F. S. Richardson, of North Adams, Mass. The officers are: president, J. D. Hunter; vice-president, H. T. Cady; clerk, C. D. Houghton; treasurer, F. S. Richardson.

TELEPHONE AND TELEGRAPH.

HAMMONTON, N. J.—Plans are under way for the installation of a local telephone system at Hammonton.

ASHLAND, OHIO—The Bell Telephone Company, of Wellington, has built a line from Pleasant Home to Wooster.

BALTIMORE, MD.—The Marydel & Templeville Telephone Company has been incorporated with H. S. Daily as president.

CLYDE, N. Y.—The Empire State Telegraph and Telephone Company has begun the enlargement of its Clyde exchange.

WALLACE, IDA.—The Rocky Mountain Bell Telephone Company will make extensive improvements to its system in Wallace.

BESSEMER, ALA.—The Southern Telephone Company will construct two additional trunk lines between Bessemer and Birmingham.

PENN YAN, N. Y.—The Seneca-Gorham Telephone Company is being extended to Potter Center and other points throughout that locality.

BLOOMINGTON, MINN.—The Market Gardeners' Telephone system, of Bloomington, has been sold to the Fisher system, of Shakopee.

MIDDLETOWN, N. Y.—The Highland Telephone Company has secured a right of way through the village of Cornwall, and will extend its line at once.

WEST CHESTER, PA.—The Delaware & Atlantic Telephone Company is constructing a new line from Berwyn to Phœnixville *via* Diamond Rock, which is expected to facilitate increasing business in that direction.

HUNTSVILLE, ALA.—A new telephone system joining the villages northwest of Huntsville as far out as Kelly Station has been connected with the Huntsville telephone exchange. The new system serves a large population.

PLAIN CITY, UTAH—The Rocky Mountain Bell Telephone Company is putting in a new telephone system, making Plain City the central station of the northwestern part of Weber County. West Weber, Warren, Poplar and Far West will centralize at this point.

SOUTH BETHLEHEM, PA.—The Passer Rural Telephone Company organized recently with the following officers: president, W. B. Price; secretary and treasurer, Jacob A. Appel. The directors are E. P. Frankenfield, Benjamin Hottle, A. R. Trumbower, Isben Gross, Jacob Steyer, Eugene Leith and Clarence Bigot. Connection will be made at Hellertown with the Pennsylvania Telephone Company.

TERRIL, IOWA—The Terril Co-Operative Telephone Company, composed of local citizens, has bought the telephone system heretofore operated by the Midland Telephone Company, of Milford. The officers of the local company are: president, D. A. Daniels; vice-president, T. J. Randolph; secretary, D. E. Neville; treasurer, W. C. Edmunds; directors, Martin Adson, David Woods, Ole Fingerson and G. W. Nefzger.

BALTIMORE, MD.—The contract for building the Chesapeake & Potomac Telephone Company's new central headquarters has been awarded to the Herbert A. Weeks Company, of New York. The new building will have a frontage of forty feet and a depth of 150 feet. Fireproof construction will be used throughout. The frame of the building will be of steel and the foundations of concrete. Though the building will be nine stories high, the construction will be such as to permit the erection of two additional floors.

CORNING, N. Y.—The organization of the Galeton & Hull Telephone Company has been perfected, the necessary poles and material purchased, and the contract let for building a first-class metallic circuit telephone line from Galeton to the Hammersley river by way of Corbett, Hull and Logue. The officers are: J. S. Hull, Conrad, president; W. D. Cool, Galeton, vice-president; H. H. Griswold, Galeton, secretary and treasurer. It is the company's purpose to establish toll offices at Corbett, Hull, Logue and on the Hammersley river, with connections to the various jobbing camps of the extensive lumber region.

Digitized by Google

NEW INCORPORATIONS.

OMAHA, NEB.—Rock & Conklin Telephone Company. $10,000.

MEREDITH, N. H.—Meredith Electric Light Company. $9,000.

DES MOINES, IOWA—Walker Telephone and Telegraph Company. $10,000.

MILWAUKEE, WIS.—Buckeye Ridge Cooperative Telephone Company. $1,500.

HARRISBURG, PA.—Wissahickon Electric Company, of Fort Washington. $10,000.

MANCHESTER, N. H.—Manchester Street Railway Company. Increased to $250,000.

SPRINGFIELD, ILL.—Springfield Light, Heat and Power Company. Increased to $325,000.

LINCOLN, NEB.—Union Telephone Company, of Pleasant Dale; $5,000. Falls City Telephone Company; $50,000.

AUSTIN, TEX.—The Anglin Light Company, of Groesbeck. $6,000. Incorporators: Z. Anglin, John Clairman and John W. Turner.

SPRINGFIELD, ILL.—Beuld Electric Light and Power Company, of Hillsboro, $10,000. Incorporators: James A. Davis, H. E. Haag, J. R. Caudry.

LINCOLN, NEB.—Sherman County Telephone Company. To build, own and operate telephone lines in Sherman and surrounding counties. $50,000.

WARREN, OHIO—Carrollton Electric Company. $20,000. Incorporators: U. C. DeFord, J. C. Ferrall, W. O. DeFord, George J. Butler and T. J. Saltsman.

MIDDLETOWN, N. Y.—The Middletown Telephone Company, Middletown. $10,000. Directors: Edwin Fancher, J. B. Hulett, M. C. Conner, Middletown.

UTICA, N. Y.—Central New York Power Company. To sell gas and electricity in all parts of the state, except in Greater New York and Long Island. $1,000,000.

MINNEAPOLIS, MINN.—Hughes Electric Company. $100,000. Incorporators: Alexander H. Hughes, of Minneapolis; E. A. Hughes and W. V. Hughes, of Bismarck, N. D.

NASHVILLE, TENN.—Central Telephone Company, Fentress County. $10,000. Incorporators: O. C. Conatser, W. R. Case, W. L. Wright, C. O. Wright and L. A. Sole.

ALBANY, N. Y.—New York & Lake Erie Power and Transmission Company, of Erie County. $100,000. Directors: J. F. Aldrich, G. A. Ricker and C. F. Powell, of Buffalo.

WHITE PLAINS, N. Y.—Homans Light, Heat and Power Company. $250,000. Directors for the first year: Robert B. Marten, William P. Homans and Martin Swatts, all of Manhattan.

JEFFERSON CITY, MO.—Bogard & Bingham Telephone Company, of St. Louis. $2,000. Incorporators: William Tomlin, J. J. Tomlin, Thomas Knott, James H. Sheehan, B. J. Hurt, W. C. Auston and others.

DENVER, COL.—Republican Mountain & Gray's Peak Railway Company. $100,000. Incorporators: C. H. Green, W. N. W. Blayney, P. B. Tolles, J. A. Curran, F. I. Smith, C. K. Wolfe, Arnold Barmettler, Denver.

ALBANY, N. Y.—Rensselaer Heat, Light and Power Company. To furnish gas and electricity. $5,000. Directors: Edward J. McKenna and Lewis E. Griffith, of Troy, and Edmund L. Worden, of Hoosick Falls.

ST. PAUL, MINN.—Freeborn County Rural Telephone Company, of Glenville. $10,000. Incorporators: A. W. Trow, Martin Moe, S. P. Nelson, A. S. Budlong, N. P. Nelson, W. S. Palmer, Walter Knutson and Fred Will.

COLUMBUS, OHIO—The Ohio Traction Company, of Cincinnati. To lease, own and operate street and interurban roads in and between Cincinnati and Hamilton. $20,000,000. Incorporators: W. Kesley Schoepf, W. S. Rowe, W. C. Proctor, Briggs S. Cunningham and W. T. Irvin.

MALONE, N. Y.—Adirondack Home Telephone Company. To operate in Franklin, Clinton, St. Lawrence, Jefferson, Lewis and Essex counties. $150,000. Directors: Howard Hendrickson, W. A. Hendrickson, H. M. Keys, F. E. Griffin, W. B. Harris, H. J. Deikman and C. J. Crummey, of Albany.

WHEELING, W. VA.—Interurban Construction Company. To build an electric line from Zanesville to Roseville, and thence to Crooksville; also to construct electric plants, telephone lines, etc. $400,000. Incorporators: W. A. Wilson, Albert G. Hallock, Charles W. Jefferson, Horace D. Kennedy, Alfred Caldwell.

ALBANY, N. Y.—The Freeport Gas and Electric Company. Organized to manufacture and supply gas for lighting, and electricity for light, heat and power in the cities, villages and towns of New York state. $1,000. Directors: Leo W. Wertheimer, Manhattan; Henry C. Miller, of Tarrytown, N. Y., and Louis A. Klipp, of Brooklyn.

ALBANY, N. Y.—Ne-Ah-Ga Telephone Company, of Sterling. Formed for the purpose of connecting various houses and business places in Sterling, running from Fair Haven to southwest Oswego in Oswego County. $1,500. Directors: John R. Ingersoll, William R. Andrews, Levi S. Fralick, William H. Williams, Alexander Johnson, John Farden and Frank McIntyre.

ST. PAUL, MINN.—Comfrey Rural Telephone Company, Comfrey; $25,000; officers: president, J. A. Prim; vice-president, L. P. Richardson; secretary, C. L. Lunkersmith; treasurer, Oscar Erickson. Sleepy Eye Telephone Company, Sleepy Eye; $15,000; officers: president, J. M. Olsen; vice-president, Charles P. Cutting; secretary, William Brust; treasurer, A. A. Larrabee.

ALBANY, N. Y.—Western Counties Transmission Company, of Buffalo; to supply electricity in various counties of the state for light, heat and power purposes; $2,000,000; directors: R. W. Pomeroy, J. G. Dudley, H. T. Ramsdell, H. G. Meadows, C. L. Gurney, R. W. Chapin and L. B. Hart, of Buffalo. International Power and Transmission Company, of Niagara Falls; to supply electricity for light, heat and power purposes; $2,000,000; directors: S. P. Franchot, J. S. Simmons, F. J. Brown, Clarence Tower, John F. Lynch and H. H. Findlay, of Niagara Falls. Lindenwald Light, Heat and Power Company, Chatham, Columbia County; to supply gas and electricity; $25,000; directors: A. B. Gardenier, S. W. Smith and M. P. H. Smith, of Chatham. Hoosick Falls Illuminating Company, Hoosick Falls, Rensselaer County; to supply gas and electricity; $150,000; directors: Roger Lewis, L. C. Tetard, Sherman Cox and R. W. Gifford, of New York, and G. D. Martin, of Greenwich, Ct. Blasdell Electric Company, Blasdell, Erie County; to supply electricity for light, heat and power; $50,000; directors: J. B. Wall, M. M. Wall and T. H. Wall, of Buffalo. The Cazenovia Electric Company, Cazenovia, Madison County; $30,000; directors: Henry Burden, 2d, and R. F. Hubbard, of Cazenovia, and R. S. Brewster, of New York.

ALBANY, N. Y.—General Transmission Company; $15,000,000; directors: James D. Ferris, Robert A. Teepell, Fred E. Pond, Byron L. Moore, of Buffalo, and Hugh Taylor, of East Aurora. Niagara & Eastern Power Transmission Company; $2,000,000; directors: Henry B. Bodine, J. Gilmour Drayton, of Niagara Falls, and Addison H. Hinman, of Buffalo. Buffalo & Montauk Company; $2,000,000; directors: Hugh Taylor, of East Aurora; Byron L. Moore, Anthony P. Harks, Fred E. Pond and James D. Ferris, of Buffalo. The Niagara Gorge Power Company, of Buffalo; $2,000,000; directors: J. T. Jones, J. A. Jones, R. E. Powers and H. P. Bissell, of Buffalo. Dutchess Gas and Electric Company, of Poughkeepsie; $25,000; directors: A. E. Seibert, James Cochrane, of Brooklyn, and W. R. Maloney, of Poughkeepsie. The Genessee County Electric Light, Power and Gas Company, Batavia; $100,000; directors: S. B. Storer, Syracuse; R. M. Walker, C. C. Bradley, Batavia. The Dexter Electric Light and Power Company, Dexter; to furnish light and power in various towns and villages in Jefferson County; $100,000; directors: Edward Hunter and Catherine J. Hunter, Dexter; Celestin C. Burns and George H. Burns, Watertown. The Albany, Susquehanna Valley & Binghamton Power Company, Schenevus; $75,000; incorporators: Melvin Baldwin, John Graney, Schenevus; George Brooks, Cooperstown. Pioneer Gas and Electric Company; $300,000; directors: William F. Carroll, G. Harris, F. V. Barnes, H. E. Martin and George Clinton, Jr., of Buffalo.

Digitized by Google

PERSONAL MENTION.

MR. FRANK P. FOSTER, superintendent of fire-alarms in Corning, N. Y., has resigned his position to become electrician at the Corning Glass Works.

MR. SAMUEL HASTINGS has been appointed local manager of the Wisconsin Bell Telephone Company at Green Bay. He will succeed Mr. Frank Carswell.

MR. ROBERT McF. DOBLE, consulting engineer of the Abner Doble Company, San Francisco, is in Mexico for the purpose of investigating several important hydro-electric long-distance power projects.

MR. CHAS. S. DAVIS, for the past six years master electrician of the Bureau of Construction and Repair, Charlestown Navy Yard, has joined the engineering staff of the Holtzer-Cabot Electric Company, Boston, Mass. Mr. Davis entered upon the duties of his new position on June 1.

MR. A. G. MILLER, who has been division superintendent of the Rocky Mountain Bell Telephone Company, with headquarters at Helena, Mont., has been appointed as the first superintendent of the Bell Telephone company's new North Idaho division. His headquarters will be at Cœur d'Alene. This appointment took effect June 1. Mr. Miller will be succeeded as superintendent of the Montana division by Mr. Harry L. Burdick, of Chicago.

MR. GEORGE GIBBS has been appointed chief engineer of electric traction of the Pennsylvania, New York & Long Island and the Pennsylvania, New Jersey & New York Railroad companies. Mr. Gibbs will have supervision of all the electrical work and electrical equipment of the Pennsylvania lines and in the tunnels from Newark, N. J., to Long Island City. He is a vice-president of Westinghouse, Church, Kerr & Company, and will also be appointed chief engineer of the Long Island Railroad Company.

MR. E. M. HERR has been elected first vice-president and chief executive under the president of the Westinghouse Electric and Manufacturing Company. Mr. Herr is widely known among railroad managers, and is skilled not only in the manufacture of railway apparatus, but is also conversant with railroad operations. Mr. Herr was locomotive superintendent of the Northern Pacific Railway for a number of years, and previous to this had many years' experience in various positions on important railways in the West. For the past seven years he has been vice-president and general manager of the Westinghouse Air Brake Company.

LEGAL NOTE.

GENERAL ELECTRIC COMPANY LITIGATION—A decree has been filed in the United States Circuit Court, District of Indiana, under date of May 1, in favor of the General Electric Company, complainant, and against the Kuhlman Electric Company, defendant, in the three-phase transformer case litigation. The proceedings involved patent No. 422,746, issued to Michael von Dolivo-Dobrowolsky. The Court has adjudged that Dobrowolsky was the first true and original inventor of the inventions and improvements described and claimed in these letters-patent. It is also adjudged that the General Electric Company is the lawful and exclusive owner of these letters-patent. The Court decrees that the defendant, the Kuhlman Electric Company, has infringed upon these letters-patent, and the claim thereof, and upon the exclusive rights of the complainant under the same. The recovery of damages to the complainant by reason of the infringement has been referred to Edward Daniels, Esq., as master. In the under-running trolley case, involving the Van Depoele reissue patent No. 11,872, a decision has been filed in the United States Circuit Court for the Western District of New York, on May 8, in favor of the Thomson-Houston Electric Company, complainant, *versus* the International Trolley Controller Company, defendant.

ELECTRICAL SECURITIES.

Of course, the paramount subject of discussion last week was the overwhelming defeat of the Russian fleet in the Korean straits. Added to this, however, was the passage of the franchise tax law. It is freely predicted in many quarters that the first-mentioned catastrophe will not have the quickening influence for peace that was hoped, and the effect of the latter, of course, can not at this time be estimated. Despite the apparent sluggishness of sales and continued low prices the business of the country holds good, and the hope is still strong that there will be no further retrogression in any department of industry.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 3.

New York:	*Closing.*
Brooklyn Rapid Transit	63¾
Consolidated Gas	187
General Electric	173¼
Interborough Rapid Transit	198¼
Kings County Electric	200
Manhattan Elevated	163½
Metropolitan Street Railway	118⅝
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	190

The Metropolitan Street Railway Company has declared the quarterly dividend of 1¾ per cent, payable July 15. Books close June 24 and reopen July 15.

The consolidated statement of earnings and expenses of the New York City Railway system (including all lines owned or controlled) for the nine months ended March 31, 1905, is as follows: gross, $13,490,318; expenses, $7,610,899; net, $5,879,419; other income, $900,080, making a total of $6,779,499; charges, $8,703,876, leaving a deficit of $1,924,377, as compared with a deficit of $642,158 for the same period of 1904.

Boston:	*Closing.*
American Telephone and Telegraph	139
Edison Electric Illuminating	246
Massachusetts Electric	58
New England Telephone	138
Western Telephone and Telegraph preferred	99

Trustees of the Massachusetts Electric Companies have voted to postpone action regarding the declaration of a dividend upon the preferred stock.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	76
Electric Storage Battery preferred	76
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	27¼
United Gas Improvement	92¼

The general balance sheet of the Electric Company of America as of December 31, 1904, shows assets of $5,061,896 and liabilities of $4,289,674, leaving a surplus of $772,222.

Chicago:	*Closing.*
Chicago Telephone	134
Chicago Edison Light	160
Metropolitan Elevated preferred	58
National Carbon common	62
National Carbon preferred	114
Union Traction common	6
Union Traction preferred	34

Northwestern Elevated's daily average of passengers for May was 77,863, an increase of 8,631.

Oak Park Elevated for May showed a daily average, including transfers, of 46,471 passengers, an increase of 3,638.

Metropolitan Elevated for May carried an average of 125,164 passengers, an increase of 10,792, making the best showing since 1903.

South Side Elevated's May daily average of traffic was 89,971, an increase of 6,629.

ENGINEERING SOCIETIES.

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The twenty-first regular meeting of the Toronto branch of the American Institute of Electrical Engineers was held on May 26, 1905. Prof. Rosebrugh presented a paper entitled "Armature Winding," which was illustrated with lantern slides. Officers were also elected for the ensuing year.

Digitized by Google

INDUSTRIAL ITEMS.

THE INTERNATIONAL NICKEL COMPANY, 43 Exchange place, New York city, has issued a small pamphlet giving a list of uses to which nickel-steel may be put.

THE ELECTRIC COMPANY, Continental Building, Baltimore, Md., has issued a catalogue of electric fans. This contains a large number of different types of fans, including desk fans, swivel fans, ceiling fans, electrolier fans, revolving fans, etc.

THE BROWN & SHARPE MANUFACTURING COMPANY, Providence, R. I., is calling attention to its new machinists' tools. These include micrometer caliper sets, improved steel beam trammels, universal dividers, scribers, straight edges, etc.

THE NOVELTY ELECTRIC COMPANY, Philadelphia, Pa., is calling attention, in a very handsome catalogue, to the "Neco" battery call telephone which it manufactures. This catalogue describes desk sets, wall sets, bracket sets and different forms of annunciators.

THE BROWNING ENGINEERING COMPANY, Cleveland, Ohio, in bulletin No. 17 describes and illustrates the "Browning Square Type" automatic grab-bucket for digging coal, ashes, cinders, coke, gravel, sand, crushed stone, slag, and for all materials of a similar character.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports that it has closed contracts for switchboards for the following places: Quimby, Ohio; Rice Lake, Wis.; Roosevelt, Ariz.; Essex, Iowa; Breeds, Ill.; Linn Grove, Iowa; Buffalo Hart, Ill.; Baldwin, Wis.

THE ECONOMICAL ELECTRIC LAMP COMPANY, 227-229 Fulton street, New York city, is calling attention to the "Economical" turndown lamp. This lamp is furnished in all voltages from 50 to 240, and with Westinghouse, Edison and Thomson-Houston bases. The manufacturer states that "it turns up and down like gas."

THE NERNST LAMP COMPANY, Pittsburg, Pa., is distributing two handsome bulletins entitled, respectively, "Church Lighting by Electricity" and "Bank and Office Lighting by Electricity." There is also a general catalogue and price list, No. 4. This supersedes all previous price lists, and should be secured by every one interested.

E. C. HOGREVE & COMPANY, 642 Main street, Cincinnati, Ohio, are distributing a folder describing and illustrating interior telephones for stores, factories, hotels, warehouses, etc. The instruments shown are intercommunicating sets, desk sets, single-line telephones, party-line telephones, hotel telephones and hotel annunciators.

DODGE & DAY, Philadelphia, Pa., have been commissioned by the Electro-Dynamic Company to make a thorough examination of the existing methods in the shops at Bayonne, N. J. The business of the Electro-Dynamic Company has increased to such an extent that it has become urgently necessary either to speed up the shops or provide more adequate facilities.

THE STANLEY INSTRUMENT COMPANY, Great Barrington, Mass., is advertising its rotated jewel-bearing wattmeters for alternating-current circuits by means of a large blotter, upon the back of which is shown a wattmeter, together with a large amount of descriptive matter concerning it. The company has also issued bulletin No. 90531, descriptive of the same instrument.

THE F. BISSELL COMPANY, Toledo, Ohio, reports that it is doing a large business in poles. The demand is heavy, and the supply is none too plentiful for actual stocks. The company is filling orders rapidly, and suggests that those who intend purchasing this year should not defer longer than necessary, as all indications point to a shortage, particularly in sizes of thirty-five feet and upward.

FRANK R. GILBRETH, 34 West Twenty-sixth street, New York city, announces that he has received a contract, on the cost plus-fixed sum basis, for a large car barn, 76 by 361 feet, at North Syracuse, N. Y. The architects, Messrs. Gaggin & Gaggin, have decided that, instead of the conventional iron roof, a concrete roof shall be used. Besides the car barn the contract calls for the building of a substation 38 by 103 feet.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., has issued a series of leaflets to be inserted in its perpetual catalogue. It must be understood that these bulletins replace older ones similarly designated. These older bulletins should be removed from the perpetual catalogue, and the new ones put in their place. The company will be pleased to send these bulletins to any one who is interested.

THE NATIONAL CONDUIT AND CABLE COMPANY, 41 Park Row, New York, in a pamphlet, entitled "Copper Gossip," discusses the business outlook and the copper market situation. Conditions are stated to be favorable, and the copper market is firmer and more active. The exports for the first four months break all records. The pamphlet also gives a comparison of the price of copper at London and New York for the past six weeks, the exports and imports of copper for the first part of 1905, and European copper statistics.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., will be pleased to send bulletin No. E-101, descriptive of standard service enclosed, self-oiling, direct-connected engines. The engines illustrated in this bulletin are built strictly in accordance with the recommendations of the joint committee of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, as to speeds, sizes of units and sizes of shafts. In addition to the text describing the engines, there are several illustrations which make evident the construction of the machines.

THE CHICAGO FUSE WIRE AND MANUFACTURING COMPANY, 203 Fulton street, New York city, is distributing bulletin No. 16, describing "Union" enclosed fuses and blocks. This system of fuses has been perfected after several years of experimental work, and now includes the styles known as "National Code Standard," and, in addition, fuses in sizes to fit other styles of blocks in common use, as well as a large variety of switchboard fuses of all sizes. "Union" code blocks are made of highest grade electrical porcelain, with mountings of heavy brass and phosphor-bronze springs.

H. M. BYLLESBY & COMPANY, INCORPORATED, engineers, New York Life Building, Chicago, Ill., have issued bulletin No. 2. This is entitled "Economy Test of a 500-Kilowatt Steam Turbine for Oshkosh Gas Light Company, Oshkosh, Wis." The results obtained in the tests are most interesting. The steam consumption ranged from 25.99 pounds per kilowatt-hour at half load (250 kilowatts) to 22.28 pounds per kilowatt-hour with an overload of 22.2 per cent, or 611 kilowatts. The complete results of the tests are given in tabulated form for half-load runs, commercial runs, full and overload runs. In addition to the tables the test results are plotted on cross-section paper. The bulletin is a most valuable addition to steam turbine literature.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., will have an exhibit on the veranda of the Manhattan Beach Hotel during the convention of the American Railway Master Mechanics' Association and the Master Car Builders, which will be held at Manhattan Beach, L. I., N. Y., June 14 to 21. The exhibit will consist of one of the company's type "5-S" four to one "Interpole" variable-speed motors belted to a generator. This motor will also be reversed under all of the different conditions of load and speed, and will show remarkable results in the operation of electric motors, either for constant or variable-speed work. There will also be on exhibition varieties of motors, running from one horse-power at a speed ratio of four to one, up to ten horse-power at a speed ratio of four to one. The motors which the company will exhibit at Manhattan Beach will cover 123 distinct varieties, enabling the user of motors a remarkable opportunity for selection. The company is rapidly enlarging its scope of operation, and within the next ninety days will be prepared to sell at least 200 varieties of constant and variable-speed motors running up as high as 150 horse-power. In addition to this exhibit, one of the company's "5-S" variable-speed motors having a speed ratio of four to one will operate the electric car-lighting equipment of the Consolidated Railway, Electric Lighting and Equipment Company.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 24. NEW YORK, SATURDAY, JUNE 17, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . } ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . }

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
The Watt-Hour Meter 959
Wireless on Trains 959
Steam Turbine Progress 959
The National Electric Light Association 960
The New Lamps 961
An Unimproved Opportunity 961
The National Electric Light Association 962
Condensed Specifications and Forms of Proposals for the Construction of Chicago Municipal Street Railways 970
International Association of Municipal Electricians 970
Twenty-second Annual Convention of the American Institute of Electrical Engineers 971
The American Society of Mechanical Engineers 972
BOOK REVIEW 973
Conventions of Railway Men 973
The Convention of the National-Interstate Independent Telephone Association 974
Trade Opportunities in Foreign Countries 974
The National Electrical Trades Association Convention 974
New Automatic Telephone Exchange at Columbus, Ohio 975
Signaling in the Subway, by J. M. Waldron 980
Application of the Differential Galvanometer to Exact Measurements of Resistance, by W. Jaeger (translated by M. G. Lloyd) 981
A Bolometer for the Absolute Measurement of Radiation 984
Wood Gas for Power Purposes 984
ELECTRICAL PATENTS 985
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE 986
INDUSTRIAL SECTION:
A New Automatic Numbering Machine 988
Efficiency Tests of a 400-Kilowatt Steam Turbine 988
Fort Wayne Prepayment Wattmeters 989
New Recording Voltmeter for Both Direct and Alternating Current 989
New Mine Conductor Line Material 990
A New Type of Cable Dog 991
Water-Power Tunnel on Vancouver Island 991
Electrical Apparatus for Medical Use 991
CURRENT ELECTRICAL NEWS 992

THE WATT-HOUR METER.

Our esteemed contemporary, the London *Electrician,* objects to the use of the term "integrating wattmeter." The descriptive participle is added here to distinguish this instrument from the true wattmeter, and its adoption has made it necessary to speak of "indicating wattmeters" when one really means "wattmeters." Moreover, no new name was needed for the first-named instrument which is really a "watt-hour meter." The point is well taken. "Watt-hour meter" is not only logical, but is more concise than "integrating wattmeter," and, if adopted, there would be no need for the "indicating" now added to designate the true wattmeter. The designation "integrating wattmeter" is probably due to the fact that the watt-hour meters first put into service did not indicate directly in watt-hours, but required that their dial readings be multiplied by a constant to reduce them to this unit.

WIRELESS ON TRAINS.

Wireless telegraphy seems to have entered upon a new stage, and, having taken to itself certain fields of usefulness, is now looking for new provinces to conquer. We commented recently upon its use in war, both on land and on sea, where it played important parts. We have also made note of its use in peace as a means of keeping ocean-going vessels informed of the doings of the world, and as a means of gathering and distributing weather reports from and to vessels. The latest reported use of wireless is as a means of communication between moving trains and the train despatcher's office. Recently a train running on the Chicago & Alton Railroad from Chicago to St. Louis kept in touch with the despatcher's office by this means. The trial was so successful that the railway officials announce their intention of installing the system on their fast trains, and using it not only as an additional safeguard, but for transmitting commercial messages to and from passengers on the train.

This use of wireless telegraphy was suggested some years ago. In fact, it was tried on one of the Canadian roads experimentally, with reported success. However, its adoption by the Chicago & Alton is, we believe, the first attempt to put it to regular use. The adaptation should not be difficult, although a moving train is not just the place one would select by preference for installing somewhat delicate apparatus. The distance to be covered will not be great and reliability of service will be the most important consideration.

STEAM TURBINE PROGRESS.

A subject of as great importance to the electric lighting station as the improvement of electric lamps is the development of the prime mover. So much has been written during the last year or two on the steam turbine that but little remains to be said, except to chronicle its success and make note of its increasing use. At the recent convention of the National Electric Light Association the committee on the investigation of the steam turbine reported in some detail on this subject. This report states that there are in operation now 224 turbines, with an aggregate output of 350,000 horse-power, in larger sized units in the United States. The sizes included in this summation vary from 300 kilowatts in output to 5,000 kilowatts. Of the 5,000-kilowatt size, there are now ten units in service; of the 3,000-kilowatt size, four; of the 2,000-kilowatt size, thirteen, and of the 1,500-kilowatt size, there are eleven. One notices with interest that little Japan, although she has so many other pressing affairs upon her hands, still finds time to take up the latest prime mover, and has installed two of the 1,500-kilowatt size in the street railway power-house at Tokio.

In addition to this interesting summary, the report discusses briefly recent improvements in turbine construction, and

Digitized by Google

describes, also briefly, certain of the newer types of machine. Steam turbines of at least six different makes may now be purchased in this country. The importance of high vacuum for turbine work is discussed by the committee, and some valuable data are given covering the cost of operating the auxiliary apparatus. The experience of the Boston Edison Company has been that the auxiliaries use from 5.7 to 8.4 per cent of the water, the smaller figure applying, of course, to the heavier loads. These results were obtained with 5,000-kilowatt units. The Nashua Light, Heat and Power Company, with 500-kilowatt units, found that the auxiliaries used from 9.78 to 12.9 per cent of the total water.

The report concludes with a test of a 1,000-kilowatt turbine of the Parsons type, built by the Westinghouse Machine Company, Pittsburg, Pa., which has been in operation at the plant of the Hartford Electric Light Company, Hartford, Ct. The test was made under normal operating conditions. The loads on the turbine were at all times purely commercial, in the respect that the current generated was used for lighting and motor driving. The load was steady at the time of the test, as the station was operating in parallel with two water-power plants. The results show that, with an output of 1,546 kilowatts, the water per kilowatt-hour was 18.98 pounds. With a load of 1,047 kilowatts, the consumption was 19.26 pounds of steam per kilowatt-hour. With a load of 735.8 kilowatts, the turbine consumed 20.68 pounds of steam per kilowatt-hour. During these tests the steam pressure varied from 135 to 138 pounds at the throttle. The absolute pressure in the condenser, in inches, varied from 2.19 at the heaviest load to 1.21 at the lightest. The steam during this test was superheated approximately 100 degrees. This is a very creditable performance for a machine of this size, running under every-day conditions.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

As had been expected, the business session of the convention of the National Electric Light Association, which was held at Denver, June 6, 7 and 8, was undoubtedly one of the most successful in the history of this important and influential body. Certain of the papers presented were of particular interest, and several exceedingly important reports were made by committees of the association. The presidential address is always looked forward to with pleasure, as the members have come to expect this to contain a statement of the general lighting situation and useful hints for promoting the interests in which all the members are most concerned. President Davis did not disappoint his fellow members, as he took up several vexatious questions and made recommendations which, it is to be hoped, will assist in improving the lighting situation.

No doubt that part of the presidential address which is of most general interest is that which refers to the relation between electric lighting companies and the public. President Davis said that the association should not be passive when laws which affect it vitally are being passed, but that it should make such suggestions as would lead to reasonable laws. Another source of trouble is the non-uniformity of the laws passed by the various states for regulating public service corporations. The stability of the industry can not help but suffer if one state passes severe restrictive laws, while its neighbor will grant perpetual franchises without any restrictions.

Closely connected with this question of government regulation is that of municipal ownership, which has been agitated so vigorously of late. To meet this agitation, it was suggested that the central station should not be satisfied to meet merely the requirements of its franchises but should go as far beyond as possible. It should serve the public so well and at such reasonable rates that no agitation, whether started for political or personal ends, would receive the support of the public. As the argument for a municipal plant is based upon a reduction in cost, the association should be prepared to prove that municipal plants do not effect the desired change. Unfortunately for the electric light company, it is not easy to convince the public that municipal plants are not cheap. It is easy for such a plant to make a satisfactory showing on paper. An item may be omitted, or due allowance not be made for the depreciation of the plant, or the figures juggled in various ways. The public, although it pays the bills in the end, does not see them, and has no idea how much it is paying for the lighting. A large part of the public, no doubt, believes that when an electric plant is installed it is done once for all, and that it will last for a generation at least. But an electric lighting plant is no more immortal than any other manufacturing establishment. Indeed, a generation in electrical machinery is probably shorter than that of any other class, and this is due, not to the poor quality of the machines themselves, but to the improvements which are constantly being made. It is unfortunate that the League of American Municipalities did not accept the offer made repeatedly by the National Electric Light Association, to join in a thorough and impartial investigation of the results of municipal plants. The difficulty would, of course, be to determine accurately the cost of running a municipal plant. There would be no difficulty in determining the cost of lighting when supplied by private plants, since they could simply point to the rates which they are charging.

Another suggestion in President Davis's address is of some interest to the public, is that the members of the association should consider the advisability of consolidating the street railways, the gas and electric companies in a given locality. Such a consolidation would serve to make the investment more stable, and should offer many possibilities of reducing the cost of all three services to the public.

The marvelous development of the electric lighting industry since the invention of the incandescent lamp is one of the striking features of the industrial progress of the past quarter century. The development in the succeeding twenty-five years may be even more marvelous. We are perfecting new machinery and new lamps, which, if they fulfil but half of what is predicted of them, will carry the electric light forward by leaps and bounds. Yet the field for future improvements is so vast that no one should be much surprised by an announcement of some invention which would revolutionize the art if such an announcement should be made.

Digitized by Google

THE NEW LAMPS.

A subject for discussion of particular interest at the recent convention of the National Electric Light Association was that of newer types of electric lamp. Recent years have been productive of a number of important advances in the art of producing light. The most important of these developments have naturally taken place in the electrical methods. Twelve years ago the introduction of the enclosed arc lamp marked a great stride forward in that branch of electric lighting, but progress did not stop there, for efforts to increase the efficiency or to reduce the cost of caring for the arc lamp have resulted in a number of new types. Bremer and Blondel have increased the luminous efficiency by adding other materials to the carbon of the rods. Steinmetz increases the efficiency and at the same time secures a long life by replacing the two carbon electrodes by one of magnetite and one of copper. Cooper Hewitt, Aarons and Steinmetz have developed lamps in which the luminous effect is produced by the passage of an electric current through mercury vapor. Gumlich and Heraeus have sought to improve the quality of the mercury vapor lamp by using a cadmium amalgam in place of the pure mercury, thus securing the red cadmium rays. The trouble with Gumlich's lamp was its short life. Heraeus, replacing glass with fused quartz, seems to have overcome this trouble, but his lamp requires preheating before it can be lit. D. McFarlan Moore has spent much time in perfecting the vacuum tube lamp. None of these lamps is suitable for all classes of illumination, but each seems to have a field to which it can be applied most successfully.

The incandescent lamp remained supreme in its field for many years, every attempt to substitute some other material for the carbon of which its filament is made failing. The first development which seemed to threaten it seriously was that of the Nernst lamp, but further work on this lamp shows that its qualities bring it rather into competition with the enclosed arc lamp. A valuable paper by Mr. E. R. Roberts was read at the convention, discussing the present performance of the Nernst lamp, in which it was shown that the lamp is not as delicate as has been supposed, that it is not expensive to maintain; and the care required may be compared to that necessary for enclosed arc lamps.

Now another threat is made. Our German friends have substituted tantalum for carbon, and, judging from what must be considered reliable reports, the attack is serious. The report presented at the convention by Dr. Louis Bell shows that the lamps which he tested had a high efficiency and a satisfactory life. At a little over two watts per candle, twenty-candle-power lamps ran 800 hours, thus giving 16,000 candle-hours. On a rating of two watts per candle average the lamps were good for 600 hours, giving over 12,000 candle-hours. On a rating of 1,000 hours they gave nearly 19,000 candle-hours at a mean energy consumption of 2.15 watts per mean horizontal candle. Assuming that the price of the tantalum lamp is one dollar, its present price in Berlin, and that the price for power is ten cents per kilowatt-hour, it would be cheaper for the customer to buy the tantalum lamps than to take the carbon lamps free.

But the carbon lamp has, as well, been attacked from another quarter. The success of the Nernst lamp has led to the use of osmium in place of carbon, or, in one instance, to supplement the carbon filament of the ordinary incandescent lamp. It is not to be supposed that the incandescent lamp will give up weakly to these attacks. In fact, we are promised a paper on a new carbon filament at the coming convention of the American Institute of Electrical Engineers. The battle is now on in earnest and which side will win none can say. Fortunately for all interested in electric lighting, the outcome will be beneficial in any case.

It is interesting to notice that the carbon incandescent lamp has, by right of priority, appropriated to itself the term "incandescent," and the newer lamps are designated by some other distinguishing term, such as "tantalum" or "osmium," although both are incandescent lamps.

AN UNIMPROVED OPPORTUNITY.

Although electrical methods of pushing important work are steadily growing in favor among contractors charged with the responsibility of producing telling results at minimum cost of time, labor and material, one frequently comes across undertakings in which there seems to be little appreciation of the savings that might be effected through the adoption of electrical apparatus in place of the wasteful machinery of the past. A case in point is that of a large railroad terminal now under construction in a city where an ample supply of electricity is a matter of course. The vast area of ground covered by the contractors' operations is marked by the presence of half-a-hundred uneconomical steam-eating donkey engines; the materials used are being painfully hauled over parts of the narrow-gauge trackage by horses; and there is no evidence of telephonic communication between the various executive shanties in different parts of the field.

It would seem that electricity could be used with immense profit upon so important a work, replacing the steam-driven derricks by motor hoists, and establishing telephone connections between every important section of the ground. Temporary trolley lines could easily be erected for the haulage of materials with despatch and convenience, the current for the entire work being drawn from a near-by central station particularly suited to the encouragement of a large day load. Certainly the electric locomotive has established a record in mining work which warrants its more extended use in a field at present so largely served by steam dummies and animal power. One can not escape the conclusion that an energetic effort on the part of the central station man and the railroad company's electrical engineers would have been the means of saving some odd thousands of dollars in the total cost of the terminal construction. Cases no doubt arise where it is inexpedient to resort to electrical methods of prosecuting construction work, but in very large undertakings where central station power is near at hand it seems a misfortune not to seize upon every possible means of economically performing the tasks at hand.

Digitized by Google

The National Electric Light Association.

The Twenty-eighth Convention, Held at Denver and Colorado Springs, Col.—Business Session from June 6 to June 8; Entertainment from June 9 to June 11, Inclusive.

THE recent convention of the National Electric Light Association was probably one of the most successful that has ever been held. Over 700 delegates and visitors were in attendance, and in addition to the business sessions, an elaborate series of entertainments was provided. The proceedings at Denver on June 6, 7 and 8 were reported at length by telegraph from a staff correspondent in last week's issue of the ELECTRICAL REVIEW. This report included the presentation of all the papers, discussion upon each, election of officers, and the complete text of the president's address.

As was announced last week, the officers for the year 1905-06 were elected as follows:

President: W. H. Blood, Jr., Seattle, Wash.

First vice-president: Arthur Williams, New York.

Second vice-president: Dudley C. Farrand, Newark, N. J.

Three members of the executive committee to serve three years: C. L. Edgar, Boston; John Martin, San Francisco; Frank W. Frueauff, Denver.

The constitution and by-laws of the association call for the appointment of the secretary-treasurer by the executive committee.

It was the sense of the nominating committee, however, that W. C. L. Eglin, Philadelphia, should be appointed secretary-treasurer, and the convention recommended that Mr. Eglin be requested to accept the office.

ENTERTAINMENT FEATURES OF THE DENVER-COLORADO SPRINGS CONVENTION.

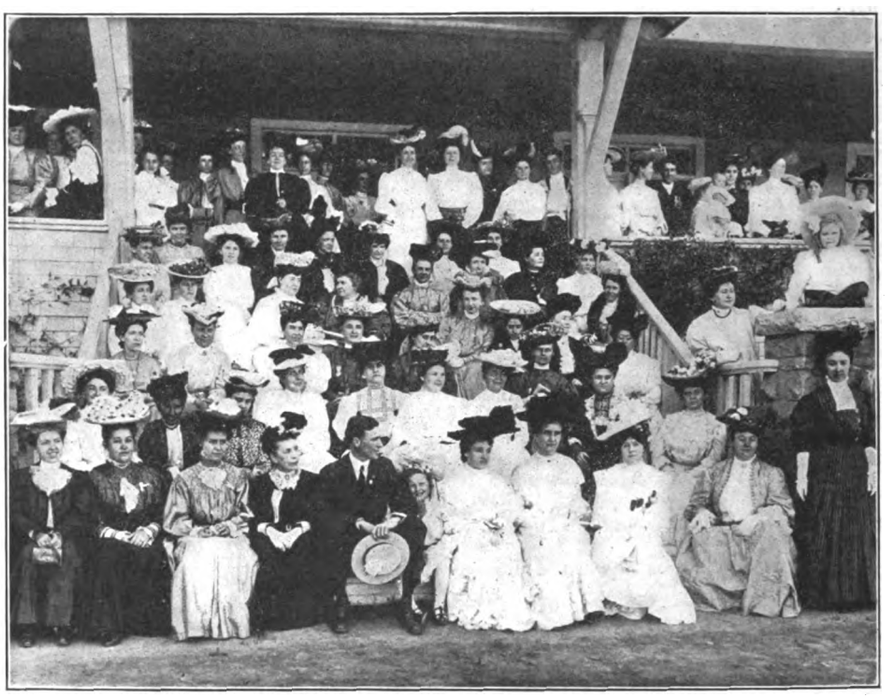
[Special Despatch to the ELECTRICAL REVIEW.]

COLORADO SPRINGS, COL., JUNE 12—It is but simple justice to the Colorado members of the association to say that the entertainment provided was the most elaborate and sumptuous ever offered in the whole history of its career. From the time the special trains crossed the line into the state welcome was expressed in substantial ways. The universal sentiment was that of appreciation for the care and attention given by the hotels, and the management of the Denver hotels went far beyond the ordinary civilities in efforts to give all the accommodations desired and to keep their service alert for the comfort of all. It was the puzzle for each to solve as to which of the attractions to select, as the local committees of Denver and Colorado Springs offered so much that one could accept only a portion of the proffered hospitalities. In fact it is hard for the phlegmatic easterner to understand the genuine and impulsive generosity which seems to grow best in the shade of the Rockies and to overcome the thought that an ulterior motive really does not lie beyond. And it's high time, too, that some of us in other sections had these good examples.

On Monday, preceding the first session, the evening was devoted to a reception in the drawing rooms of the Brown Palace Hotel, which was followed by dancing and several supper parties. Tuesday afternoon a coaching party was arranged for the ladies at the Overland Club, and in the evening the visitors were entertained by a special performance at one of the attractive summer gardens in the suburbs of Denver. Wednesday morning the ladies were entertained by special trolley rides to the interesting points of Denver, and the gentlemen after the business session in the evening were entertained at a smoker, where athletic exhibitions were given, while the ladies were taken to the theatre.

Thursday a number of excursions were enjoyed and during the afternoon many of the guests made the journey to Colorado Springs. For those who remained a serenade was given in the Brown rotunda by the famous Denver Drum and Fife Corps.

On Friday, June 9, almost the entire party journeyed to Colorado Springs on special trains over the Denver & Rio Grande Railroad. During Friday afternoon the guests, for the most part, enjoyed trips to points of interest about Colorado Springs, taking in Glen Eyrie, the Garden of the Gods, Cheyenne Cañon, and others inspected the power plants of the Colorado Springs Interurban Railway Company, the Colorado Springs Electric Company, the Curtis Company's coal mines, the reduction mills at Colorado City, and the hydroelectric plant of the Pike's Peak Hydroelectric Company at Manitou. A number of the delegates also made the trip to Pike's Peak.



THE VISITING LADIES AT THE OVERLAND CLUB, DENVER, NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION, TUESDAY, JUNE 6.

On Friday evening all who desired were taken in special cars to the Broadmoor Casino where dancing and music were enjoyed. On Saturday a dance was given at the Antlers, Sunday and Monday the entertainments and excursions were continued and on these days the outward bound trains began to take homeward the delighted visitors. S. H. G.

PAPERS AND DISCUSSION.

Among the many papers which were presented at the Denver meeting, those pertaining to our newest forms of illumi-

Digitized by Google

nants were particularly interesting. These, as well as the report from Messrs. Dow and Stewart, on "Present Methods of Protection from Lightning and Other Static Disturbances," elicited some valuable discussion. Copious abstracts of these papers and the discussion follow:

THE TANTALUM INCANDESCENT LAMP.
DR. LOUIS BELL.

The writer was lucky enough to receive through the courtesy of Mr. E. D. Adams ten twenty-five-Hefner, 110-volt tantalum lamps. These were, with the kind assistance of Professor Puffer, put through various tests, and in particular two of them were given a decay test with the rather startling results recently published in a joint paper. The upshot of the matter was that these two lamps, selected as being about the average of the lot in performance, gave a life of some 850 hours before falling below eighty per cent of their initial candle-power, and were both burning at 16.6 candle-power at the end of 1,190 hours, although one of them had at some unknown time in the previous three days' run broken a filament close to one of the spider arms and had automatically mended itself by the fall of the loose end across the other side of the same loop where it welded itself firmly into place and went on burning.

These two lamps ran 800 hours of their life at a mean horizontal candle-power of twenty and at about 2.05 watts per candle, thus giving 16,000 candle-hours of useful life at this extremely high efficiency. On a rating of two watts per candle average the lamps were good for 600 hours, giving over 12,000 candle-hours. On a rating of 1,000 hours they gave nearly 19,000 candle-hours at a mean energy consumption of, say, 2.15 watts per mean horizontal candle. The circuit on which the run was made was on the average fully up to the rated 110 volts, although the pressure varied somewhat irregularly, perhaps a couple of volts on each side of this figure.

The light of the tantalum lamp is, as might be expected from its high efficiency, rather whiter than that of an ordinary incandescent, being as white as the Nernst lamp or the acetylene flame. Its distribution of light is in the present form of filament rather less uniform than that of the common incandescent, being relatively more powerful in a horizontal zone and less powerful for points near the axis. The ratio of mean spherical to mean horizontal candle-power, as found in Professor Kennelly's investigation of the frosted lamps, proved to be 0.73 and the writer's figure from the clear lamps was substantially the same. The distribution, however, could very easily be improved, so that the spherical reduction factor would not differ materially from the usual figures and the light at the top could be correspondingly increased.

Since the tantalum filament has a low initial resistance (between fifty-five and sixty ohms) it jumps into incandescence with startling rapidity as compared with a carbon filament, but because of its positive temperature coefficient it seems to be decidedly less sensitive to changes of voltage in its working condition. This is a useful property in certain respects. The fact, however, that the initial resistance of the tantalum is so low and its thermal inertia so small owing to its small mass and low specific heat, means rather violent heating up, which is probably the cause of some doubts which have been expressed as to the endurance of these lamps upon alternating circuits. It is not difficult to imagine pretty severe strains upon the filament if it had time to cool down much between impulses. If such cooling could take place, for instance, on an ordinary alternating circuit, the results might be serious.

Some stroboscopic tests were therefore made at the last moment to determine whether at, say, twenty-five cycles there was a specially violent fluctuation of light from the tantalum lamp; in other words, to find out whether on a twenty-five-cycle current the filament had time to cool down materially. The result showed that the light fluctuation at this frequency was somewhat but not much more pronounced than in a carbon filament. The tantalum lamp behaved in fact about like a ten-candle-power carbon filament lamp. Even a seventy-five-candle-power carbon filament lamp, however, shows perceptible variation under this test. At sixty cycles the fluctuation while still perceptible was trivial both in the tantalum and carbon lamps. It hardly seems probable that at sixty cycles the life of the tantalum would be enough impaired to cause serious trouble, but the writer now has some lamps on alternating-current tests and proposes to pursue the enquiry.

The tantalum filament seems to stretch and sag at first as if undergoing annealing and losing the set produced by drawing. Then it shows local bright spots which grow lumpy as if the material tended to flow a little from the heat, and with the increasing lumpiness the filament draws up tight. At this stage it is rather fragile and would probably break easily from vibration or shock. It seems likely that the final break comes just where one of the lumps has reduced the cross-section of the wire beside it. The break in the lamp during test, already referred to, showed considerable attenuation of the loose end.

The lamps as tested showed the following characteristics:

Lamp.	Watts.	C. P.	Watts per C. P.
Clear globes.....	41.58	21.42	1.94
	38.61	20.90	1.84
	41.58	24.93	1.66
	41.58	21.55	1.93
	41.91	21.81	1.92
	41.91	22.59	1.85
Frosted globes...	40.36	19.79	2.03
	40.04	18.54	2.15
	40.04	18.74	2.13
	40.48	19.27	2.09

The mean result from the clear globes was 22.2 candle-power at 1.85 watts per candle-power, that from the frosted globes 19.08 candle-power at 2.1 watts per candle-power.

It is interesting to note that the clear lamp gives just about one candle-power per inch of incandescent filament, which implies an intrinsic brilliancy of somewhere about 500 candle-power per square inch of filament—a figure much higher than in the ordinary incandescent.

As illuminants the lamps are certainly very excellent, but their introduction raises some most interesting questions for the central station operator.

Putting aside all the petty questions that will be raised about the new lamps for commercial reasons, the broad fact remains that we are here dealing with a *bona fide* two-watt lamp having a life fairly comparable with the carbon filament lamps now customarily in use. Moreover, it is a competitor of these socket by socket, and not as a substitute with particular requirements as in the case of the Nernst lamp or the very small arcs. There is some doubt as to the life of the tantalum lamp when exposed to unusual vibration, which may perhaps bar it in some special locations, but for the every-day work of the central station there is good reason to believe it generally applicable.

Its price can hardly be said to be fixed in this country, but abroad in Berlin it is about one dollar (M. 4), which will give at least a fair line on its commercial results. On this basis and with current at ten cents per kilowatt-hour one finds taking the new lamp on its 600-hour rating that the cost of its 12,000 candle-hours, including the lamp, amounts to $3.40. The same number of candle-hours

Digitized by Google

from a lamp giving a mean efficiency of 3.25 watts per candle would cost $3.90, exclusive of lamps; *i e.*, the consumer could afford to pay $1 for the new lamp better than to take the old ones free. With current as low as five cents per kilowatt-hour, the user of tantalum lamps could only afford to pay seventy-five cents per lamp as against getting carbon lamps free. That means that a sliding scale of discounts for lamps according to quantity could be made to catch the consumer at all prices ordinarily charged for current by central stations. Does this mean that the carbon lamp will shortly be down and out? Probably not, for there is no spur like competition to start up improvements, and there are some signs that carbon lamps may be improved enough in efficiency to make things interesting at least with current at the prices charged to very large consumers. This, however, remains to be seen, and the thing which the central station man has to meet is the immediate probability of consumers putting upon their circuits lamps taking less than two-thirds the energy per candle-power of the best lamps now in use and thereby cutting down their meter bills enormously. Now, broadly, what shall be the attitude of the central station man toward this income-scalping innovation? There are some managers who may be inclined to put up a fight to discourage the user, either by raising pettifogging objections or by trying to discriminate against two-watt lamps by readjusting discounts in various ingenious ways. The writer is very strongly of the opinion that such a policy is wrong and will certainly lead to ultimate disaster in the form of municipal restrictions or regulation of rates by law. In the long run, opposition to improvements does not pay. If, on the other hand, the central station man hangs quietly on and gives the consumer the glad hand, the change will work to his ultimate benefit. In the first place, the tantalum lamps now made are of twenty-two candle-power instead of sixteen and the filament will hardly bear much reduction in cross-section. The tendency therefore will be to use these slightly more powerful lamps taking, say, forty-two watts instead of a trifle over fifty watts in the sixteen-candle-power carbon lamps. The actual loss in energy sold is likely therefore to be for the present quite a little less than the difference of efficiency would indicate.

Besides this the attraction of cheaper light will certainly bring into line new consumers, so that the net result will probably be an actual increase in sales of current, quite a little of it being among the smaller consumers who pay the higher rates. Such a change means upon the whole more lights connected per unit of capacity in transformers or feeders, and hence a slightly better utilization of material and improved load. In the case of stations with underground service, the change to two-watt lamps ought to bring with it increased earnings per unit of cable capacity. The fact is that improvements in the efficiency of utilization of electric energy help the business and it is both fruitless and inadvisable to oppose them for any short-sighted notion of small temporary savings.

I have here said nothing regarding the inevitable competition between present lamps and the newcomer. In the first place, the merits of the final issue remain to be determined and in the second place competition in lamps is on the whole a good thing for the user of them, however it turns out. So far as the central station is concerned, it is a case of dog eat dog.

The really important thing is that from now on the station manager will have to deal directly with the two-watt lamp proposition, for there is no disguising the fact that it is here, and in a form which is quite unexpected. The appearance of tantalum lamps in quantity may be a little delayed in this country, but delay will improve them as in the case of every new product, and will serve to assure a better understanding of their truly remarkable properties and of their possible limitations. The unexpected has certainly happened, for most engineers had long ago abandoned the idea of a lamp with a metallic filament. Only the discovery of a metal virtually new, and possessed of most sensational qualities, could have brought about the present striking result.

DISCUSSION.

ARTHUR WILLIAMS—I am of the opinion that it makes very little difference to the consumer whether he buys part of his light in current and part in lamps, or all in current, and that with this lamp remaining at the present high price, $1 in Germany and perhaps $1.50 or $2 here, at present it will not be a serious competitor with the incandescent lamp as we now know it. As an illuminant it is certainly very interesting, and promises well for the future; but as there probably have not been more than 100 of these lamps in this country, and they have not been here long enough to be subjected to any kind of commercial tests I do not think it would be practicable to discuss the lamp in any commercial sense. I do not think, because of the high price at which the lamp is obtainable, that it will be immediately a competitor with the ordinary incandescent lamp, because a high lamp cost will offset the economy of the lamp, compared with the standard we now have.

JOHN F. GILCHRIST—The bringing out of this lamp raises a question which has been in the minds of some of the central station men for some little time, and that is a question of selling electricity for illuminating purposes, particularly incandescent lighting, on the lamp-hour basis instead of on the kilowatt-hour basis. It can be readily seen that, should it seem wise to push this lamp hard, the first thing that the central station man is liable to consider if he is selling current on the kilowatt-hour basis, is that it is going to cut down his income and consequently, while he may agree with Mr. Martin, [Progress report] that it is unwise to attack anything which has merit, he may want to hold it back until he can build up his business to meet it and not impair his income too much. In the legislative action which seems to have taken the form of a wave throughout the country, the talk seems to be entirely along the lines of the kilowatt-hour and it has occurred to me whether it is not a wise proposition for this association and the electric light men to try to guide that legislation along the basis of charging on a flat-hour basis so that any new lamp of this type can be put out by the central station men.

A. C. DUNHAM—I have experimented with the tantalum lamps, and I find that the tests given in this paper are practically correct. They burn a long time after the filament breaks, and it has occurred to me that the history of the osmium lamp is a curious history. They could not find osmium enough so as to make a large quantity of the lamps, and they adopted this system—putting the lamps on central stations and charging twenty cents a month rent. They pay the central station for the power consumed for the osmium lamp at the same rate as for the carbon lamp. They return the lamp and make it over into a new lamp, and the osmium lamp goes on indefinitely. There is small wastage. I think we must find some way to get over the sudden drop, if it is sudden, on the tantalum lamp.

DUDLEY C. FARRAND—We have had two of the tantalum lamps. The first showed an efficiency of 1.99, which is better than that mentioned by Dr. Bell. That lamp, however, lasted only some twenty odd hours, a little over a day. The second lamp is still burning and showed an efficiency of 1.68. I do not know how long it will burn. The commercial efficiency is a matter which will have to be determined. The theoretical efficiency amounts to very little. Mr. Gilchrist touched on the question of cutting down the revenue of the central station by using a high-efficiency lamp. My own opinion on that subject is that it is not going to work

Digitized by Google

against the company's interest a bit. Every time you double your efficiency in the lamp, you double the plant's capacity, and while the higher efficiency may tend to increase the distribution expense, the net result will all be in favor of the high-efficiency lamp. I am heartily in favor of it and only wish we could get them in sufficient quantity to supply our business to-day. It will not upset all your commercial calculations. Your business will increase upon the general announcement of this lamp coming into use faster than you can get the lamps to put them into use.

W. H. GARDINER, JR.—As I remember the figures, the introduction of the tantalum lamp will show a loss of current consumption, owing to the size of the lamp, twenty-two candle-power over sixteen, of only about twenty per cent. The gain in individual candle-power per lamp, I think, will be a very advantageous thing, because the sixteen candle-power lamp was introduced at a time when other illuminants, for instance gas, was of a lower candle-power than at present, and before the extended introduction of incandescent gas lighting. Therefore, the unit of illumination in the tantalum lamp shows up approximately on the same basis as its competitors. To-day we have twenty-five-candle-power gas in a great many places, and we also have the incandescent gas lighting which is very much more brilliant. Consequently, if one lights a sixteen-candle-power lamp, it is very usual that one has to light two of them, in order to get the same illuminating effect. Therefore, I should say that we should welcome this increase in the size of the lamp, even if accompanied with a slight decrease in current output. That is only about twenty per cent. I will add, in this connection, that the gas industry had a very much larger decrease to face. They had formerly, with their gas at twenty-five candle-power, consumed five feet to the burner per the hour, but when the incandescent lamp came in the consumption went down to three feet, and the candle-power went up to fifty. That was a very much greater difference, a greater drop and some gas managers were not very quick to recognize the point, but I think it is now very generally accepted that it is to the advantage of the gas manager to use the incandescent gas mantle over the open flame, in spite of the shrinkage in consumption of forty or fifty per cent. I think we should welcome the tantalum lamp.

THE NERNST LAMP—ITS PRESENT PERFORMANCE AND COMMERCIAL STATUS.

E. R. ROBERTS.

The Nernst Lamp Company has completed a series of photometric and life tests on standard Nernst lamps, and these tests are presented in this paper. The efficiency tests and average readings obtained from six, four, three and one-glower 220-volt lamps ranged from 472.7 to 23.9 for the six-glower lamp; from 314.3 to 18.1 for the four-glower lamp; from 200.6 to 15.6 for the three-glower lamp, and from 64.5 to 2.9 for the one-glower lamp. The readings were taken every fifteen degrees from ninety degrees below the horizontal to sixty degrees above the horizontal. The lamps were run on a sixty-cycle, 220-volt circuit, which was interrupted every three and one-half hours. The spherical distribution of candle-power was taken at zero, twenty-five, 100, 200, etc., hours' life, the lamps being allowed to operate on normal voltage for forty-five minutes just before candle-power measurements were made. The maintenance of Nernst lamp systems was described, and was stated to be quite similar in its main features to the arc maintenance system of the New York Edison Company. The work of the maintenance bureau operated by the Nernst Lamp Company in the Pittsburg district was described, and the total cost per glower-month for the months of December, January and February, 1904-1905, was stated to be 9.56 cents. In describing the application of the Nernst lamp, a brief history of the lighting industry is given, taking up gas and electricity, and describing the carbon filament and the Argand and incandescent types of gas burner. A description of the illumination of the art buildings of the St. Louis Exposition is also given. A prediction is made of the future use of the Nernst lamp for street lighting.

DISCUSSION.

ARTHUR WILLIAMS—I would suggest that this is a subject upon which we should have the fullest discussion—the extent to which the Nernst lamps have been used by central station managers and the results of their use. Mr. Dunham, for example, has had a great deal of experience with these lamps in Hartford. We find that the lamp does not materially interfere with the field of incandescent lighting or arc lighting, but fills a gap between the two, a gap which would be filled, perchance, if we had a 200-candle-power incandescent lamp. The light is of high quality, and wherever it has been used it seems to give entire satisfaction as regards the quality of the light. We find, however, that the field admits of the largest development with the three and six-glower lamp rather than with the single-glower lamp, which competes more directly with the ordinary incandescent lamp of sixteen candles. The life is fairly satisfactory and the cost of renewal is slightly over one cent a kilowatt-hour and probably would not exceed one cent a kilowatt-hour were the lamps used to a larger extent. The growth, while rapid in one sense, is slow in another. The income is substantially $11 annually per eighty-eight-watt glower, which is about twice the average income of an incandescent lamp of sixteen candle-power. Through the medium of the Nernst lamp we have secured the return of a large amount of business, large relatively for this small territory, which had left us and gone to the intensified gas burners. We feel, while we have had some experience covering more than a year with the Nernst lamps, we should like to get the benefit of the experience of the other companies with the same device.

A. C. DUNHAM—I have used the Nernst lamp for over three years, almost four years. We have 3,500 glowers, about half what they have in Pittsburg, although our population is not quite half the population of Pittsburg, being 90,000. The lamp has filled a place and we do not see how we possibly could get along without it. As the displacer of gas arcs it is remarkable. If you put up a three-glower Nernst lamp in a place where they have had a gas arc, the gas arc immediately comes out and there is no question about it. I think that has led to the use of the lamp in our city very largely. I would say that we have one suburban town, within four miles of Hartford, in which we placed 248 lamps in the street, all single-glower lamps, and they have given great satisfaction. They started with about 140 and they have added to them every year until they now have 248. They have been running about three years—that is the original installation. We charge $18 for all-night service and we find it is a very good business. They take the place of the ordinary gas light used in such towns.

I think the only thing which has retarded the progress of the Nernst lamp is the fact that the high price of the glower has led the users of the lamp to try to get the full life out of the glower. We have tested the life of the glower—the present glower is a very good one and the whole lamp has been greatly improved in the last year and a half—and we find that the life of the glower now is from 800 to 840 hours—if you put up ten lamps they will average about 840 hours. We have one lamp which is now running that has been running for 1,700 hours. But if you undertake to get the full life out of the glower you are almost sure to burn out the heater, because if the glower is burned out in the night, when it may not be noticed, the current goes on and burns out the heater. The heater is a very expensive affair; the list price is seventy-five cents. Of course, this creates a prejudice against the lamps. We put out a number of single-glower lamps in Hartford. They find uses in all kinds of places. We put them out on a card system, and do not let any lamp burn over 450 hours. Like all lamps the candle-power of the Nernst lamp, if it is a fifty-candle-power glower lamp, will burn for the first fifty hours at seventy-two candle-power, it then drops to sixty-two, and stays there for about 450 hours, so that you are giving not a fifty-candle-power lamp but a sixty-candle-power lamp. When it begins to drop below that it drops much more rapidly. Our

Digitized by Google

system is to give the best light we can, and we take them out and trim them when they reach a limit of 450 hours. If the glower in this country was sold at what you might call a fair commercial price, everybody would use them, but all stations can not face such a proposition as that. On the other side, the glower sells for 2.25 cents, and in addition to that they give something besides. Here the glower runs from seventeen to twenty cents. Of course, that price is made because originally there were great expenses involved in developing this glower. Those expenses have to a certain extent been compensated for, and when the Nernst people get ready to put the price of the glower down to eight cents they will increase their sales very materially.

REPORT ON PRESENT METHODS OF PROTECTION FROM LIGHTNING AND OTHER STATIC DISTURBANCES.

ALEX DOW AND R. S. STEWART.

This report is intended to be a brief of present practice, with notations thereon. It does not present any new theories or devices.

Preliminary—Lightning arresters were built on a kind of "hit-or-miss" plan until Dr. Lodge showed that lightning discharges differed from static discharges in magnitude only, the same laws governing both. When this was recognized the manufacturing companies carried out exhaustive tests with static machines on various protective devices, and in this way developed protective apparatus that could not have been designed had it been requisite to make all tests on live lines during thunder-storms.

After long tests with static machines had indicated the best general designs the apparatus was put into actual service in places where thunder-storms were unusually severe. Many minor changes have been and are still being made, due largely to the changes in the kind of apparatus to be protected, but the main features of the standard arresters have not been changed in many years.

Duty of Lightning Arresters—Transmission lines are occasionally subjected to excessive high-potential strains that would be injurious to generators, transformers or motors, and it is the function of a lightning arrester to protect the apparatus from such strains. These excessive strains are due to the following:

First—Lightning: during a storm, if the potential difference between two clouds or between a cloud and the earth becomes excessive a disruptive discharge occurs. This discharge is usually oscillatory, the frequency of the oscillations being very high. Induced currents are set up in all surrounding conductors, even when they are several miles distant.

Lines are seldom struck by a direct stroke of lightning, and when struck the damage is not necessarily serious, if the line is struck some distance from the station, for the line chokes back the discharge. Poles are split by the lightning traveling down them instead of following the line into the station.

A good example of the action of a direct stroke was observed in Detroit some years ago. One of the street-lighting towers was struck in the daytime, when no current was on the lines, the lines being thoroughly grounded at the station a mile away. As the tower was of iron, the main portion of the discharge evidently traveled down this to earth. Two of the switches at the top of the tower were burned out, the current jumping from the tower to the line, the auxiliary cut-out in one of the lamps was raised and the contacts welded together, showing that a very large current had flowed through this contact. This current then traveled down the line wires to the base of the tower and jumped to the case of the switch at the bottom and from thence to earth. Current also traveled down all four guy lines, splintering all the guy stubs. To one of these stubs a guy line to a telephone pole was fastened. A portion of the current jumped to this line and from there to a trolley wire, puncturing the insulator on the hanger. Nowhere else on the line was there any evidence of damage.

The damage sequent to a lightning discharge is in most instances the work of the induced currents set up in surrounding or adjacent conductors. The potential strain is usually from the line to earth, but may be (and frequently is) between the several wires of a circuit. This latter is more likely to be the case on lines in which the wires are strung some distance apart.

Second—High-frequency waves set up by sudden changes of load or by resonance: these waves are similar to the induced currents from lightning, but the frequency is not so high, nor is the potential difference as great. The maximum strain is almost always between the several wires of the circuit.

Third—Static charges: a line insulated from the earth may become charged to a high potential if the climatic conditions are favorable. A very dry atmosphere, hot-wind storms, sand storms and great variation in the altitude of the pole lines are some of the causes of static charges. During severe sand storms the arresters may not be able to keep down the potential of the line, although they may be discharging almost continuously.

The best methods of protection are:

First—Non-inductive high resistances connected from the circuit to the earth.

Second—Lightning arresters. These should have enough resistance in series with them to prevent the discharges from becoming oscillatory.

Third—Overhead ground wires, as described later.

Essential features of protective apparatus:

First—They should discharge at a potential slightly higher than that of the system.

Second—The ordinary working of the system should not be affected by the discharge.

Third—The electric energy of the static disturbance should be dissipated as rapidly as possible.

Fourth—The static waves should be prevented from developing high-potential difference in generators, transformers and other apparatus.

First condition: an ordinary spark-gap from the line to earth fulfils this perfectly. The gap can be set to break down at any voltage desired. A spark-gap is dispensed with altogether in some arresters, the line being connected to earth through a non-inductive resistance which is high as compared with the resistance of the rest of the circuit. Water jet and tank arresters are examples of this.

Second condition: the gap once broken down, the line current will follow unless some means is adopted for preventing this. Inserting resistance in series with the gap, subdividing the gap into several smaller ones, making the metal cylinders between the gaps of some non-arcing material, increasing the size of these cylinders so as to present a large cooling surface for the arc, and blowing out the arc by a magnet, are the methods adopted at present.

The third condition is very hard to comply with, as static disturbances differ so much from one another. To protect from a direct stroke of lightning, as little resistance as possible should be in circuit. If, however, the line is charged with static electricity, oscillations will be set up in the line when the arrester discharges, unless a certain amount of resistance is in the circuit.

The fourth condition requires the use of choke coils for disturbances due to

Digitized by Google

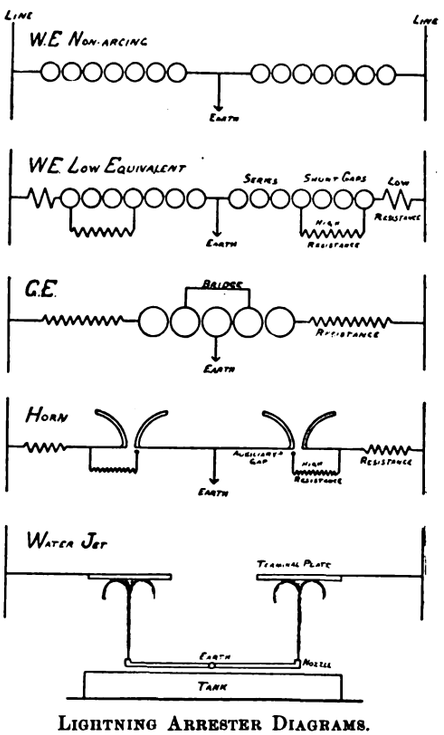
lightning, or combinations of choke coils and condensers for static waves due to short-circuits and other sudden changes of load.

Description of the main parts of standard arresters—Alternating current. General Electric Arrester for 2,000 Volts—Two one-thirty-second-inch air-gaps are connected from line to earth in series with a non-inductive high resistance. Cylinders are large, to give a large cooling surface for the arc. The current is kept low by the high resistance used. For protection from stresses between the separate wires of line, half of the gaps are cut out by a bridge connecting the two cylinders which are midway between the line and earth. The arrester thus connected will have the same number of gaps between the lines as from the line to earth. For very high-voltage systems several arresters are connected in series. This arrester should protect very well from ordinary disturbances, but the high resistance does not permit of rapidly dissipating the large amount of energy in a lightning flash.

Westinghouse Arrester for 2,000 volts—Six one-thirty-second-inch air-gaps are in series from line to earth. Cylinders are made of non-arcing metal. No resistance is used with this when connected to lines fed by 2,200-volt generators of moderate size. When a higher potential than 2,200 volts is used more gaps are used and a resistance is connected in series with the arrester to prevent an excessive current from the generator flowing through the arrester. This arrester protects from severe flashes very well, but as the length of air-gap is longer than in the General Electric arrester, a higher difference of potential is required to break down the gap. On discharging a line that has a static charge oscillating waves may be set up in the circuit, since no resistance is used.

These two arresters show how differently two companies will sometimes reason in designing apparatus for the same service.

Westinghouse Low-Equivalent Arrester—This was designed some five years ago in order to cut down the number of gaps required in the standard arrester when used on very high-voltage circuits. It consists of a small number of gaps which should break down at a little above the line voltage. In series with these is a high resistance, and shunted across this resistance is a second set of gaps equal in number to the first set. In series with the whole arrester is a small non-inductive resistance, to keep down the main current. Non-arcing metal is used for the cylinders. The operation is as follows: if the potential of the circuit increases, the series gaps break down immediately. As the resistance of these gaps when broken down is small compared with the high resistance in series with them, practically full-potential strain is put on the gaps shunted across this resistance and they will break down. After the static discharge the arc immediately dies out in the shunted gaps if the arrester is properly designed, and the high resistance cuts the current so low in the series gaps that the arc in these is next extinguished. This arrester combines the good qualities



LIGHTNING ARRESTER DIAGRAMS.

of both those already described, for it furnishes a high-resistance path for small static discharges and a low-resistance for violent discharges.

It was the privilege of one of the writers to install the first of these arresters. A considerable amount of lightning trouble had been experienced with a high-voltage generator, several generator coils and a transformer having been burned out in a single year. The generator always ran through heavy thunderstorms, but a little lightning anywhere along the line would cause trouble. The trouble was always due to short-circuits, the discharges never going to earth except through the arresters. The arresters were changed by shunting part of the gaps by a high resistance. No trouble had been reported from this plant three years after this change was made.

Horn Arrester—This consists of a single large gap, the sides of which are horn-shaped metal pieces to which iron pieces are fastened. The theory of the arrester is that the discharge across the gap sets up a magnetic field, which is distorted by the iron pole pieces. This field draws up the arc which follows the discharge to a point where the field will be symmetrical around the arc. At this point the gap will be so long that the arc will be extinguished, provided the current through the arrester is kept low by a non-inductive resistance. When used on very high-voltage systems the air-gap has to be very large to prevent excessive current across the gap. To remedy this fault a small auxiliary gap and a high resistance are shunted across the main gap. When a discharge occurs across the auxiliary gap the heat of this starts an arc across the main gap. This would seem to be a defect, for by the time the arc had started across the main gap all the damage might have been done by the static wave. The reports concerning this arrester are too meagre for us to judge of its operation. It is used on several lines in Europe, but has been tried very little in this country.

Water Jet Arrester—Water jet discharge devices have been used on some of the high-voltage transmission lines in Europe, and these are reported to be operating very satisfactorily. Jets of water are thrown from a grounded nozzle against terminal plates that are connected to the several wires of the circuit. These columns of water furnish high non-inductive resistance paths from the line to earth for any static waves. The power lost is said to be about three kilowatts, and the water used less than one gallon per minute. It would seem that the resistance of the water columns must be so high that it could not dissipate the energy of a violent disturbance with sufficient rapidity.

Direct-current Arresters—In direct-current service the arc formed by a discharge is much harder to extinguish than in alternating-current service. Fortunately, however, direct-current voltages are usually small.

Thomson Magnetic Blow-Out Arrester—In this the single air-gap is between two metallic horns. An electro-magnet is placed with its poles opposite the lower extremity of the gap. This magnet is excited either by the discharge current or by the main-line current. The magnetic

Digitized by Google

field set up blows out the arc immediately. The operation of this arrester is very satisfactory.

Westinghouse Direct-Current Arrester—This is built in accordance with the principle that if the voltage across a gap is very low no arc will be maintained in the gap. A large number of minute gaps are connected in series. Carbon particles are used to form the sides of these gaps. It is necessary in this arrester to keep the lines of carbon particles protected from the air, or an arc will be carried across the air above the carbon and will burn up the arrester. The objection to this arrester has sometimes been made that its operation has to be taken on faith. There is no evidence of discharge unless one is observing the arrester at the time of discharge. Tell-tale papers in a small auxiliary gap connected in series with the arrester would be advisable.

Garton Arrester—Two gaps are connected in series with a non-inductive resistance. Shunted across part of this resistance is a small coil. On discharge the current in the coil lifts an iron armature, and increases the length of one of the gaps so much that the arc is immediately extinguished. The most serious objection to this arrester is that it contains moving parts. If a second static wave follows immediately after a first, the air-gap at this time will be so long that no discharge can occur, and the apparatus on the line may be subjected to a dangerous potential.

Westinghouse Tank Arrester—This was designed many years ago for the protection of large railway stations. Instead of air-gaps, a tank of running water is connected directly from the line to ground. The current taken will be small in comparison with the load. The arrester is disconnected from the circuit, except during thunder-storms.

Choke Coils—With all arresters choke coils are placed between the arrester and the apparatus to be protected.

A coil of wire offers opposition to the passage of an electric discharge through it. The more sudden the discharge the greater will be the opposition. The opposing electromotive force in the choke coil may be so high that the path across the air-gap of an arrester will be easier than through the coil. In the case of lightning the discharges are either very sudden or they are oscillatory discharges of very high frequency, and a coil which offers practically no opposition to the main current is sufficient. The potential at a choke is greater than it would be if the coil were not present, for the potential is the resultant of the advancing wave and of the wave that is reflected by the coil. This resultant will always be greater than that of the advancing wave alone. It is standard practice to divide a choke coil into several parts and to place arresters between these so as to furnish paths to earth for any discharge that has passed the first arrester.

Distribution of Arresters—In long-distance transmission the lines need no protection and the arresters are grouped at the two ends of the line. Several choke coils are used, and the arresters are connected to the line at several places between the coils, so as to be sure that some of the arresters will be at a maximum point of a static wave.

In distribution networks arresters should be scattered all over the network. There is no general rule as to the number necessary, except that the more arresters installed the better the protection.

In low-voltage networks that are tied together in many places, if one branch extends some distance from the network, weak spots near the end of the branch are punctured by discharges during thunder-storms. Experiments with static machines and small networks of conductors showed the same phenomenon many years ago. A static wave traveling down the conductor is reflected back at the end of the conductor. The resultant of the advancing and reflected waves gives at the end of the line a potential strain that is double that of the advancing wave.

The remedy is to put choke coils in the branch at the point where it is connected to the network. The wave in the network will then be divided at the coil, part being reflected at this point and only a small part advancing along the branch.

Overhead Ground Wires—In many long-distance transmission systems the lines are protected by ground wires strung above the lines. These ground wires are connected to earth every thousand feet. The theory is: if lightning strikes the line the ground wire would be struck directly instead of the line wires that are insulated from ground. As the earth's potential is above and also below the line wires these can not be charged with static to a high potential. The inductive action of lightning on the line is much reduced, as the ground wire is much nearer the line than the earth is.

There is one case in which ground wires are of no service. If the earth and a cloud are charged, the line is charged to the same potential as the earth. If a disruptive discharge occurs, the line, being insulated from earth, is discharged much more slowly, and there may be a great difference of potential between the line and earth. Arresters would be required to protect the line from such strains. A ground wire is also no protection from strains caused by high-frequency waves that are set up in a circuit by sudden changes of load or by resonance.

The result of years of test has been favorable to ground wires in many cases. It is particularly noticeable that on lines provided with ground wires poles are not split by lightning.

Theoretically, barbed wire should be used for an overhead ground wire, as the points of the barbs draw off the charge from the surrounding air. The action is the same as that of the comb in the static machine. In practice, however, there does not seem to be any gain in the use of barbed wire. It is very difficult to string on poles, the points are far from being theoretical points, and the wire is of a poor grade. These disadvantages more than offset the theoretical advantages. A good construction would be No. 8 B. & S. gauge E. B. B. wire, strung on glass insulators, and grounded every thousand feet. The two outside pins on the top cross-arm are sometimes used for ground wires, but as the construction is expensive and there is some difficulty in connecting the wires to ground, a single ground wire, either above or below the circuit, is more frequently employed. Glass insulators are used, so as not to subject the pole to any unnecessary electric strain from the line.

Conclusion—There is still much to be done before we can claim to have our lines perfectly protected. The engineers of the manufacturing companies have developed apparatus that operates successfully under ordinary conditions, but each transmission line is a separate problem, and can only be solved empirically. Complete records of static troubles and, so far as can be determined, their causes should be kept by the different power companies, to show how their apparatus is affected by the local conditions.

DISCUSSION.

C. R. MAUNSELL—I ask if any cases have come to the knowledge of the committee of the puncturing of the lead lining of storage batteries by lightning on railway systems.

MR. DOW—Not to my knowledge, but flashing across the battery terminals to ground has happened to my knowledge—the spitting across seemingly to the surface of the tanks. That that will occur is quite likely indeed. The conditions in the railway battery practice are often those which approximate to the conditions of the water jet recommended as a protector and lightning discharges will break across the wet surface to get away, where to get

Digitized by Google

over any electrolytic or inductive surface is beyond question.

R. F. HAYWARD—Most of the members probably know that in Utah we have a number of miles of transmission lines running from 28,000 to 40,000 volts. There are altogether about 300 miles of 40,000 and 200 miles of 28,000 volts running in parallel, but there are no thunder-storms occurring within a range of 140 miles, north and south, that seem to miss us. I believe we catch a little of everything. I do not think during last summer that any one storm passed through our lines without striking something either directly or inductively, giving us a secondary shock. We put in all the lightning apparatus we can, not so much to protect our machinery and lines, as to protect our consciences. We do not believe that it protects our apparatus, but we do like to say to the board of directors that we have taken every precaution that is known. We have about come to the conclusion—and this conclusion is based on what we have run up against, and upon the advice of the best authorities in the East, from Mr. Steinmetz down, and from our friends in the Westinghouse company, who have done some very good work in the investigation of this line, especially Mr. Thomas—that we must spread our lightning protection all over the line in the form of lightning conductors. Lightning likes to follow a line which is as non-inductive as possible, and you can not get a heavy discharge involving a large amount of current which will keep itself together in one part, because the large amount of current in itself entails heavy self-inductance. It will split up if it possibly can. We find when a storm passes over us that it will generally strike the lines and splinter a number of poles, shattering all the insulators on one pole and puncturing a number of insulators on other poles. The effect is seldom found far from the point where it strikes. If the stroke is near the power-house you are pretty sure to lose some apparatus, or if you do not lose apparatus, you are pretty certain to have all the terminals burned out.

We believe that we should put the ground wire on the line. We believe after all that is going to be the only protection. Mr. Honnold, our operating engineer, has devised a scheme which seems to be successful. When a thunder-storm comes along if we have not a ground wire on the line, we ground one of the two circuits at each end of the line. In this way we have had several storms pass over without doing damage. This plan will not prevent the lightning from striking the pole line, and if it strikes it you can not tell what will happen.

There is one point mentioned by Mr. Dow to which I take some exception. I do not believe that the place for the ground wire is in with the other wires. I want it above; first of all because I have a notion that when a thunder-storm is coming prior to the discharge which causes the trouble there may be a certain amount of brush discharge which we do not see coming on the line. This comes to the line from the clouds and forms a preliminary rake-down path. This may or may not be so, but we are guessing on these matters all the time. If I had a ground wire above the other lines, I would like it to be as far above as possible, and one of the reasons is that when the stroke comes it will discharge to this ground wire and take the ground by a number of different paths, and I do not think the arc is liable to effect a short-circuit, whereas if the ground is in between the neutral point of the main circuit it is almost certain to cause an arc which will give a short-circuit, and these sudden short-circuits I believe are the cause of setting up waves which go into the power-house and, being low frequency waves, pass through the choke coil and are liable to break down the apparatus, whereas the high-frequency wave will be checked by the choke coil.

E. P. DILLON—Those of us who are operating in Colorado have our troubles, especially in the zone in front of the foothills, and we feel that lightning is probably more severe in this particular section than in any other part of the state, and we venture to say more severe than we have heard of in other sections of the country. It has required a good deal of attention and study of the peculiar conditions of each system. In Colorado Springs we feel we have a fair amount of protection now, although it is not absolute. We have liberally distributed lightning arresters at various plants and substations, but we have nothing on the line. We do not feel that the placing of lightning arresters on the line is warranted, the risk of having lightning arresters on the line more than offsetting their advantage. We have no ground wire, but I think, perhaps, a well-constructed ground wire would probably obviate some of the difficulties which we have had. Our triangle is not very large, sixteen-inch centres, no double circuits on the pole line. At three different times in the last two years we have had lines burn down directly in the middle of the span. It seems that the arc starts in some way between the wires, resulting from some sort of a short-circuit, and runs along the line until it finds a weak point and burns the copper. Our copper is No. 1, with large engines behind it, with heavy flywheel capacity, tending to hold the arc long enough to burn the lines down. This has never occurred on junction poles where you would think the lightning would jump around, but invariably happens on the straight line.

Many of us feel, I believe, that our static disturbances are most likely to come in the summer time, during the summer season. Last winter, in December, due probably to a heavy wind which was blowing at the time, we had some exceedingly severe discharges from the lightning arresters, and they appeared to be heavy enough to destroy some apparatus, if it had not been for the lightning arresters being in service. Another peculiar thing here is that with lines in extremely high altitude, 11,000 feet, the disturbances are much less severe—they are practically unknown on extremely high lines—while the valley lines suffer severely. I think this is due to the fact that the clouds come down so low there is not a chance for much difference of potential between the clouds and the earth. I have been on high ridges during storms and you can feel a tingle all through your body like a slight electric shock. It seems to me at these points there is a constant discharge between the clouds and the earth, and no opportunity offered for a great difference of potential to be formed and then discharged in the form of a heavy volt. But this will not hold true in all cases, because in the mountains immediately around here, while the altitudes are not very great, the disturbances are very severe and heavy, especially on the mountain railway lines.

In Colorado we are not very partial to the use of a barbed-wire ground. A well-constructed ground wire no doubt has its advantages, and is certainly good in theory, but the barbed ground wire due to the uneven quality of the wire in twisting has been known in many cases in the West to break and cause more serious line trouble than any lightning disturbances. A great many of the operators in this country prefer to take chances on what has been designed in the way of lightning protection, than to put in the barbed ground wire. I think a well-made steel wire of good tensile strength would no doubt give very good protection and help out the regular arrester. In our main generating station, just outside of Colorado Springs, which we installed, there was considerable experimenting with lightning arresters, and we finally went over to the high-resistance arrester in combination with the spark-gap. They did not completely take care of the trouble, and about two years age we put them up in a combination, or series parallel arrangement, giving the discharge a straight path to ground, a split through the arrester. I am glad to say up to date, ever since that change has been made, we have not had any discharges on our switchboard. It appears to have been a very successful arrangement.

GEORGE R. STETSON—While in the far East we hardly expect to carry the matter of lightning protection to the extent they do in the far West, we have our troubles which are perhaps as serious and as difficult to account for. In the station I had the care of in last December, and after having run direct current for a good many years, and an underground system of transmission for four or five years, there was an epidemic broke out among our motors that raged for several weeks and in two weeks destroyed more motors than had been destroyed in all the fourteen previous years in the operation of our plant. This was an unexpected epidemic with us, and we went to work and treated it as fast as possible, but have not got over it yet. It was a static manifestation. Previous to this we had never found it necessary to make any particular provision for the care of our motors, but at this time the motors were punctured within a radius of three to five miles, one after the other, some

Digitized by Google

being served by the underground system and some being served by the overhead system. The puncture was very much in the nature of a lightning puncture generally on the armature. At first we were able to repair the armatures within a reasonable time and without much inconvenience to our customers, but it finally went beyond the motors outside, and came into the generators inside, and that was more serious. The singular feature of the matter is the manifestation at this particular time. We immediately went to work to take care of the motors as far as possible by putting up lightning arresters and kicking coils, and seemed to have conquered the trouble to quite an extent, but occasionally we have a manifestation now, particularly if we have not taken proper care of the motors.

I relate this experience, so that if any of our members feel they are pretty safe about static discharges they had better not be too sure. These discharges take place under particular conditions, usually such conditions of atmosphere as contribute to a high electric potentiality, a condition of atmosphere, clear, such as would make electric transmission easy. We set up a Bristol gauge, putting in the proper resistances, and the manifestations on that gauge were very interesting. The gauge sometimes failed to be large enough to take the limit of the stroke, but it kept up very lively and painted the index pretty nearly all over, and you could see the flash coming in and the work of that needle, so that you must be prepared not only for lightning but for static disturbances, and in this case it was very singular to us after so many years of repose that we should be kicked out so vigorously at this one season.

W. B. JACKSON—Regarding the static conditions on transmission lines, some three or four years ago I made a somewhat complete examination of a line in northern Italy, and at that time they had the jet static arresters in use. They were very much troubled by the attacks of static disturbances on their 20,000-volt generators, and they were frequently shut down as I was informed, not on account of the lightning particularly, but on account of the static going through the insulation of the 20,000-volt machines. They then installed jet static arresters, and I think the arresters had been in about six months. I was informed at that time that since the installation of the jet arresters, the water jet arresters, they had no trouble from static effects. It would be very interesting if there is anyone in the audience who could bring that information more nearly to date, to know if the action of the jet arresters was thoroughly satisfactory up to the time they were last heard from.

ALEX DOW—In the matter of the action of the water jet on the Valtelina line the water jets are still satisfactory. Your reporters believe that the water jets are the most comprehensively reliable arrangement that we have just now for protection against either lightning or static discharges when installed in connection with choke coils. The function of the choke coil is to locate the point of discharge for any excessive voltage. The objections to the jets are first of all, the things are sloppy, and, next, that they take energy. Because of this taking of energy, we made verbally the recommendation that they be held as emergency devices where possible, and upon the appearance of symptoms of static charge on the line the water jets be turned on. At 20,000 volts, the amount of current that one of these jets will take is enough to do quite a little work toward earning dividends for the company. There would be quite a loss through their constant use, and we do not recommend that they be left on the service continuously.

In regard to the position of the ground wire, the centre of the square on the two-phase transmission should be at earth potential. In a two-phase transmission, the geometrical centre of the square is the theoretically correct position of the ground wire, as likewise is the centre of the triangle in a three-phase transmission; for the reason that these positions are theoretically at earth potential if the line is insulated, and are absolutely so, if, as is usually the case with Y-connected transformers, the central point of the Y is positively connected to the earth. If the distance between the two-phase conductors, or the delta distance between the wires of the three-phase circuit is correct for the voltage between the wires, then the distance to the ground wire will of necessity be correct. That admits of mathematical demonstration as to placing the ground wire above the transmission lines instead of among the wires. The theory is that as the earth's potential is above and also below the line wires these can not be charged with static to a high potential. The fact is exactly what Mr. Hayward points out. The preliminary brush discharge or discharge of the atmosphere, is taken by the ground wire. To all intents and purposes a variation of the vertical position of the ground wire within two or three feet is immaterial. But if the ground wire is nearer to one of the transmission wires than to any of the others, when a stroke takes place and the ground wire discharges instantly, as it were, the wire nearest to the ground wire, on the transmission, will be very highly stressed relative to the ground wire. There will be stress between the wires of the transmission and there will also be great stress between the closest wire and the ground wire. Under these conditions the position of the ground wire is better in the middle than above. We can not consider the gradient of potential between the clouds and the earth as a straight line. I may say it is not entirely theory that causes us to recommend this position of the ground wire; it has proved to be good in practice on a certain Michigan line. The fact which Mr. Hayward has noticed of the jumping across the transformer terminals is common. It indicates he should have static discharges across the line and indicates a difference of potential between the two or three wires of the system, which a non-inductive resistance such as the water jets will take care of. A jump represents merely an equalization of the temporary stresses between two wires of the three. The obvious remedy is the providing of a good non-inductive path between the two wires.

The point is made that barbed ground wire is not good. We recommend flatly against it in our report. I want to say that the distinction between static and lightning is not essential. You refer to lightning when there is a thunder-storm, but there are differences of potential on hills and in valleys, a different potential between one point on the line and other points on the line which are essentially the same in their laws and yet they are not the terrific discharges which we recognize and call lightning. The laws are the same and the protection is the same. The discharges from our own apparatus and from our own lines which follow the break of a short-circuit are of the same order, except that they are of lower frequency, and the protection again is the same.

I can not make it too strong that the provision of low-resistance non-inductive paths to, around and between lines is the perfect protection. It is only a question whether we can stand the losses of energy that these low-resistance non-inductive paths require.

Condensed Specifications and Forms of Proposals for the Construction of Chicago Municipal Street Railways.

Bion J. Arnold, as consulting engineer, has prepared a volume containing condensed specifications and forms of proposals relating to the construction and operation of a municipal street railway for the city of Chicago, Ill. This volume also includes notes to bidders and instructions to bidders. The volume sets forth, in as few words as possible, the material necessary for each portion of this extensive work. In addition to the text there are twenty-nine plates, giving profiles and details of the construction.

International Association of Municipal Electricians.

The convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 23, 24 and 25, 1905. This is a change of date from that previously announced. All indications point to this convention being one of the most successful the association has ever held. The location of the city of Erie is fortunate, and at the time of the year when the convention will hold forth, the weather conditions are said to be exceptionally good. The list of papers which has already been announced includes a number of important subjects. The secretary is Frank P. Foster, Corning, N. Y.

Digitized by Google

TWENTY-SECOND ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

ASHEVILLE, N. C., JUNE 19-23.

The headquarters of the American Institute of Electrical Engineers, for the twenty-second annual convention, will be at the Battery Park Hotel, Asheville, N. C. The sessions will last from June 19 to June 23, inclusive. Elaborate preparation has been made to afford an opportunity of making the most of the trip to Asheville, and in addition to the papers and discussion, there will be plenty of entertainment.

The following programme has been announced:

MONDAY, JUNE 19, 9.30 TO 1.

Address of welcome, by the Hon. A. S. Barnard, mayor of Asheville. Address, President John W. Lieb, Jr. "High-Potential Oscillations of High Power in Large Power Distribution Systems," by Chas. P. Steinmetz. "The Constant-Current Mercury-Arc Rectifier," by Chas. P. Steinmetz. "An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances, such as Switches, Grounding, Etc.," by Percy H. Thomas.

AFTERNOON—Drive through Geo. W. Vanderbilt's estate at Biltmore.

EVENING—"Data Relating to Electric Conductors and Cables," by Henry W. Fisher. "Methods of High-Pressure Measurement," by S. M. Kintner. "Some Comments on Remarks Made by Colonel R. E. B. Crompton before the International Electrical Congress at St. Louis," by John W. Howell.

TUESDAY, JUNE 20, RAILROAD DAY, 9.30 TO 1.

"Three-Phase Traction," by F. N. Waterman. "Heavy Electric Freight Traction," by C. de Muralt. "Choice of Motors in Steam and Electric Practice," by Wm. McClellan. "Electrical Features of Block Signaling," by L. H. Thullen. "Weight Distribution on Electric Locomotives as Affected by Motor Suspension and Draw-Bar Pull," by S. T. Dodd.

AFTERNOON—Visit to the Weaver Power Company's high-tension transmission plant.

EVENING—Ball in the main ballroom at the Battery Park Hotel, as arranged by the local committee.

WEDNESDAY, JUNE 21, ELECTRICAL DESIGN DAY, 9.30 TO 1.

"Limits of Injurious Sparking in Direct-Current Commutation," by Thorburn Reid. "A Study in the Design of Induction Motors," by C. A. Adams. "Limitations in Direct-Current Machine Design," by Sebastian Senstius. "Motor-Generators and Synchronous Converters," by W. L. Waters. "A New Instrument for Measuring Alternating Currents," by E. F. Northrup. "Eddy Currents in Large Slot-Wound Conductors," by A. B. Field.

AFTERNOON—Trolley excursion through Asheville and vicinity. Tea at the Swannanoa Golf Club.

EVENING—Banquet at the Battery Park Hotel, as arranged by the local committee.

THURSDAY, JUNE 22, NEW DEVELOPMENT DAY, 9.30 TO 1.

"Water Power of the Southeastern Appalachian Region," by F. A. C. Perrine. "The Development of the Ontario Power Company," by P. N. Nunn. "A New Carbon Filament," by John W. Howell. "A New Induction Generator," by William Stanley. "Note on a Simple Device for Finding the Slip of an Induction Motor," by Charles A. Perkins. "The Preservation of the Southern Streams—a Forest Problem," by Charles E. Waddell.

AFTERNOON—Organ recital at All Souls' Church, Biltmore.

EVENING—Smoker at Albemarle Club.

The programme for Friday, June 23, will be arranged by the local committee.

The visiting members will be given the privileges of the Swannanoa Golf Club, and of the tennis courts of the Battery Park Hotel.

TRANSPORTATION ARRANGEMENTS.

Tickets will be issued at all the principal stations and ticket offices of the Trunk Line Passenger Association, the Central Passenger Association, and the New England Passenger Association, to members and guests, on the certificate plan, which allows the holders of such certificates to purchase tickets from Asheville to original starting point, at one-third the regular fare, provided there are at least one hundred certificates presented.

Railroads that are members of the Southeastern Passenger Association will sell from any point included in the territory south of the Ohio and Potomac rivers, and east of the Mississippi river tickets to Asheville, N. C., at a single fare plus twenty-five cents for the round trip, tickets to be sold on June 15, 16 and 17, with final limit of return June 28. This includes Southern Railway terminals at Norfolk, Washington, Richmond, Cincinnati, etc. Members starting from points in the above territory can purchase tickets direct to Asheville and return, at the one-rate fare, plus twenty-five cents. In order that members starting from points not in the Southeastern Passenger Association territory may avail themselves of the one-rate fare, it will be necessary for them to pay the full round-trip fare to and from a Southeastern Passenger Association terminal.

Tickets at full fare for the going journey may be obtained three days (exclusive of Sunday) prior to the meeting, and also during the first three days of the meeting.

Application for certificates must be made when purchasing tickets for Asheville. Should certificates not be available at the office where application is made, a ticket should be purchased to the nearest station where such certificates are issued, and a ticket to Asheville, together with the certificate, obtained there.

Immediately after arrival at Asheville tickets should be presented to be viséed at the secretary's headquarters in the Battery Park Hotel. A fee of twenty-five cents will be charged by the railroad agent for each certificate endorsed by him.

Members starting from New York should leave *via* Pennsylvania Railroad, Cortlandt or Desbrosses street ferry at 4.30 P. M., West Twenty-third street ferry at 4.25 P. M., Saturday, June 17. If a sufficient number warrants a special train from Washington to Asheville, Saturday night, June 17, it will be provided; if not, extra cars will be attached to the regular train leaving New York at the time mentioned above, Washington at 10.45 P. M., and arriving at Asheville Sunday afternoon, June 18.

Tickets will be sold *via* Old Dominion Steamship Company, New York to Norfolk, thence *via* Southern Railway to Asheville, on the certificate plan at the following rates: going fare, $18.95; return fare, $10.15; both including meals and berth on steamer.

Old Dominion steamers leave Pier 26, North river, New York, at 3 P. M., daily, except Sunday, and arrive at Norfolk about 11 A. M. the following day. The Southern Railway runs through sleeping cars leaving Norfolk 7.30 P. M., and arriving at Asheville at 1.40 P. M. the following day.

Members wishing to travel *via* Old Dominion Steamship Company should make application for accommodation immediately direct to Old Dominion Steamship Company, traffic department, 81 Beach street, New York city.

Boston members can reach Norfolk by Merchants' and Miners' Line; round trip, including meals and berth, $22.

Tickets *via* Southern Railway Company, from Norfolk to Asheville, can be purchased on the certificate plan, as explained above.

Members who wish to start from Chicago, St. Louis, etc., should apply for additional information to John H. Finney, member of local committee, National Bank of Commerce Building, St. Louis, Mo.

An invitation to visit the Bureau of Standards, Washington, D. C., has been extended to the members of the Institute by E. B. Rosa, acting director. The bureau is open until 4.30 P. M. Saturdays; and, if advised of intended visits in advance, Mr. Rosa will arrange to keep open later.

Members who desire to accept this invitation, either on their way to Asheville, or on their return from the convention, should take the Chevy Chase car which leaves the Treasury every quarter-hour during the day. This car runs directly to the Bureau, a ride of twenty-five minutes toward the northwest.

Digitized by Google

The American Society of Mechanical Engineers.

Fifty-first Meeting, Held at Scranton, Pa., June 6 to 9, 1905.

THE fifty-first meeting of the American Society of Mechanical Engineers was held at Scranton, Pa., from June 6 to 9 inclusive. The meeting was one of the smallest held in recent years, the number of members and guests registered being but 264. The delegates commenced to assemble early on June 6, and were met at the railroad stations by a reception committee composed of Maxwell E. Bessell, David Boles, William L. Chamberlain, and Worthington Scranton. The headquarters of the society were at the Hotel Jermyn.

The first session was held Tuesday evening, but the early arrivals were entertained during the afternoon by a trip to the plant of McClave & Brooks, where the manufacture of McClave stokers is carried on, and to the Pine Brook breaker, which has been rebuilt, after being destroyed by fire.

The opening session was held on Tuesday evening in the auditorium of the Young Men's Christian Association, where all subsequent sessions were held. John R. Freeman, president of the society, presided. The delegates were welcomed by William F. Mattes on behalf of the local members, by Colonel F. L. Hitchcock for the Board of Trade, and by E. M. Zehnder for the Scranton Engineers' Club. President Freeman responded briefly for the society. Secretary F. R. Hutton then read letters presenting house privileges from the Young Men's Christian Association and the Scranton Engineers' Club to the society. Following this, papers entitled "Standard Unit of Refrigeration," by F. E. Mathews; "Formation of Anchor Ice and Precise Temperature Measurements," by Howard T. Barnes; "Some Types of Centrifugal Pumps," by William O. Weber, and "The Transfer of Heat at High Temperatures," by Frank C. Wagner, were presented.

The second session was held at ten o'clock on Wednesday, June 10. The early part of the session was devoted to business and the latter part to professional papers. President Freeman announced that Chattanooga, Tenn., had been selected as the place for the next spring meeting. The tellers of election reported that all candidates for membership had been elected, making the total membership of the society 2,930. An invitation was received to attend the Pacific Coast Congress of Engineers which is to be held at the Lewis and Clark Exposition June 29 to July 1. Charles W. Hunt reported for the building committee that the contracts for the new building for the various engineering societies in New York would be let on June 20. Mr. Charles H. Haswell was unanimously elected an honorary member of the society. The following papers were then read: "Microstructure and Frictional Characteristics in Bearing Metals," by Melvin Price; "Cast Iron, Crushing Loads, and Microstructure," by William J. Keep; "Smoke and Its Abatement," by Charles H. Benjamin.

Wednesday morning the visiting ladies were driven to the Scranton lace curtain factory and to the Klotz throwing mill. In the afternoon they were taken to the Scranton Country Club, and then to the residence of Mrs. J. Benjamin Dimmick where they were tendered a reception. The delegates in the afternoon visited a number of points of interest, including the International Correspondence Schools and the Allis-Chalmers works.

The third session was held Wednesday evening and papers were presented as follows: "Can a Steam Turbine Be Started in an Emergency Quicker Than a Reciprocating Engine of the Same Power?" by A. S. Mann. "Notes on Efficiency of Steam-Generating Apparatus," by A. Bement; "Performance of a Superheater," by A. Bement; "Counterweights for Large Engines," by D. S. Jacobus; "Steam-Actuated Valve Gear," by William H. Collier.

The closing session of the meeting was held on Thursday morning, June 8, and the following papers were read and discussed: "Note on Heads of Machine Screws," by H. G. Reist; "Belt Creek," by William W. Bird; "Function of Laboratory Courses in the Curriculum of Engineering Schools," by Charles E. Lucke; "Continuous Measuring and Mixing Machines," by E. N. Trump; "Epochs in Marine Engineering," by Rear-Admiral George W. Melville.

After the reading of the paper a set of resolutions was passed thanking the many people and concerns in Scranton who had extended courtesies to the society and its guests. During the session the ladies were entertained by a drive around Lake Scranton.

On Thursday afternoon a special train on the Lackawanna railroad took all the members and guests through the Keyser valley, where they inspected the power plants of the Lackawanna railroad, the water-hoisting plant at the Hampton colliery, and the new shops of the Lackawanna railroad. The two former places have been recently described in the ELECTRICAL REVIEW. On Thursday evening a reception was tendered to the society at the Scranton Bicycle Club by the local members, the Board of Trade, the Scranton Engineers' Club, and the citizens of Scranton.

On Friday the officials of the Lackawanna & Wyoming Valley Railroad, otherwise known as the Laurel Line, furnished a special train in which the members and guests were taken to Wilkesbarre, where the Vulcan Iron Works and the Sheldon Axle Works were visited.

Abstracts of some of the papers presented follow:

PERFORMANCE OF A SUPERHEATER—A. BEMENT.

This paper gives the performance under various conditions of a Babcock and Wilcox boiler of 5,000 square feet of heating surface equipped with a Babcock & Wilcox superheater of about 1,000 square feet of heating surface. A number of diagrams are plotted showing the performance, and a wide variation in capacity is shown, probably due to variations in the coal. The author concludes that capacity increases more rapidly than does the temperature of the steam. The curves given show the relation of total horsepower to degrees of superheat; horsepower produced in superheater to horsepower produced in boiler; horse-power developed in superheater to degrees of superheat, and horse-power produced in boiler to percentage of boiler horse-power produced in superheater. A number of drawings are given showing the various arrangements of the apparatus.

CONTINUOUS MEASURING AND MIXING OF CRUSHED OR POWDERED MATERIALS IN ACCURATE PROPORTIONS.—E. N. TRUMP.

The author first gives a brief review of the various methods now in use of making accurate mixture and measurements. The apparatus which may be used are screw conveyers, shaking spouts, revolving pockets, revolving rolls, reciprocating tables, and revolving tables. He then takes up the development of a continuous measuring and mixing machine consisting of a pair of revolving tables and bottomless cylinders through which the materials are fed to the tables, from which they are removed by a fixed knife. A table

Digitized by Google

of results of a number of experiments made on this type of machine is given.

NOTES ON THE EFFICIENCY OF STEAM-GENERATING APPARATUS—A. BEMENT.

This paper was suggested by the discussion on one presented by the author at an earlier meeting. In it he takes up the question of what the efficiency of steam-generating apparatus really is. The difficulty of properly understanding the subject is increased by the confusion which exists in regard to the various terms used—thus, boiler may be made to mean only the portion containing water and steam, or it may be used to designate the entire equipment including furnace, setting and stoker. The author regards the boiler simply as the vessel containing water and steam. In discussing the efficiency of a boiler the author treats of the various causes which affect it, as the shape and size of the metallic parts, the influence of scale and dirt, and of the condition and character of the fire.

In speaking of furnace efficiency the statement is made, the definition of furnace efficiency is incomplete if it neglects the matter of temperature. The stoker or grate is not regarded as part of the furnace. The furnace is assumed to be a brick chamber in which combustion takes place. The proper and most convenient measure of the furnace efficiency is stated to be the composition of the gases leaving the furnace. The formation of the grate or stoker is taken up and briefly treated and then the subject of manipulation is considered. A good word is said for the fireman, who is often held responsible for the faults of the designer. The value of an apparatus for indicating oxygen is shown. The paper is concluded with the report of two tests and the conclusion drawn therefrom.

BELT CREEP—WILLIAM W. BIRD.

In this paper a number of experiments are described which were made on four and six-inch single and double belts. The belts were run without load, and the sum of the tensions was made twice the desired tension, which was taken as fifty and eighty pounds per inch of width of single and double belt respectively, on the tight side. The corresponding figures for the slack side were twenty and thirty-two pounds. The average of ten tests showed a percentage of creep for the various belts as follows: four-inch single, 0.70; six-inch single, 0.67; four-inch double, 0.67; six-inch double, 0.66. The author analyzes the test and draws the conclusion that for conditions which exist in good practice the creep should not exceed one per cent.

THE TRANSFER OF HEAT AT HIGH TEMPERATURES—FRANK C. WAGNER.

Experiments are described, which were made to determine the time required to raise plates of iron or steel to a welding temperature in an open hearth regenerative furnace. Preliminary experiments were made by heating plates in a muffle of the size commonly used in chemical laboratories. Plates were used varying in thickness from 0.104 inch to 0.129 inch. The temperature of the plates was measured by a Le Chatelier thermocouple whose junction was at the centre of the plate. A second thermocouple measured the furnace temperature. Readings of the plate temperature were taken every five seconds until the plate attained the temperature of the furnace. The transfer of heat was principally by radiation. The temperature of the plates varied from 239 degrees Fahrenheit to 1,639 degrees, and the number of British thermal units absorbed per second per square inch of plate varied from 0.0491 to 0.0144. Tables are given in the paper showing the conditions at every 100 degrees temperature above 239 and the results are also given in the form of curves.

BOOK REVIEW.

"Modern Electrical Construction." H. G. Horstman and Victor H. Tousley. Chicago. Frederick J. Drake & Company. Flexible leather. 243 pages. 4¼ by 6½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $1.50.

This handbook is put forward to provide the beginner in electrical construction with a practical guide telling him just how to install his work in accordance with approved methods. As a basis, the rules of the National Electrical Code of the National Board of Fire Underwriters have been taken and explained clearly, diagrams being used where they will assist in making the matter clear. The principle of calculating electric lines is explained, and a method given for finding the equivalent cross-section of stranded cables. A number of valuable tables are added, which greatly simplify wiring computation. There are also useful tables giving the dimensions of standard appliances such as porcelain knobs, tubes, screws, nails, etc. The book deals in detail only with inside wiring or such wiring as is necessary to connect the house with the supply mains, but for this work it should be an acceptable and useful guide.

CONVENTIONS OF RAILWAY MEN.

THE ANNUAL CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS, THE MASTER CAR-BUILDERS' AND THE RAILWAY SUPPLY MEN'S ASSOCIATIONS.

The thirty-eighth annual convention of the American Railway Master Mechanics' Association was opened on Wednesday morning June 14, at ten o'clock, at the Oriental Hotel, Manhattan Beach, L. I. There were present about 250 railway men, the pleasant quarters having attracted a particularly happy gathering. The business sessions of the convention were held in the ballroom of the Oriental Hotel, a platform having been erected at the south end of the room and an auditorium formed by the proper disposal of the seating arrangements.

The following programme was announced:

WEDNESDAY, 9.30 A. M. to 1.30 P. M.

Prayer. Address of president. Action on minutes of last meeting. Report of secretary. Report of treasurer. Assessment and announcement of annual dues. Election of auditing committee. Unfinished business.

New business: consideration of matters affecting the association. Appointment of committee on correspondence, resolutions, nominations, obituaries, etc.

Discussion of report on "Proper Loading of Locomotives."

Discussion of report on "Locomotive Tests of the Pennsylvania Railroad Company at St. Louis Exposition."

Topical discussions: 1. "The Best Known Dimensions for Water Space Around Fire Box to Produce Minimum Consumption of Fuel; and Replacement of Fire-Box Sheets and Reasons for Same," to be opened by Mr. Lawford H. Fry, Baldwin Locomotive Works. 2. "Locomotive Stokers," to be opened by Mr. William Garstang.

Discussion of individual paper by Mr. H. H. Vaughan, on "The Value of Superheated Steam for Locomotive Work."

THURSDAY, 9.30 A. M. TO 1.30 P. M.

Discussion of the following reports: "Locomotive Driving and Truck Axles and Locomotive Forgings." "Shrinkage Allowance for Tires." "Motive Power Terminals."

Discussion of individual paper by Mr. George M. Basford, on "The Technical Education of Railroad Employés: the Men of the Future."

Topical discussions as follows: "High-Speed Steel," to be opened by Mr. J. A. Carney. "Staybolts." Discussion of report on "Flexible Staybolts."

FRIDAY, 9.30 A. M. to 1.30 P. M.

Discussion of reports, as follows: "Water Softening for Locomotive Use."

Digitized by Google

"Service of Locomotives." "Shop Layouts."

Discussion of individual paper by Mr. C. B. Young, on "(*a*) Proper Lubrication of Valves When Drifting: (*b*) Relative Setting for Piston and Slide Valves."

Topical discussions as follows: "Relief and Bypass Valves for Locomotives," to be opened by Mr. A. E. Manchester. "Are Engines with Self-Cleaning Front Ends Satisfactory," to be opened by Mr. E. W. Pratt.

Discussion of reports on "Subjects." Correspondence and resolutions. Election of officers.

The annual convention of the Railway Supply Men's Association was held on Wednesday, June 14, at the Oriental Hotel.

MASTER CAR-BUILDERS' ASSOCIATION.

The programme of the convention of the Master Car-Builders' Association is as follows:

The opening meeting will be held June 19, from 10 A. M. to 1.30 P. M. After the transaction of the business of the association, the reports on "Revision of Standards and Recommended Practice," ""Triple-Valve Tests," and "Brake-Shoe Tests" will be read. This will be followed by topical discussions on "The Best Method of Preventing or Minimizing the Damage to Metal Parts of the Right of Way from Salt Water Drippings," and "Riveting Yokes." Adjournment will be taken after the discussion of a report on "Air-Brake Hose."

The second session will be held Tuesday, June 20, and will be opened by a discussion of a report on "Tests of Master Car-Builders' Couplers," followed by a discussion of reports on "Revision of Rules for Loading Long Materials," "Rules of Interchange," including reports of arbitration committee and passenger car rules, "Arch Bars," "Safety Appliances," "Tank Cars," and "Steam Connections." The discussion of these reports will be followed by topical discussions on "The Establishment of a Standard Height from Top of Rail to Centre of Drawbar for Passenger Equipment Cars," and "Is It Advisable to Use Malleable Iron for Wearing Surfaces?" These topical discussions will be followed by discussion of reports of "Repairs of Steel Cars," and "Stenciling Cars."

The closing session of Wednesday, June 21, will be opened at 9.30 A. M. by a discussion of the reports on "Coupling Chains," "Draft Gear," "Guarantee for Cast-Iron Wheels," "Doors," and "Subjects." After the discussion of these reports the unfinished business of the association will be taken up, and reports on the committee on resolutions, correspondence, etc., will be received. This will be followed by topical discussions on "How Does the Master Car-Builder Cast-Iron Car Wheel Show Up in Service as Regards the Breakage of Flanges," and "Do We Need Greater Braking Power on Freight Cars?" These discussions will be followed by the election of officers, after which adjournment will be taken.

THE CONVENTION OF THE NATIONAL-INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

AUDITORIUM, CHICAGO, ILL., JUNE 20, 21, 22.

The annual convention of the National-Interstate Independent Telephone Association will be held at Chicago, Ill., June 20, 21 and 22, 1905. The headquarters of the convention will be at the Auditorium.

The following preliminary programme has been announced:

JUNE 20, MORNING SESSION.

Address of welcome by Mayor Edward F. Dunne, of Chicago. The response will be made by S. P. Sheerin, president of the New Long-Distance Telephone Company, Indianapolis, Ind. The presidential address will be given by Mr. James B. Hoge, entitled "The National-Interstate Telephone Association." Mr. Theodore Gary, Macon, Mo., president of the Interstate Independent Telephone Association, will deliver an address on "Ways and Means to Make Our Association a Success." The appointment of committees will follow the reading of the following addresses: "Shall the Independent Companies Have an Insurance Company of Their Own?" by James S. Brailey. "Combined Telephony and Telegraphy," by Samuel G. McMeen.

JUNE 20, AFTERNOON SESSION.

The afternoon session will be called to order at 2.30 o'clock. There will be a roll call of states. It is expected that each state will be represented, and that the delegate responding for his state will devote from three to five minutes explaining the telephone situation for his constituency.

The following papers will be presented:

"Standard Toll Signs," W. G. Laubach, Akron, Ohio.

"Value of Telephone Securities," A. B. Greenshields, Philadelphia, Pa.

These papers will be thoroughly discussed.

JUNE 21—MORNING SESSION.

Meeting will be called to order at ten o'clock.

There will be presented reports of committees on "Standard Operating Rules and Regulations," "Standard Forms of Accounting," "Standardization of Equipment," "Best Methods of Advertising," and "What Arrangement Is Necessary between the Operators and Manufacturers to Protect Independent Companies."

These reports will be discussed and action taken by the convention.

JUNE 21, AFTERNOON SESSION.

The afternoon session will be called to order at 2.30 o'clock. A number of papers will be presented and miscellaneous business will be transacted, followed by the election of officers.

Friday, June 22, will be devoted to visiting and inspecting the exhibits. The manufacturers' committee and the local entertainment committee will provide entertainment to occupy the entire day. The convention will close Friday evening with a banquet at the Auditorium.

The manufacturers and supply men have reserved the entire sixth floor of the Auditorium for exhibit purposes.

On Tuesday morning, June 20, the committee on the matter of the consolidation of the Interstate Independent Telephone Association and the National Independent Telephone Association will report. At this meeting the report will be ratified so as to be in readiness for the opening of the convention of the National-Interstate Independent Telephone Association.

Trade Opportunities in Foreign Countries.

United States Consul-General Guenther, Frankfort, Germany, reports foreign trade opportunities as follows:

Italy—The Società Italiana di Industrie Ellectriche, in Spezia, has obtained a concession for building a line to Migliarina a Monte.

Mexico—The Compañía Exportadora de Jalisco, in Guadalajara, has been formed with a capital of $6,000,000, gold, to build a line from that city to the port of Chameta, on the Pacific, and another line twenty-four miles long to Hacienda de la Soledad.

Spain—The Dirección General de Obras Públicas, in Madrid, will award a contract for building a line in that city.

The Compañía de Tranvias de Gijon, in Gijon, will construct a tramway line in that city.

Brazil—The government of the state of Bahia has appointed a commission to examine the waterfalls and rapids and report upon their availability for producing electric energy.

England—The city of Andover intends to construct electric power works.

The National Electrical Trades Association Convention.

The convention of the National Electrical Trades' Association will be held in Montreal, Canada, beginning June 23, 1905. The meeting will be called to order at 2 P. M. John Foreman, of Montreal, is president of the association.

Digitized by Google

New Automatic Telephone Exchange at Columbus, Ohio.

ON JUNE 1 the Columbus Citizens' Telephone Company, of Columbus, Ohio, commenced cutting over its service from a manual central energy system to an automatic system manufactured by the Automatic Electric Company, of Chicago.

The automatic exchange is located on the fourth floor of a new four-story building which has been erected by the company immediately in rear of its old building, at the southwest corner of Long and Third streets, which will be abandoned.

The new building has a frontage of ninety feet on Third street and ninety-four feet on Elm street, the exterior being handsomely constructed of light pressed brick with terra-cotta trimmings.

The building throughout is thoroughly fireproof, the floors and columns being of steel-concrete construction and the walls of tile. With its carefully planned interior it is one of the best types of a modern telephone building in the country.

Part of the basement will be used as a storeroom for heavy line and cable material. The ground floor will be rented for storerooms, the second, third and fourth floors being used entirely by the local company, the Franklin Telephone Company and the United States Telephone Company, for telephone purposes.

On the second floor are located the general offices of the local company, its interior wiring department and storeroom, the offices of the United States Telephone Company, and its public pay stations.

On the third floors are located the long-distance operating room of the United States Telephone Company and the Franklin County Telephone Company, the long-distance wire chief's room, the long-distance telephone and telegraph battery room, the repair room for the automatic board, and the operators' apartments consisting of recreation, hospital, dining, locker and toilet rooms.

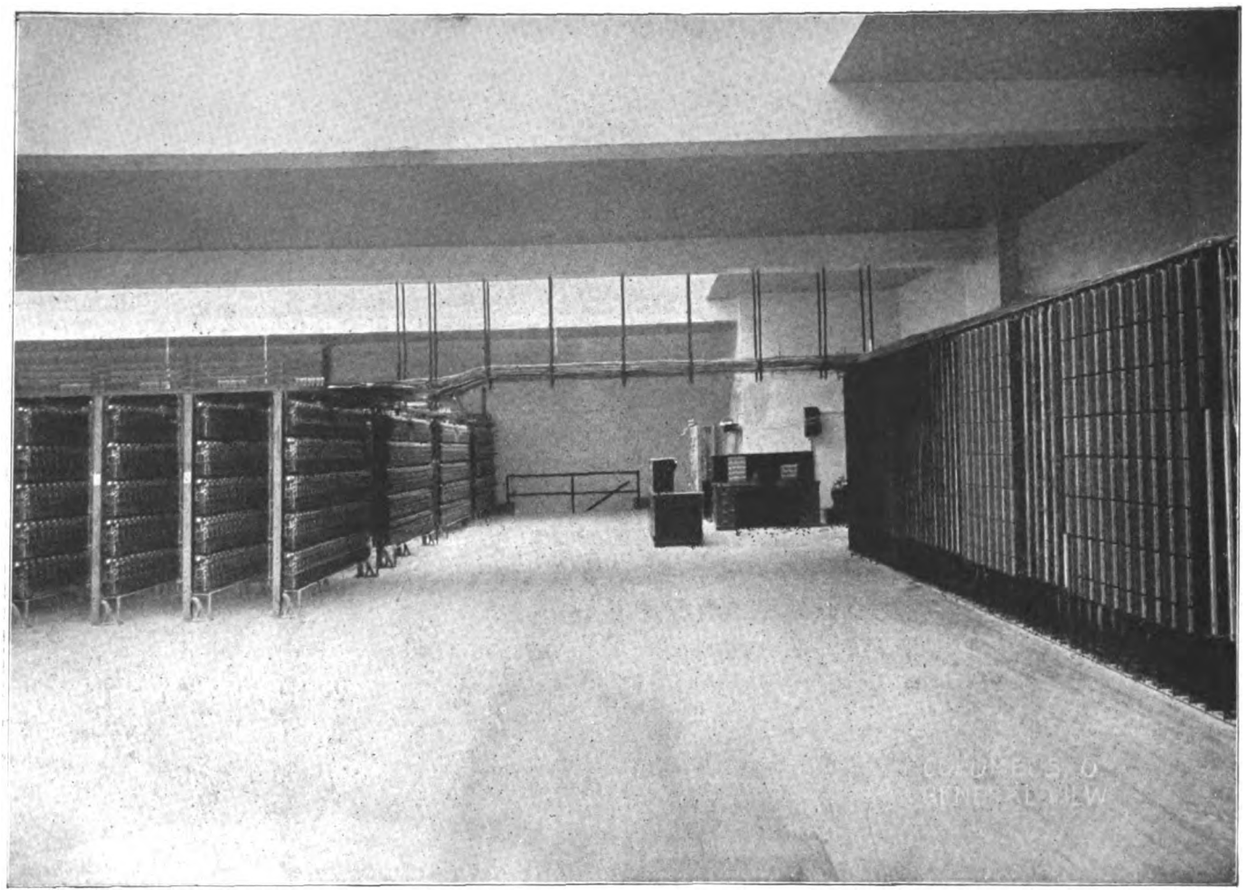
The fourth floor, with the exception of the local storage battery room in the southwest corner, is one large room lighted from above by two skylights—sixty-four feet by eighteen feet. Columns are entirely absent, the roof being supported by trusses. This floor contains the automatic switchboards, main distributing frame, local storage batteries, power apparatus, etc., as described by Mr. Lubberger in the subjoined article, which is reprinted from *Sound Waves*.

The 200-pair underground cables enter a cable tunnel in the basement of the building and are carried along the walks of this tunnel on cast-iron adjustable hangers.

From the tunnel the cables are suspended on messenger wire to the fourth floor level, where they are spliced to 200-pair cotton-silk cables which are terminated in the terminal blocks on the line side of the main distributing frame. An illustration shows a view of the cable tunnel.

The company has added 190,000 duct-feet to its subway, increasing it to 500,000 duct-feet and added 3,800 lines to its cable capacity, increasing it to 9,600 lines. B. H. Brooks is chief cable engineer of the plant and Geo. M. Painter, contractor, of Chicago, has built the additional subway and installed the additional cable. The plant throughout is a model of good construction.

The Citizens' Telephone Company, of



AUTOMATIC BOARDS AND WIRE CHIEF'S DESK, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.

Digitized by Google

Columbus, Ohio, has been operating a manual common battery exchange of a maximum capacity of 5,200 subscribers.

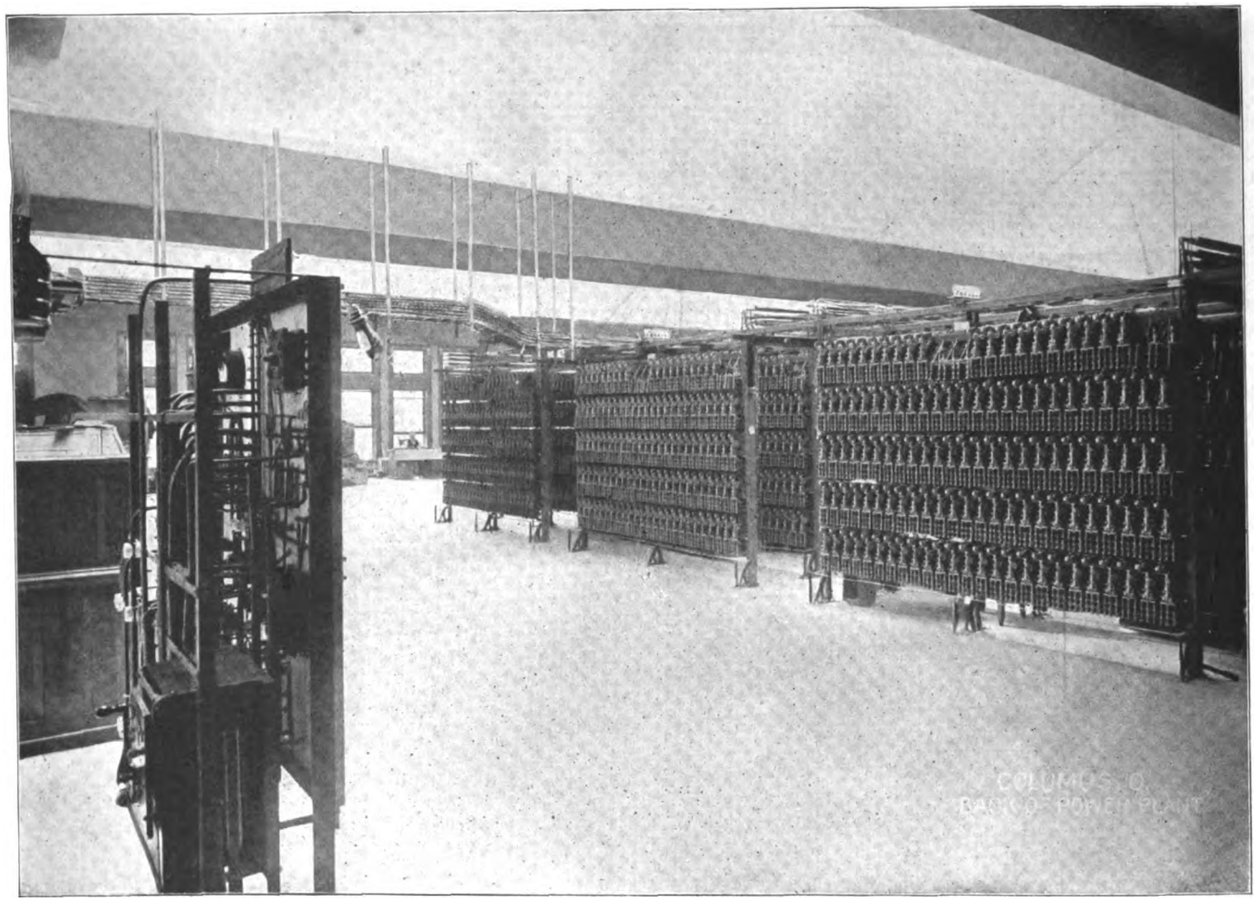
The calling signal is a drop thrown by the current through receiver and transmitter after receiver has been removed from the hook. The clearing-out signal is given by lighting a lamp in the cord circuit. The lamp is controlled by a double wound relay whose two windings are counter-energized as long as the receiver is off hook. For clearing out only one winding is energized, the circuit being closed to ground through the bell in the subscriber's station.

The board gave good service, but the demand for service outgrew its capacity far beyond the expectations of the Citizens' company. An increase of the multiples was impossible and the Citizens' Telephone Company decided to install an automatic plant. The Automatic Electric Company, of Chicago, has erected an exchange of 8,000 stations, the installation beginning early in March. The exchange will be ready for service June 1st.

This plant is the second largest single automatic exchange in the world, being surpassed only by Chicago with 10,000 in one office and by numbers in Los Angeles, Cal., with its seven automatic exchanges of 9,700 stations altogether.

The Columbus exchange is equipped with the most modern apparatus. A good many circuits were introduced for the first time, as all the varieties of the former manual service were to be taken care of. This fine work of the Automatic Electric Company deserves wide recognition.

The subscriber's telephone is a local battery instrument. The automatic calling device consists of a dial on the front of the box with ten numbered finger holes, the dial being mounted on a shaft. This dial may be turned clockwise about its centre, but a clock spring always tends to restore it to its normal position whenever it is released. The calling party, for calling "5," rotates the dial from finger hole "5." The calling device is arranged so that as the dial returns to normal position five ground impulses are sent over one line and a single impulse over the other line. In the exchange the lines end at two relays of the so-called "first selectors." The principal mechanical element of a selector is a vertical shaft. The five impulses over the one line cause the shaft to step up five divisions, the line therefore being called "vertical" line; the single impulse over the other line starts the rotary motion of the shaft, but does not control the number of rotary steps. There are ten vertical and ten rotary steps, or 100 different possible situations of the shaft. Each shaft carries three contact arms "wipers," two serving for the lines and the third for the "private," *i. e.*, guarding circuit. In every position of the shaft the wipers touch firmly the so-called "bank contacts" that are brass contacts, insulated from each other and supported by small steel frames. The illustrations show how the selectors are mounted on iron frames, so-called "boards." Each board has five "shelves," the top shelf being equipped with twenty switches, the lower four with twenty-five switches each.



REAR VIEW OF POWER-BOARD AND SELECTOR RACKS, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.

Each subscriber is represented in the exchange by a first selector. These are seen in groups of four times twenty-five, or 100, on the lower four shelves. The first part of a call, *i. e.*, the thousand digit, as described above, is made with the first selector bearing the number of the calling party. The second operation, *i. e.*, the hundred digit, is performed by the second selectors located on the left end of the top shelves. The "tens" and "units" are taken

Digitized by Google

care of by the connectors located on the right end of the top shelves.

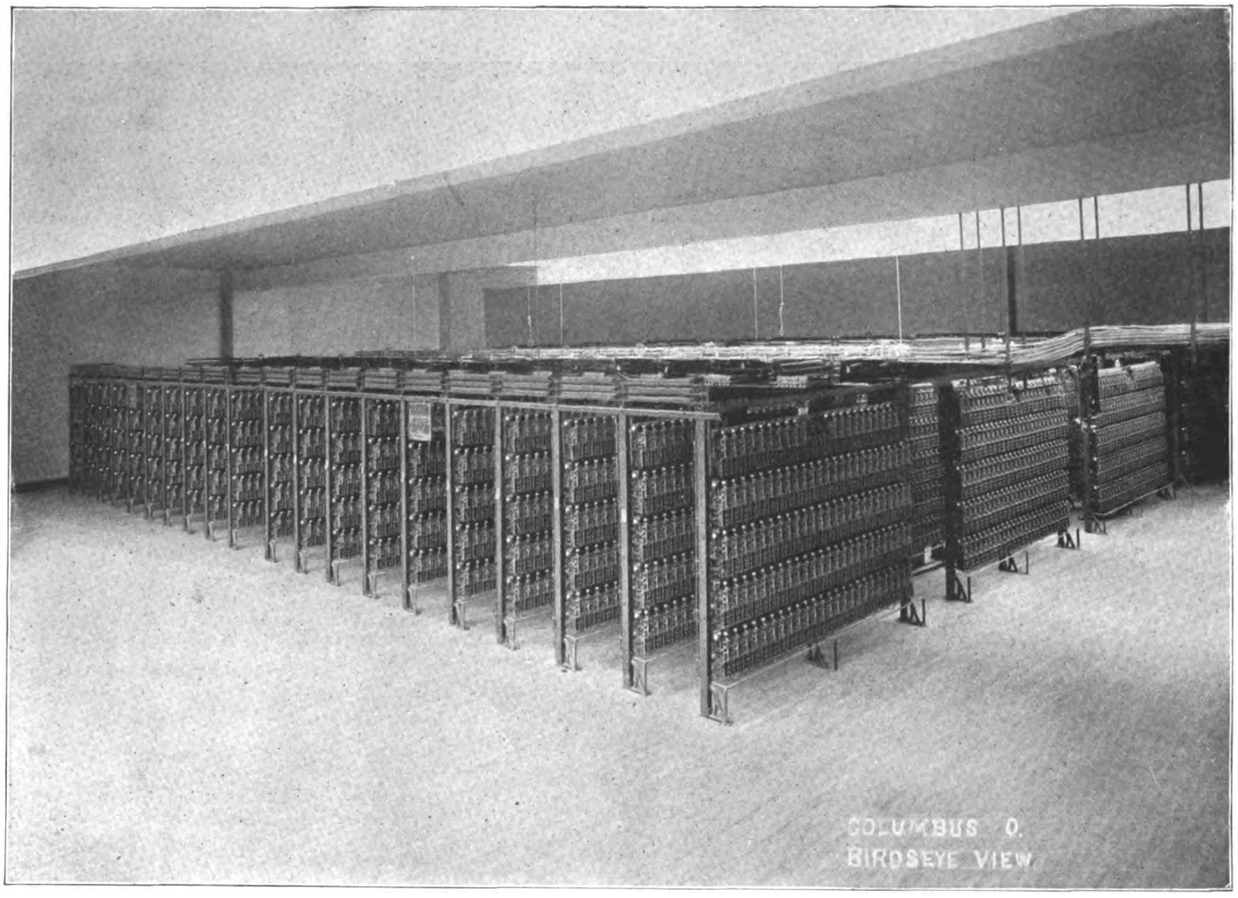
The building is a four-story, absolutely fireproof construction, located at Third street, near Long street, almost in the centre of the business district. The exchange occupies the fourth floor—a magnificent hall of ninety feet by ninety-four feet, without a single column to support the roof. It is lighted by two large skylights and a row of windows on the street side. There is room for 16,000 stations. In case of an increase beyond 16,000, it is intended to build branch exchanges.

Another set of terminals is alongside of the end uprights of the boards; these cable connections are also open to inspection and testing all around. The exchange is not wired to an entangled mass in one lump, but is subdivided into ten entirely independent groups. If any trouble is to be found the groups can easily be divided into smaller groups by simply cutting the small connecting wire at the front end of the terminals without even touching a cable. "Shorts" and "crosses" are just as easily located as "opens."

The lead-covered paper-insulated 200-pair underground cables enter the exchange building through a tunnel. The cables are spliced to silk and cotton ends a few feet from the distributing frame. The distributing frame was made by Frank B. Cook, and is equipped on the switchboard side with 150 pairs per column of protectors, with self-soldering heat coils; fifty pairs of beeswax switchboard cables connect the distributing frame with the switchboard terminals over the right end of the boards, the cables being supported by a runway suspended from one side of the roof trusses.

The line cables do not finish the cabling. The photographs were taken before the last set of cables was put in. There will be another rack of eighty-five of the Automatic Electric Company's standard cable terminals above the main distributing frame, filling the whole space between the distributing frame and the ceiling. These cables are used to connect the automatic board to the toll-board. The United States Telephone Company will soon put in one of the largest toll equipments in the state of Ohio. The toll-board will be located on the third floor. A call for toll will go through in the following way:

There is a special manual section, the so-called "switching" section, located on the fourth floor next to the windows. This section is equipped with a two-spring line and testing jack for each line, the lines being brought over from the distributing rack. The order wires of the operators at the section are connected to order wire keys on the toll-board on the floor below. Now, an automatic subscriber wishing a toll connection calls "Long Distance," *i. e.*, the last finger hole of his dial is marked that way. By calling this "Long Distance" his first selector is raised to the tenth step or "0" level, as is usually said. This "0" level is connected directly to relays controlling lamp signals at the recording clerk's positions, of which there



VIEW OF AUTOMATIC BOARDS, SHOWING CABLE DISTRIBUTION, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.

The eighty automatic boards are put up in four sections of two groups each and occupy a space of fifty-one feet by fifty-eight feet. Each ten boards form a group of 1,000 stations. The directory numbers are from 2,000 to 9,999, the group of 2,000 being at the staircase.

The principal idea to make every cable and contact accessible without disturbing any other part, is carried through all wiring. The pictures show hardly any cable, but attention is called to the small racks of three strips over the right and left end of each board. These parts are the cable terminals—the cables being connected to them on the inside, the connections between the cables being made at the outside.

Digitized by Google

will be three. The recording clerk takes the order and requests the subscriber to replace his receiver again, to restore the line to normal condition. The toll order is passed to the proper operator. After securing the toll connection, the toll operator communicates over the order wire with the operator at the switching section and the latter operator designates the trunk line between toll and switching positions. Both operators insert plugs, the toll operator into the toll jack, the switching operator into the line jack of the subscriber.

By inserting the switching plug "ground" is thrown on the test ring and this test ring is connected to certain contacts in the automatic board. This "ground" takes care of guarding the line from interference over the automatic board.

In the night-time, the switching sections are closed down, and connection from the toll-board to the automatic subscriber is made by means of automatic calling devices connected with each toll operator's position.

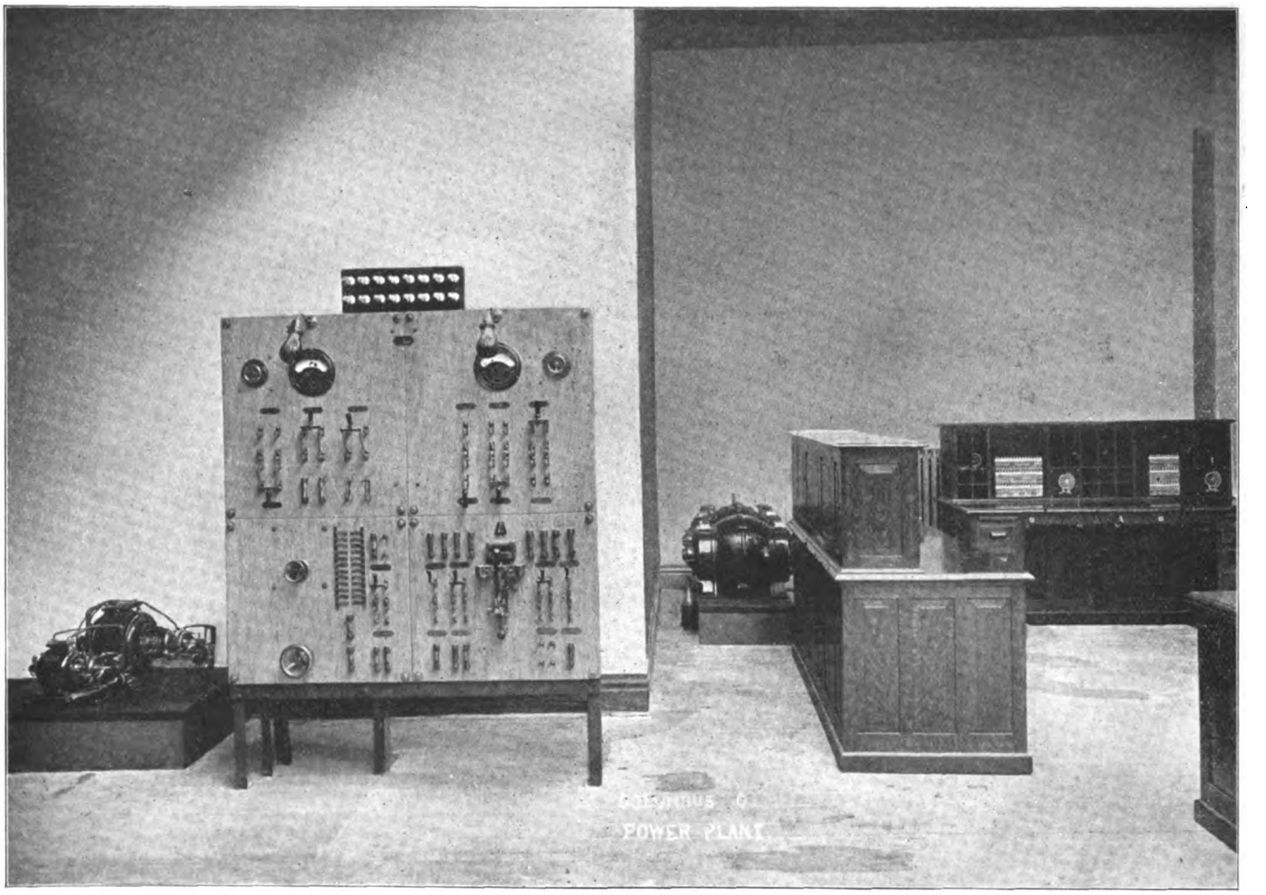
There are about forty-five private branch stations with two or more lines. In the automatic board a multiple line station has only one number and the automatic switches take care of completing a call over either one of the wires. The capacity of such lines is unlimited. The highest number of trunks of one directory number is at present fifteen, and the board is wired for an immediate increase to twenty-two trunks, but it takes only very little work to go beyond that. The private branch boards themselves are left as they are, *i. e.*, will be operated manually and the automatic part will be taken care of by equipping as many cords as there are trunk lines to the exchange with keys and relays required for automatic operation from the operator to the automatic exchange. A private branch telephone user will proceed by first getting his local operator, who will make the connection for him and plug the two stations together. In the night-time, however, some of the telephones around an establishment may be connected directly to the exchange. All these special telephones will be regular automatic telephones in daytime, calling the operator; in night-time calling directly to the exchange.

Great care was taken to imitate all combinations of extension circuits with two and three telephones on a line. All telephones are wired according to circuits designed especially for the requirements of quick changes from single telephones to extension telephones.

Another set of circuits was also engineered with great care, *i. e.*, information, trouble, wire chief and traffic. Some of the pictures show three two-position desks located in the automatic exchange. The one toward the automatic board, page 975, is a wire chief and assistant wire chief's desk; the one next to the power board has a combination position and information position No. 1. The desk at the wall, on this page, has information positions Nos. 2 and 3.

All information and trouble trunks loop through the combination position, and end at other positions. So in the daytime four operators may be placed at information trunks, but in the night-time one operator can handle all trunks at the combination position. The combination position and the wire chief's desk are next to each other, so that in night-time one person alone can take care of all calls. All positions are equipped with automatic telephones so that the operators may call out.

The so-called "traffic trunks" are a very interesting feature of this exchange. The idea of these trunks is to take care of all calls which might go to numbers from where no answer can be received, for instance: numbers not used but called by mistake, number published, but taken out; numbers changed; and numbers of parties out of town. In manual practice the operator is supposed to know all that sort of information. In Columbus extra terminals are placed on the cable racks over the right end of the boards. These extra terminals are connected altogether, to twelve trunks, ending at different information positions. As described above, all lines are carried to the same cable terminals, so if a line is a "dead number," it is connected by a short jumper to the



RINGING MACHINES AND INFORMATION DESK, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.

Digitized by Google

"dead number" traffic trunk, and calls to this line end at information position and will be answered. This traffic trunk wiring could certainly be done at the main distributing frame, but a rack with 8,000 jumper wires is just filled up enough and all special wiring is better kept away from it.

These traffic trunks are divided into four different classes, such as "unused numbers," "changed numbers," etc., each class of trunks ending at signals designated by the names, so that the information operator is given a clue to the cause of the call by noticing the trunk over which the call was received.

The power for the exchange is taken from the regular city mains, 220-volt, direct current. Two five-horse-power Lundell dynamotors convert the 220-volt current into seventy-five-volt to charge the two sets of American Battery Company's storage batteries, each of twenty-seven cells. The batteries have a capacity of 420 ampere-hours each, and are placed in a separate room in back of the power board. They are supported by heavy wooden racks and a light roof was built over the cells to protect the cells from dirt that might possibly fall from the ceiling.

From every joint between any two cells a fused wire is brought to a jack placed on the wire chief's desk, so that the voltage of each cell can be measured by the voltmeter on the wire chief's desk. The power board is a four marble slab design five feet long and six feet high. It contains all regulating, switching and measuring apparatus and also fuses for the common battery transmitters of the desks. The power is brought to the automatic board by No. 0 wire, two wires for each thousand group. The wires are pulled in flexible conduit and distributed in chutes left under the maple flooring. For ringing a one-sixth horse-power ringing machine for night work running on the storage battery and a one-half horse-power running on the commercial circuit for day work are installed and are shown herewith. Both machines have busy and howler attachment.

A few words about the "cut-over" may not be out of place. The literature about cut-overs is very scarce, anyhow, so this cut-over from a large common battery exchange to an automatic is a choice cut for a telephone man.

The cut-over is conducted along the following plan: the automatic exchange is absolutely finished first. Every line which ends in the manual board is multipled to a first selector, in other words, the drop at the manual board and the first selector in the automatic board are in multiple. As long as the subscriber's telephone is wired for manual service, he calls manually by means of the operator, his first selector meanwhile being plugged so that it is not in service.

The telephones are changed at the rate of about 100 a day, so that at the time of the start of the cut-over all stations are equipped with the new telephones. They are wired for manual service, *i. e.*, for calling purposes current is flowing through the secondary of the induction coil and through the receiver, and for clearing out one side of the ringer is wired to "ground."

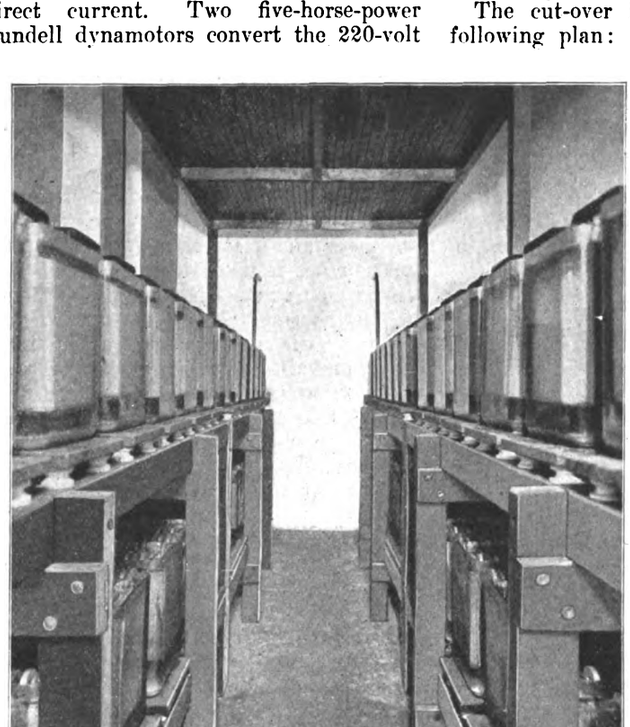
After the completion of the automatic exchange, the telephone men go around again and make in a minute's time the changes in wiring. The automatic switchboard man at the same time cuts in the first selector and the manual switchboard man cuts off the drop.

In following this plan no station will be out of service longer than a few minutes —the time the telephone man is working at it.

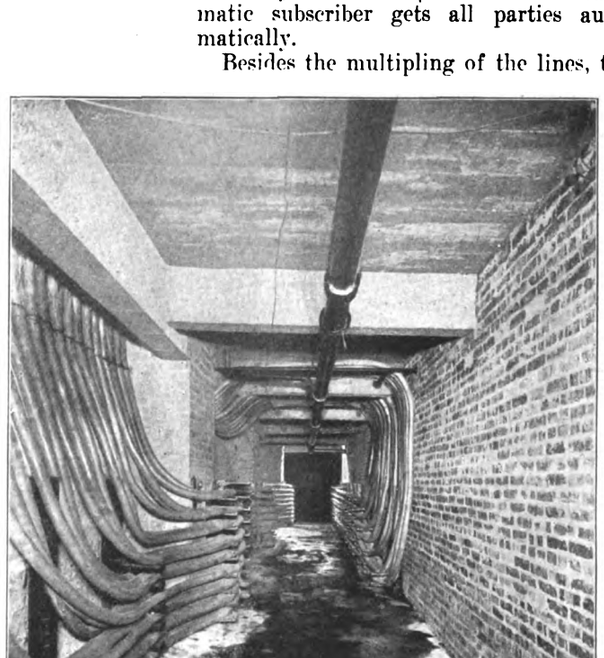
As said before, all lines end in both exchanges, whether operated automatically or manually. Therefore, during the time of cut-over, a subscriber who has a manual telephone will get any other subscriber through the manual switchboard in the old way, the calling signal and the two clearing-out signals being given in the same way as before, whether or not the called party is using a manually or automatically wired telephone. Each automatic subscriber gets all parties automatically.

Besides the multipling of the lines, the cut-over requires the multipling of the testing or guarding circuits. In the manual board the busy test is thrown on the jack rings by closing the two springs on the drop, cut-off relay. In the automatic board a guarding potential is established by grounding the private contacts of the connector banks. This feature is taken care of by a special set of jumper cables which connect these bank contacts and the drop cut-off relays.

Another difficulty has to be overcome—that is, the drop cut-off relay has been operating on the twenty-volt battery, while the automatic exchange operates on a fifty-four-volt battery, and some very ingenious engineering work had to be done so that the two exchanges would work in multiple and at the same time take care of the two different battery voltages.



BATTERY ROOM, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.



CABLE TUNNEL, COLUMBUS CITIZENS' TELEPHONE COMPANY, COLUMBUS, OHIO.

Digitized by Google

SIGNALING IN THE SUBWAY.[1]

BY J. M. WALDRON.

The low-voltage gravity battery, commonly used for track circuits, has always been a source of more or less trouble in automatic signal work. On account of the impossibility of making an automatic block signaling system work successfully with a direct-current track circuit, when the running rails were used for a return for the propulsion current for trains, a new system was devised in which the signal operating current was of such character that the instruments designed to be operated by it would not be affected by the propulsion current. It was found that sixty-cycle alternating current would flow through the tracks with the return direct current, also that a relay could be made which would be operated by an alternating current, and not respond to a direct current, nor would a direct current hold the relay in the clear position after it had once been cleared.

Alternating current is supplied at a potential of 550 volts from thirty-five-kilowatt, single-phase, sixty-cycle motor-generators placed in the several substations to the mains which extend throughout the subway. These machines operate in multiple. The signaling system requires but forty per cent of the motor-generators to be in operation at one time; the other sixty per cent being held in reserve. These generators are run continuously for twenty-four hours, machines in adjacent substations being run on alternate days. The cutting in and out of machines is done at midnight, as the traffic is light at that time and little damage would result from a careless employé cutting in his machine on the line before it was in synchronism.

As a reserve source of supply of alternating current there is provided at each substation a twenty-five-kilowatt transformer with a ratio of twenty to one, the secondary coil of these transformers at a potential of 550 volts is connected to two terminals of a double-throw switch which is on the signal switchboard. By reversing this switch the generator is cut off from the signal mains, and the sixty-cycle 550-volt current from the secondary coils of the transformer cut in. The current is supplied to the primary coils of these transformers direct from the turbo-generators which are used for lighting purposes at a potential of 11,000 volts. Thus, there are two independent sources for the alternating-current track circuits, each of which has boilers, engines and dynamos in triplicate. This makes the supply as nearly constant as is obtainable.

At each signal is a transformer, the primary coils of which are connected to the alternating-current mains; cutouts with three-ampere fuses are placed in each of these connections. These transformers have two secondary coils, one with a ratio of ten to one for lighting the signals, the other with a ratio of fifty to one for the track circuits. This gives about eight volts between the running rails of the track at the transformer end of the track circuit, and about seven volts across the terminals of the relays; as the relays are adjusted to pick up at three volts, this leaves a working margin of about four volts or a little over 100 per cent. A fifty-ampere fuse is placed in each connection between the block signal rail and the instruments in the mechanism case. For the month of February there were but three failures on account of alternating current for 4,206,720 signal movements.

A resistance grid of one ohm is placed in series with the track circuit at the transformer end and another at the relay end of the block, to prevent the flow of an excessive amount of alternating current at the transformer, and also to prevent a harmful amount of direct current through the apparatus. An impedance coil of very low ohmic resistance is placed in multiple with the alternating-current relay; the chief object of which is to permit the passage of all direct current which returns through this path, and relieve the relay winding of this extra duty.

For lighting purposes each signal is provided with two sixty-volt three-candle-power lamps in multiple, which receive their current direct from special secondary coils in the track transformers. These lamps give little trouble, as five months' operation with about 1,500 lamps, and no detentions on account of lamps burning out, amply demonstrate. The functions of the alternating current end with the track circuits, and the lighting of the signals; all other relays, signal valves, automatic stop valves and switch valves are operated by means of direct current from storage batteries, at a potential of sixteen volts. These batteries are connected in multiple to two mains which extend throughout the length of the subway. Each battery unit consists of two sets of eight storage battery cells, one motor-generator, one switchboard with the necessary starting and controlling rheostats, charging and discharging switches, ammeters, voltmeters, overload charging circuit-breakers, etc. Battery stations are located in or near interlocking towers; all batteries are carefully inspected and charged each day. Each set is given a charge of about twenty-five per cent in excess of its discharge of the previous day. The capacity of these batteries is such that there is always enough current on hand for five days' operation. Current for lighting the towers and driving the motor-generators which charge the storage batteries is taken from the third rail. Battery stations are so situated, that should any one be disabled, the adjacent station would supply all necessary current to keep the signals and interlockings running until the disabled batteries could be replaced.

One of the battery stations is situated on the Manhattan valley viaduct about seventy-five feet above the street level, at a point where it has full benefit of the cold winds which come across the Hudson from northern New Jersey. No attempt was made to heat this enclosure, yet the operation of this battery was perfect during the coldest days of the winter.

The compressed air for throwing switches and clearing signals and automatic stops is taken from the main pipe-line which extends throughout the length of the subway. Bends are used to take care of expansion and contraction in the pipe, and the customary expansion joints are used where it is found unadvisable to use expansion bends. All branch pipes leading from the main air pipe to the various stops, signals and switches are one-half-inch heavy, galvanized.

The air-compressors for supplying the compressed air are situated in the basement of the substations; one in each station. These are motor-driven, automatically controlled machines, each with a capacity of 230 cubic feet of air per minute. All compressors are on the air line at all times, but the automatic controlling device on each compressor is adjusted so as to shut down the machine when the air pressure reaches a predetermined point, and start it after the pressure has fallen to a predetermined point which is considered the minimum pressure allowable.

At points where the different signal repairmen make their headquarters, recording air gauges and recording alternating-current voltmeters are located; this makes it possible for a repairman at all times to know the air pressure in the pipes, and the voltage on the alternating-current mains.

There are interlocking plants at forty different points in the subway system. Most of these interlockings are very busy places; at tower "B," Ninety-sixth street, during the rush hours of the day, fifty-eight five-car trains and fifty-seven eight-car trains, or a total of 115 trains are handled each hour, and fifty-eight of these trains are crossed from one track to another. Switches, signals and stops must be operated for every train which passes this point; yet, so well has this been taken care of that for months there have been no detentions on account of defects in the mechanism.

[1] Abstract of a paper presented before the Railway Signal Association in New York, May 23, 1905.

Digitized by Google

APPLICATION OF THE DIFFERENTIAL GALVANOMETER TO EXACT MEASUREMENTS OF RESISTANCE.[1]

BY W. JAEGER.

Two resistances can be exactly compared with each other by the ordinary Wheatstone bridge method only when they are directly connected together (as in a

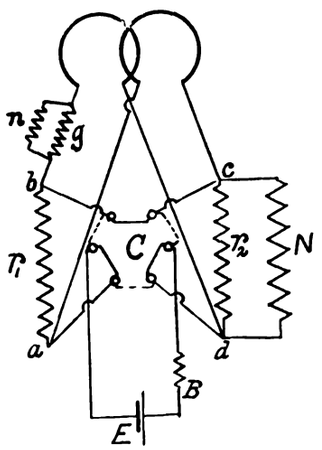


FIG. 1.—COMPARISON OF RESISTANCES.

resistance box) or when they can be so connected in series that the connecting resistance is negligible in comparison with the resistances to be compared. Consequently small resistances, with separate current and potential terminals, can not be compared by this method; similarly with standard columns of mercury, where the connecting resistances assume considerable proportions. With larger resistances, on the contrary, this method is generally applicable.

In all other cases the connecting resistance must be eliminated in some way, as for instance, in the Kelvin double bridge, by the use of auxiliary ratio arms.[2] The Kohlrausch method,[3] using a differential galvanometer, can also be used in all cases where two coils of the same magnitude are being compared. In this method the effects of two oppositely directed currents on a needle are balanced and thus a comparison of two resistances is obtained.

In getting a differential effect, it is not practicable to oppose two separate coils of the galvanometer, because this produces a sidewise motion of the needle, which disturbs the observation and makes an exact measurement impossible. It is far preferable to wind two wires in juxtaposition on the same spool, so that if connected in series and opposed, the electrodynamic action almost entirely disappears.

In case oppositely directed currents in the two windings exactly neutralize each other, and the two windings have exactly equal resistances, then the two resistances being compared have equal values if there be no deflection of the galvanometer. This condition of equality in the two windings should be approximately attained by means of extra turns or external resistance in one of the coils. But it will be shown in what follows, that it is by no means necessary exactly to compensate the two windings of the galvanometer in using the Kohlrausch method with a six-pole commutator, and thereby much time and trouble may be spared.

Any instrument may serve as a differential galvanometer which has two windings of equal diameter wound together, thereby ensuring approximately equal resistances and magnetic actions. The bifilar winding has the additional advantage that different sensibilities for the galvanometer may be obtained by connecting the two windings in series or in parallel. It also becomes possible to test the insulation of the windings. Consequently the bifilar winding recommends itself in all cases where it is possible.

In order fully to understand what follows we will first briefly consider Kohlrausch's method of overlapping shunts.

In Fig. 1, r_1 and r_2 are the resistances to be compared, the larger of the two being provided with a shunt N, so that the resistances of the two arms may be made equal. B is a resistance for regulating the test current, C is a six-pole commutator with three connecting links, shown in solid lines for one position of the commutator and in dotted lines for the other. Reversing the commutator alters the connections as shown in Fig. 2; the current is reversed in r_1 and r_2, but not in the galvanometer. The galvanometer G is connected to r_1 and r_2 in such a way that one winding joins the points *a, c,* the other winding the points *b, d.* Connected to one winding of the galvanometer is an auxiliary resistance *g,* adjustable by means of a shunt *n.* It is found by trial in which side of the galvanometer this should be placed.

The effects of the two parallel resistances N and *n* are different in kind. If we assume adjustments to have been so made that there is no deflection for either position of the commutator, then a change in N produces a deflection which is equally large for both positions of the commutator, but is in opposite directions. A change in *n* alone, on the contrary, has the effect of giving a deflection which is in the same direction for both positions of the commutator. It is, accordingly, always possible so to choose N and *g* (or *n*) as to reduce the deflection to zero for both positions of the commutator.

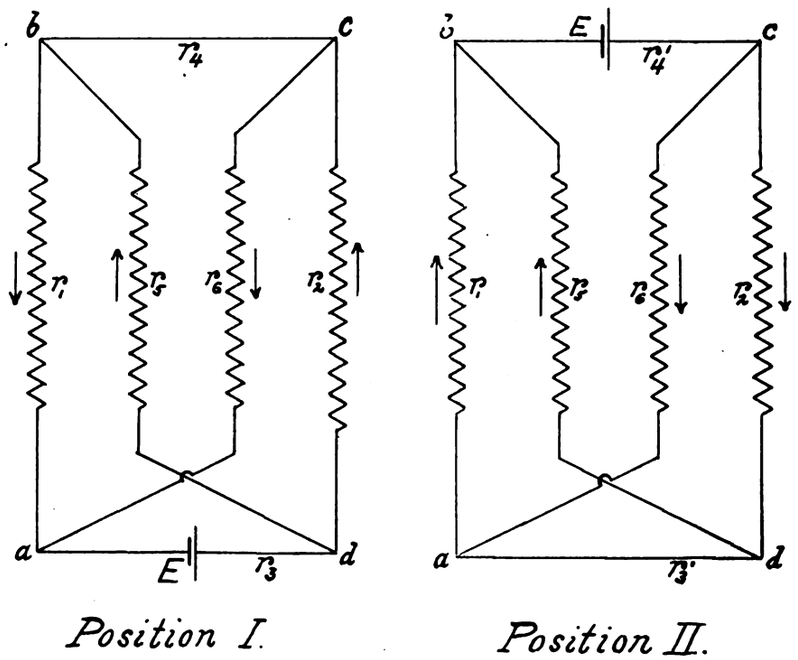


FIG. 2.—EFFECT OF TWO POSITIONS OF COMMUTATOR.

In Fig. 2, which represents the two positions of the commutator, r_1 and r_2 are the resistances to be compared, r_5 and r_6 the galvanometer resistances, r_3 and r_4 connecting resistances. The corresponding currents are i_1, i_2, i_3, etc. Let the

[1] Translated especially for the ELECTRICAL REVIEW from *Zeitschrift fuer Instrumentenkunde*, vol. xxiv, p. 288, 1904, by Morton Githens Lloyd, Ph. D.

[2] See ELECTRICAL REVIEW, January, 1904.

[3] F. Kohlrausch, *Wied. Ann.*, xx, p. 76, 1883.

Digitized by Google

total current in the battery E be I_1 for position I, and I_2 for position II, and let

$$M_1 = \frac{I_1}{(r_1 + r_6)(r_2 + r_5) + r_4(r_1 + r_2 + r_5 + r_6)}$$
$$M_2 = \frac{I_2}{(r_2 + r_6)(r_1 + r_5) + r_3'(r_1 + r_2 + r_5 + r_6)} \quad (1)$$

This assumes that in reversing, the current and connecting resistance are changed. We have then for position I

$$i_5 = M_1[r_2(r_1 + r_6) + r_4(r_2 + r_6)]$$
$$i_6 = M_1[r_1(r_2 + r_5) + r_4(r_1 + r_5)]$$

and for position II (2)

$$i_5 = M_2[r_1(r_2 + r_6) + r_3'(r_1 + r_6)]$$
$$i_6 = M_2[r_2(r_1 + r_5) + r_3'(r_2 + r_5)]$$

Since the deflection resulting from the slight inequality in the action of the two currents is very small, we may introduce into the formulæ the sensibility of the galvanometer (relation between deflection and current) in place of the actual strength of field.

Let the deflection of the galvanometer for one ampere in the winding of resistance r_5 be A divisions of the scale, and for one ampere in winding r_6 be B divisions, then the sensibility of the galvanometer with the two coils opposing each other is given by the following deflections:

For position I

$$a_1 = M_1[A\{r_2(r_1 + r_6) + r_4(r_2 + r_6)\} - B\{r_1(r_2 + r_5) + r_4(r_1 + r_5)\}]$$

and for position II (3)

$$a_2 = M_2[A\{r_1(r_2 + r_6) + r_3'(r_1 + r_6)\} - B\{r_2(r_1 + r_5) + r_3'(r_2 + r_5)\}]$$

From these equations we can get all the relations necessary for the use of the differential galvanometer.

If $a_1 = a_2 = 0$ we get two expressions for $\frac{A}{B}$ which when equated give an expression of the form

$$C(r_1 - r_2) = 0$$

where C has some value other than zero. Hence r_1 and r_2 are equal, if no deflection be obtained in either position of the commutator, no matter what the values of A and B may be, nor what the relative values of the unknown resistance and galvanometer resistance may be. And since $r_1 = r_2$ we have in this case

$$\frac{A}{B} = \frac{r_1 + r_5}{r_1 + r_6}$$*

This ratio of $r_1 + r_5$ to $r_1 + r_6$ is actually obtained by adjustment of g and N to give no deflection.

If a_1 and a_2 are equal but not zero, that is, if the deflections for the two positions of the commutator are equal and in the same direction, and if further $I_1 = I_2$ and $r_3' = r_4$, that is, if the resistances are not changed by reversing the commutator, then we obtain the same result as above. On the other hand, if the current and resistance are changed on reversal, as would in general be the case, then this relation is only approximate, but the approximation is so close that with small deflections the error would be negligible.

To show this, let

$$\frac{M_2}{M_1} = 1 + y$$

where y is a small quantity, and let

$$e = \frac{r_2 - r_1}{r_1}$$

Then if $a_1 = a_2 = a$ we have, neglecting terms of the second order, for e the expression

$$e = \frac{a}{AI_1} \frac{(r_1 + r_5)(2r_4 + r_1 + r_5)}{2r_1(r_4 + r_5)} \left(y + \frac{r_3' - r_4}{r_1 + r_4}\right)$$

in which the approximate relations $r_1 = r_2$, $r_5 = r_6$ and A = B have been used, since we are only considering the small discrepancy between r_1 and r_2.

AI_1 is the deflection which would be obtained if the current I_1 were sent through one coil alone, while a is the deflection due to the differential action of the two coils, and can always be made small by adjustment of n and N. Hence $\frac{a}{AI_1}$ is always very small. For example, let A = 10^8 divisions, a = 100 divisions (a quite large deflection), I_1 = 0.01 ampere; then $\frac{a}{AI_1} = 10^{-4}$. Since this is to be multiplied by the small expression in the parenthesis, the value of e in practice would be less than 10^{-6}, and this agreement between r_1 and r_2 is all that is necessary even in most measurements of precision.

Hence we may express the above results as follows:

Two resistances compared by the Kohlrausch method are equal, when the deflections obtained by reversing the commutator are equal and in the same direction, regardless of the ratio of A to B, and regardless of the ratio of the galvanometer resistance to the resistances being compared.

In practice the two deflections are not actually made equal, but the correct value of the shunt N is determined by interpolation between two values N_1 and N_2 lying on either side of N.

Example—The above will be made clear by an example of a comparison of two resistances of the nominal value of one ohm.

DEFLECTIONS.

	N_1 = 74 ohms.	N_2 = 75 ohms.
Position I.	−7.2	+1.2
" II.	+2.2	−5.2
Difference,	−9.4	+6.4

CURRENT REVERSED.

Position I.	+6.8	−1.3
" II.	−2.3	+5.0
Difference,	−9.1	+6.3
Mean,	−9.25	+6.35

The deflections in positions I and II are combined by subtracting, thus giving a deflection of — 9.3 scale divisions for N_1 = 74 ohms and + 6.4 divisions for N_2 = 75 ohms. If n had been exactly adjusted, we should have obtained in the first case a deflection of — 4.7 divisions for position I, + 4.7 divisions for position II; and in the second case + 3.2 divisions for position I, — 3.2 divisions for position II. This would have given the same result. But an example was purposely chosen, in which n was not exactly adjusted, in order to show how, by proper combination of the observations, the incompleteness of balance is corrected for. If, on the other hand, N were properly adjusted, while n retained its value in the example, we should have had

Position I.	−2.5
" II.	−2.5
Difference.	0.0

since equal deflections to the same side indicate equality of the resistances.

In this case the sensibility is such that a deflection of eight divisions corresponds to a difference in resistance of 1.8×10^{-4} of its value. By interpolation between $\frac{1}{N_1}$ and $\frac{1}{N_2}$ the value of N may be calculated which would make the two resistances equal, and then the relative

*This expression is obtained by equating a_1 to zero. If we equate a_2 to zero, we get

$$\frac{A}{B} = \frac{r_1 + r_6}{r_1 + r_5}$$

from which it follows that $r_5 = r_6$ and A = B. It is thus seen that the deflections can be zero only when the two halves of the galvanometer are equal in resistance and in magnetic effect.—*Trans.*

Digitized by Google

values of r_1 and r_2 are obtained from the relation

$$\frac{1}{r_1} = \frac{1}{r_2} + \frac{1}{N}$$

which gives

$$r_2 - r_1 = \frac{r_1 r_2}{N}$$

Sensibility—We shall now consider what resistance should best be chosen for the galvanometer. Theoretically the greatest sensibility is obtained when the resistance of the galvanometer is equal to the resistance being measured, which is in parallel with it, or

$$r_1 = r_2 = r_5 = r_6$$

Since the galvanometer resistance can usually be varied within certain limits, and need not be large compared to the resistance measured, it is best to fulfil the above conditions as closely as may be practicable. In measuring very small resistances, this condition can not usually be satisfied.

Equation (3) gives the sensibility for a given strength of the test-current. If we let $r_2 = r_1 (1 + \epsilon)$ and $r_1 = r_5 = r_6$ and A = B we have

$$a = \frac{A I}{4} \epsilon$$

or since half the current flows through each side $a = \frac{A i_1}{2} \epsilon$

Calling C the deflection for one ampere with a galvanometer resistance of one ohm, then, since the total resistance is $2 r_1$, the deflection due to the terms in one of the windings is

$$a = \frac{C}{2} \sqrt{2 r_1}$$

The maximum sensibility with a current i_1 through the resistance r_1 is

$$a = \frac{C}{2\sqrt{2}} i_1 \sqrt{r_1} \epsilon$$

If r_1 and r_5 are not equal, a will be smaller in the ratio $\sqrt{\frac{r_1}{r_5}}$

Comparison with Sensibility of Wheatstone Bridge and Kelvin Double Bridge—It is of interest to compare the maximum sensibility of the differential method with that of the bridge methods, assuming the same current strength to be used in the resistance measured. This condition must be taken as the basis of comparison. From the equation for the current in the galvanometer arm of the Wheatstone bridge (Fig. 3)

$$i_0 = I \frac{r_1 r_4 - r_2 r_3}{r_0 (r_1 + r_2 + r_3 + r_4) + (r_1 + r_3)(r_2 + r_4)}$$

we obtain the sensibility in the same manner as above. The sensibility is greatest when the resistance r_0 of the galvanometer is equal to the external resistance completing the galvanometer circuit, or

$$r_0 = \frac{(r_1 + r_3)(r_2 + r_4)}{(r_1 + r_2 + r_3 + r_4)}$$

Since

$$i_1 = \frac{I r_3}{r_1 + r_3}$$

we have

$$i_0 = i_1 \frac{r_1 r_4 - r_2 r_3}{2 r_3 (r_2 + r_4)}$$

and

$$a = i_1 r_1 C \sqrt{r_0} \frac{r_1 r_4 - r_2 r_3}{2 r_1 r_3 (r_2 + r_4)}$$

Two cases now arise, according to whether

$$r_1 = r_2 (1 + \epsilon) \text{ and } r_3 = r_4$$

or

$$r_1 = r_3 (1 + \epsilon) \text{ and } r_2 = r_4.$$

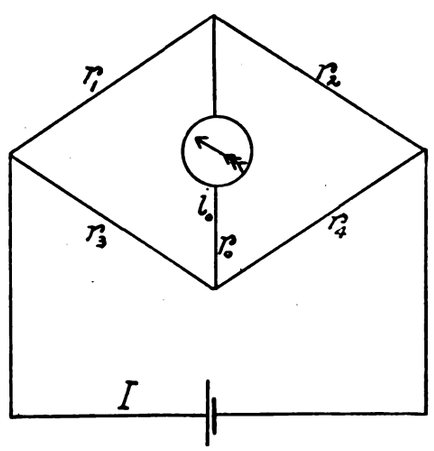


FIG. 3.—WHEATSTONE BRIDGE.

In the first case, as shown, the external resistance of the galvanometer circuit is $\frac{1}{2}(r_1 + r_3)$; and in the second case it is $\frac{2 r_1 r_3}{r_1 + r_3}$, and r_0 should have this same value. In the first case the greatest sensibility is obtained when $r_3 = r_4 = 0$; in the second case when $r_2 = r_4 = \infty$ (for constant i_1); both are limiting cases, never reached in practice. In both cases the sensibility is given by

$$a = \frac{C}{2\sqrt{2}} i_1 \sqrt{r_1} \epsilon$$

and hence is equal to the sensibility obtained with the differential galvanometer, when the same current is used in the resistance measured.

If a change in one of the coils under comparison is to give the same deflection as a change in one of the ratio coils, then all of the resistances r_0, r_1, r_2, r_3, r_4, should be made equal, and the sensibility becomes

$$a = \frac{C}{4} i \sqrt{r_1} \epsilon$$

which is smaller by the factor $\sqrt{2}$.

In the Kelvin double bridge the sensibility is smaller, since the auxiliary ratio coils increase the external resistance of the galvanometer circuit.[1] If the resistances of the auxiliary ratio coils are r_5 and r_6 the resistance of the galvanometer arm is $r_0 + \frac{r_5 r_6}{r_5 + r_6}$

and the total resistance of the galvanometer circuit is larger by the quantity $\frac{r_5 r_6}{r_5 + r_6}$. In comparing equal resistances we have approximately $r_1 = r_2$, $r_3 = r_4$, $r_5 = r_6$ and in the most favorable case $r_0 = \frac{1}{2}(r_1 + r_3 + r_5)$.

This gives for the sensibility

$$a = \frac{C i_1}{2\sqrt{2}} \sqrt{\frac{r_1}{r_1 + r_3 + r_5}} \sqrt{r_1} \epsilon$$

which is smaller than the maximum sensibility with the Wheatstone bridge by the factor $\sqrt{1 + \frac{r_3 + r_5}{r_1}}$. In practice the resistances r_3 and r_5 can not be made small, and are usually much larger than r_1.

It is to be noticed, however, that in measuring small resistances, the most favorable values can not be used in the differential method, so that here also the sensibility is correspondingly reduced.

Influence of Poor Insulation in the Galvanometer—Very low insulation between the two windings of the galvanometer may introduce serious errors into the measurement; hence good insulation is an important requisite. The value of the insulation resistance is easily obtained by disconnecting the ends of the two windings. If one is in doubt as to whether the measured insulation is sufficient for the purpose in hand (for instance, if an accuracy of one part in a million is desired in the comparison of two resistances), the two resistances can be interchanged and the measurement repeated. If the same result as before, within the prescribed limit of accuracy, is obtained, the insulation is sufficient for the purpose. The shunting effect arising from poor insulation can affect the measurement in two ways; it acts as a shunt to the resistance measured, and thereby changes its value; and the current between the two windings may act on the needle of the galvanometer. The effect of poor insulation on the result depends upon the position of the fault.

For instance, a shunt between points

[1] See ELECTRICAL REVIEW, January 16, 1904, p. 97.

Digitized by Google

a and d or between points b and c (Fig. 2) or between the middle points of the two windings would do no harm, whereas a shunt between points a and b or between points c and d would diminish one of the resistances, without acting upon the galvanometer. A uniform leakage between the two windings over their entire length would be without effect.

Conclusion—Good insulation is desirable in a differential galvanometer, but perfect equality of the windings in resistance or magnetic action is not necessary if the observations in the Kohlrausch method are taken by means of the six-pole commutator, and combined as indicated above. To obtain the greatest sensibility, which is then equal to the maximum sensibility of a Wheatstone bridge, the resistance of the galvanometer windings should be nearly equal to the resistance measured. The sensibility of the galvanometer, for a current i in the resistance r, as measured by the deflection a, is then

$$a = \frac{C}{2\sqrt{2}} i \sqrt{r}\ \epsilon$$

where C is the deflection for a current of one ampere when the resistance is one ohm, and ϵ is the fractional change in the resistance measured.

The sensibility of the Kelvin double bridge is smaller on account of the auxiliary ratio coils, it being assumed in all cases that the same test-current is passed through the resistance measured, and that the other resistances have the most favorable values.

Wood Gas for Power Purposes.

A paper was read recently by Mr. G. M. Douglas before the British Institution of Mining and Metallurgy, of Great Britain, on "Wood Gas for Power Purposes and Gas Generators." This paper described the gas-producing plant of the Moctezuma Copper Company, in which the gas is supplied to the engines from a Loomis-Pettibone gas-generating plant. The fuel used is an inferior, scrubby oak. The generator is started with a coke fire about three feet deep, at the top of which is placed a layer of wood. Only enough combustion is required to transform the wood into charcoal. It is said that the gas gives good results in the engine, being better than gas from coal of the same calorific value. The results of a test, during which nearly 40,000 kilowatt-hours were generated, the average consumption being 447 electrical horse-power, show that the consumption of wood per electrical horse-power-hour was 2.6 pounds. During the same time coke was used in addition at the rate of 0.11 pound per horse-power-hour.

A Bolometer for the Absolute Measurement of Radiation.

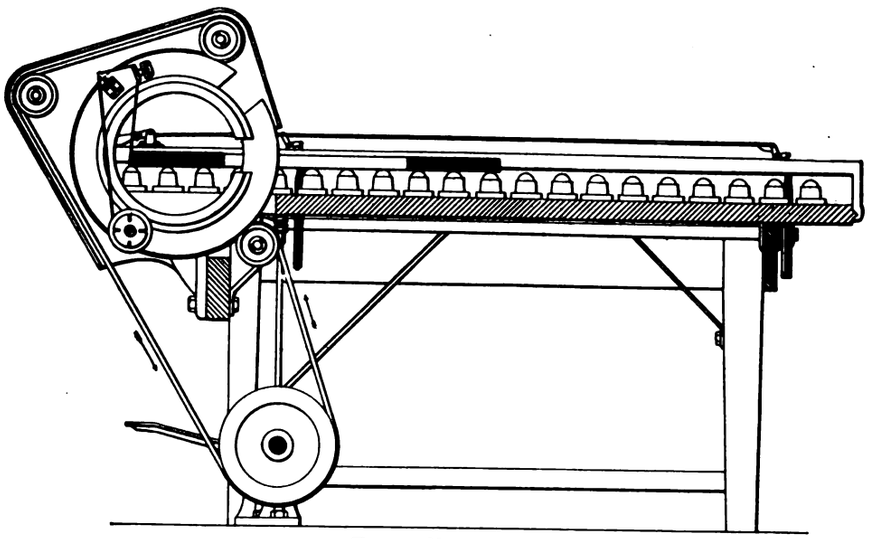
At a meeting of the London Physical Society, on May 19, Professor H. L. Callendar read a paper on "A Bolometer for the Absolute Measurement of Radiation."

It is now generally agreed that the electric compensation method, in which the heat received by radiation on a metallic strip is determined by measuring the electric current required to produce the same rise of temperature in the strip, is the most satisfactory and accurate method for absolute measurement. Two methods have been used for this purpose. (1) the thermo-electric method of Angström, in which the equality of temperature between the strip exposed to radiation and that heated by the current is determined by means of a copper-constantan couple, the two junctions of which are attached to the backs of the two strips with silk paper and shellac; (2) the bolometric method of Kurlbaum, in which the rise of temperature produced by the radiation or by the electric current is measured by the increase of resistance of the metallic strip itself. In applying the first method it is necessary to use a sensitive galvanometer for the thermo-couple, and an accurate milliammeter for the current. It is also necessary to make measurements with the strips interchanged, as it is impossible to secure exact equality of resistance of the strips, and exact equality of thermal contact for the junctions which are insulated from the strips by paper and shellac. The advantages of the second method, which has not hitherto been applied to the extent which it merits warrant are (1) that the strip is also the thermometer, and can therefore be made much thinner and quicker in action as no paper insulation is required. (2) That the power available is much greater, so that the same portable milliammeter which serves for measuring the current may also be used for the resistance balance in place of a sensitive galvanometer. (3) That the actual resistance of the strip may readily be verified at the time without special additional apparatus. (4) That uniformity of resistance of the strip is less important than in the thermoelectric method, in which the mean resistance of the strip is not necessarily the same as the resistance at the central point where the temperature is taken by the couples. (5) That the area exposed to radiation may be more accurately measured. In the practical application of the bolometric method for the absolute measurements of solar radiation, the author has introduced certain modifications suggested by experience in platinum thermometry, with the object of securing (1) temperature compensation, so that the zero remains constant in spite of changes in the surrounding temperature; (2) conduction compensation, so that loss of heat by conduction at the ends of the strips may not affect the readings; (3) accurate measurement of the area of radiation absorbed.—(1) In order to secure accurate temperature compensation during the observations of radiation when changes of temperature of the instrument are sometimes unavoidable especially with powerful sources of radiation, in spite of the water-jacket in which the instrument is enclosed, the bolometer is balanced against a balancing resistance constructed of the same platinum, enclosed in the water-jacket, but protected from the radiation. (2) To secure conduction compensation, this balancing resistance is made in two parts, one (a) precisely similar to the bolometer itself, but with strips one centimetre long instead of three centimetres, so that the ends of the strips are subject to the same conduction losses as those of the bolometer when heated by the electric current, the change of resistance measured being that of the central two centimetres only of the strips, which length is uniformly heated. The other part (b) of the balancing resistance is replaced by a resistance of manganin when the actual temperature of the bolometer or the heating effect of the current is measured. (3) To secure accurate measurements of the area of radiation which is absorbed, this area is determined by an aperture in the cover of the water-jacket having a width of two centimetres coinciding with the central portions of the bolometer strips. The strips are arranged with a small overlay, so that all the radiation entering this area falls on the strips. The necessity of accurate measurement of either the length or the width of the strips themselves is thereby avoided. With these modifications the bolometric method appears equal in convenience and probably superior in accuracy to the thermoelectric. Owing also to the great increase in power available, the absolute measuring bolometer can be directly used with one of the author's self-recording instruments for solar radiation. Comparisons have been made between the bolometer, in which the platinum strips are directly exposed to radiation, and one of the author's ordinary sunshine receivers enclosed in a glass bulb, in order to determine the effect, if any, of the glass bulb in selective absorption. The values of the reduction constant obtained for the glass receiver showed no certain variation over a wide range of quality of radiation, from sunshine or arc light down to a dull red heat. This result is probably to be attributed to a self-compensating action of the glass bulb, which radiates to the enclosed coils precisely those rays which it absorbs.

Digitized by Google

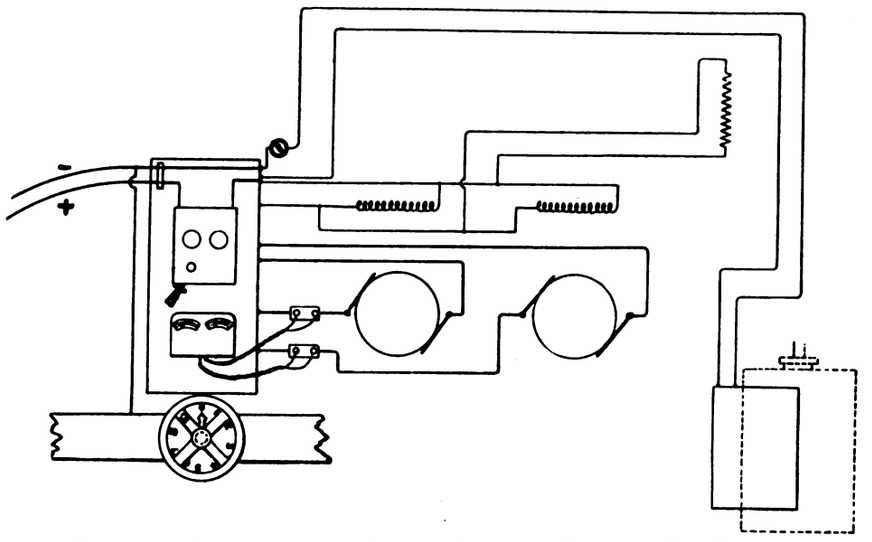
Electrical Patents.

Albert G. Davis, of Schenectady, N. Y., has assigned to the General Electric Company, of New York, a patent granted to him on a taping-machine (791,081, May 30, 1905). The invention more particularly relates to machines for taping transformer coils of the larger sizes. Various devices have heretofore been designed for this purpose, but such machines have been objectionable on account of their complex structure or, when the structure has not been so complex, on account of the great muscular effort required to manipulate the coils while being operated upon. The object of the invention is to provide a taping-machine which shall consist of few parts and which shall require but slight effort on the part of the operator even when taping the largest sizes of coils. In the embodiment of the invention, a table is employed, a winding-head and a follower. Means are employed for actuating the follower whereby the straight portion of the coil may be moved relatively to the head. Antifriction means are carried by the table to facilitate the turning of the coil, whereby the corner portions may be properly moved relatively to the head.



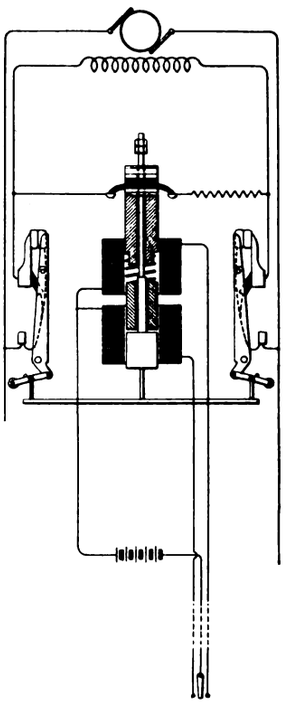
TAPING-MACHINE.

The Weaver Electric Fire Engine Company, of Pittsburg, Pa., controls a patent recently granted to James E. Weaver, of Allegheny, Pa., on an electric-power system. (790,941, May 30, 1905.) The invention relates to electric-power devices, especially those for fire engines, and is designed to provide a new and improved arrangement of electric motors and connections for driving pumps on the portable engine. The object of the invention is to provide a motor arrangement which shall be flexible and easily regulated for driving the pumps at different speeds, also to provide a compact arrangement which shall be light enough to carry on a portable engine. A plurality of shunt-wound motors are employed with permanent mechanical driving connections between them. Pumps are mechanically connected to one of these motors, and means are provided for successively connecting the motors in series, then cutting out one of the motors electrically, then connecting them in parallel while rotating in the same direction. Means are also employed for cutting out resistance through successive steps both in the series connection and while one motor is electrically disconnected.



SYSTEM OF CONNECTIONS FOR DRIVING PUMPS ON PORTABLE FIRE ENGINE.

A switch for electric circuits is the invention of Benjamin P. Rucker, of Wilkinsburg, Pa., and the patent obtained thereon has been assigned to Westinghouse Electric and Manufacturing Company, of Pennsylvania (790,983, May 30, 1905). The invention has particular reference to devices employed in connection with dynamoelectric generators for short-circuiting the field-magnet coils through a resistance at the instant of or before the opening of the field-circuit. The object of the invention is to provide a switch of this character which may be controlled from a distant point and which may be effectively opened and closed to attain the desired result by electromagnetic means. In carrying out the invention, means are employed for short-circuiting a field-magnet winding through a resistance, comprising a switch for the electrical-supply circuit, a switch for the field-magnet and resistance circuit, a magnet-coil for first closing the resistance circuit switch and then opening the electrical supply circuit switch, a second magnet coil for closing the electrical supply circuit switch and opening the resistance circuit switch, and means for controlling the current supply to the coils from any advised point.



SWITCH FOR ELECTRIC CIRCUITS.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

The Real Efficiency of Steam Boilers.

The point is here made by Mr. W. H. Booth that, in testing the efficiency of a steam boiler, it is not fair to charge it with the heat necessarily carried off by the water formed during the process of combustion; nor is it right to charge a boiler with the heat which must pass off in the products of combustion. It is not possible to reduce these to a temperature lower than that of the steam, and, even assuming that there is no excess of air, a certain amount of heat must pass up the chimney. Mr. Booth believes that these inevitable losses should be allowed for. In an example which he takes, this correction raises the efficiency of the boiler from fifty-eight to sixty-six per cent.—*Abstracted from the Electrical Review (London), May 26.*

Electrically Propelled Fire Engines.

The city of Hanover, Germany, has two electrically propelled fire engines and one driven by steam. These have been in service for three years, and seem to have given excellent practical performance, as well as satisfactory financial results. The total expense of the two electric machines for 1902-1903 was $2,950; for 1903-1904, it was $2,500, and for 1904-1905 it was $4,743. This includes repairs to the apparatus, depreciation, the cost of normal charging of the batteries, and the cost of charging for drilling. The large expense of the last year mentioned was due to repairs on the batteries. For the three years mentioned the following distances were covered: 3,759, 3,113 and 3,273 kilometres; hence the total expense per kilometre for the three years was eight, eight and 14.5 cents, respectively. The mean for the three years was ten cents per kilometre. When horses were used for the same purposes, the cost per kilometre was about sixty cents. The expense of maintenance and repair of the steam engine was $186 for 1902-1903; $1,270 for 1903-1904, and $3,654 for 1904-1905. If these machines had been drawn by horses the annual expense would have been about $3,000, hence the introduction of automobile fire engines has saved Hanover, during the three years, about $9,300. The negative plates of the batteries are still in good condition after three years of service.—*Translated and abstracted from L'Electricien (Paris), May 27.*

The World's Production of Copper.

The statistics here given show the progress in copper production during the past ten years. While they indicate a steady growth in the yearly output of copper, it is not yet certain whether this growth is keeping pace with the increase in consumption. For the year 1904 the aggregate output was 613,125 tons, in comparison with 574,740 tons for the preceding year; 541,255 tons for 1902; 479,514 tons for 1900; 399,730 tons for 1897, and 324,505 tons for 1894. The output has almost doubled in the past ten years. The better proportion of the 38,385 tons increase during the past year is traceable to the United States, which continue to furnish more than fifty per cent of the world's copper. Australia made fair progress, putting out over 34,000 tons. Chili made but little increase, putting out about 31,000 tons. Japan shows an increase of about ten per cent, while Spain and Portugal show decreases. Mexico shows an increase of about ten per cent. Canada and Germany remain about the same. The outputs of the different sources of the United States were as follows: Montana, 110,500 tons; the Lake sources, 92,320 tons; Arizona, 81,750 tons; other states, 49,600 tons. Reports from Alaska and the other northern districts indicate that they may become important copper producers.—*Abstracted from Engineering (London), May 26.*

Transformer Insulation.

In this article Mr. O. B. Moore discusses the question of the relation between ohmic resistance and dielectric strength of insulating materials. An insulator must perform two functions: it must prevent a leakage of current by conduction either across its surface or through it, and it must prevent the current from breaking through. The first property is called its ohmic resistance, the second its dielectric strength, and the two together form its insulating power. Electrical work may be divided into two branches, wherein the requirements for insulation are widely different. In telephony and telegraphy, where low voltages are used, the dielectric strength of the insulating material is of relatively small importance; but as small currents are used and circuits are long, the insulating material must have a high ohmic resistance. On the other hand, in apparatus designed for the generation and transmission of electrical energy, where the currents are large and voltages are high, dielectric strength is the property mainly desired, as the leakage of a small amount of current is not objectionable. This difference of requirement for an insulator in the two branches of electrical work naturally gives to the term "insulation" a double significance, which has often led to confusion. For one branch of electrical art good insulating material means something with a high resistance; in the other branch it means a material with a high dielectric strength; and the two properties do not necessarily go hand in hand. The insulation resistance of a transformer may be suspiciously low, and still it may run continuously for years, under average conditions of load, without breaking down; perhaps getting better as the insulating material dries out. On the other hand, a transformer may show an exceedingly high insulating resistance when tested at a low voltage, and yet break down as soon as it is put into actual service. The ohmic resistance of an insulator depends largely upon the amount of moisture it contains. If one measures the insulating resistance of undried material during the drying process, it is usually found that the resistance falls rapidly as the temperature rises until a minimum point is reached; then, as the moisture is gradually expelled, the resistance increases. For this reason it is usual to treat insulating materials with moisture repellents. Tests of a number of transformers of different sizes showed apparently no connection whatever between the ohmic resistance and the dielectric strength. These tests lead to the following conclusions: the ohmic resistance and dielectric strength of moist insulation are higher when cold than when hot. As the moisture is expelled during the drying process, it collects at certain parts and thus reduces the ohmic resistance considerably, until there is a decrease in the rate at which moisture is being expelled, when the resistance begins to rise. This drying characteristic for sheet materials is usually smooth. A high voltage should not be applied to apparatus when the ohmic resistance is low. A material which is badly deteriorated mechanically by heat may have a high

Digitized by Google

ohmic resistance, but very poor insulating qualities. The principal use of ohmic resistance measurements of insulation lies in the comparison they afford of the damp-proof qualities of various dielectrics, and in the measurement of the degree of dryness attained.—*Abstracted from the Electric Journal (Pittsburg), June.*

Incandescent Lamps.

An interesting and detailed discussion is given here by M. A. H. Bainville of recent developments in incandescent lamps. The various attempts to improve the carbon filament lamp are first described. The advantages of carbon are the ease with which the filament is prepared and its mechanical properties when hot. Moreover, carbon, being a simple body, is not electrolyzed by the passage of current. Its high resistance enables a short filament to be used. The defects of the carbon lamp are due to its chemical and physical properties. It oxidizes easily, and is not an efficient luminous radiator. Another defect is the blackening of the globe, due to a deposit of carbon. This blackening takes place more rapidly at high voltages. The author has found by experiment that it may account for an absorption of from twenty to seventy per cent of the light given off by the filament. To avoid this blackening a patent was taken out in 1902 by Siemens & Halske in which an attempt is made to localize the deposit of carbon by maintaining one spot of the globe cooler than the rest. Attention is called to the decreased cost of lighting with higher voltages. Assuming a price of power of twenty cents per kilowatt-hour, the author shows that, allowing for interest and depreciation of the line, cost of current and the expense of replacing the lamps, it will cost no more to operate a four-watt, 220-volt lamp than it will to operate a 110-volt, three-watt lamp. This is with a line loss of two per cent. With a line loss of one per cent the 220-volt, four-watt lamp costs only about seventy-five per cent as much as the three-watt 110-volt lamp. With a loss of two per cent in the line, the three-watt, 220-volt lamp is a little more expensive than the two and one-half-watt, 110-volt lamp. If the cost of power is less than twenty cents per kilowatt-hour, the higher-voltage lamp gains more than the low-voltage, so that a 220-volt lamp is more economical in all cases. A number of attempts have been made to improve the carbon lamp by coating the filament with other materials. For this purpose salts of metals and metalloids have been added to the cellulose, and carbides of the infusible metals have been formed on the surface. Tests show, however, that there is a tendency for these compound filaments to break up, and the filament reaches an unstable condition. The first hign-efficiency lamp with a metallic filament was the osmium lamp. There are about 50,000 of these lamps at present in service, distributed in Berlin, Munich and Vienna. The metal is obtained in a powder in the residue left after refining platinum. The powder is reduced to osmic acid, is agglomerated, and then pressed into filaments. These are calcined at a high temperature, thus giving a filament containing a mixture of osmium and carbon. These filaments are brought to incandescence by passing an electric current through them in an atmosphere of water vapor, which oxidizes both the carbon and the osmium, but the latter is easily reduced to the metal by hydrogen, so that, at the end of the process, the filament consists of practically pure osmium. Its surface is porous and rough. This filament is fused to platinum leading-in wires in an electric arc. As it is soft and flexible at the temperature of incandescence, it must be held in place by anchors. These are small crooks of thorium oxide attached to little glass columns fastened to the side of the globe. If the lamps are not suspended in a vertical position, the filament takes an ungraceful position. To disguise this it is customary to frost the globe. Tests of the osmium lamp are given, and show that the efficiency is about 1.5 watts per Hefner candle. The efficiency increases with a rise in voltage, but not as rapidly as does that of the carbon lamp. The osmium lamp is, however, able to withstand an abnormal voltage better than the carbon lamp. At the present time the following lamps are made: ten candle-power, forty-five volts; sixteen candles, forty-seven volts; twenty-five candles, sixty-two volts; thirty-two candles, seventy-six volts. Recently it was stated that a lamp for 110 volts had been made, in which the filament was 0.03 millimetre in diameter. As, however, the osmium filament is delicate, this exceedingly fine filament would seem to be impracticable. The author, besides the lamps referred to, discusses at length the Nernst and the tantalum lamps.—*Translated and abstracted from the Bulletin de la Société Internationale des Électriciens (Paris), May.*

Cost of Electric Lighting in Various Cities.

In the *Municipal Journal and Engineer* for June, Mayor Fobes, of Syracuse, N. Y., presents statistics regarding street lighting in a large number of cities in the United States. Both private and municipal electric light plants are included in the list which is given below:

City.	Population.	Municipal or Private Plant.	Cost Per Arc Light Per Year.	Fuel Used.	Average Price Coal.	Capitalization of Plant.
Albany	93,920	private	$117.80	coal	....	$2,000,000
Allegheny	138,018	municipal	68.59	coal	$1.88	.....
Atlanta	96,550	private	75.00	coal	2.50	.....
Baltimore	531,313	private	99 92	coal	3.20	2,700,000
Boston	594,618	private	124.10	coal	....	10,500,000
Bridgeport	77,635	private	82.00	coal	....	.....
Chicago	1,873,890	municipal	75.00	water	....	.....
Cincinnati	382,934	private	96.00	coal	3.75	700,000
Cleveland	414,950	private	54.36	coal	2.75	1,650,000
Columbus	85,487	municipal	66.00	coal	1.75	31,000,000
Dallas	44,159	private	78.56	coal	1.80	2,500,000
Denver	144,588	private	54.86	coal	2.75	1,650,000
Detroit	309,658	municipal	85.00	coal	1.40	485,000
Elmira	37,106	private	73.00	coal	2.00	.....
Fall River	114,004	private	90.00	coal	3.00	3,250,000
Grand Rapids	91,630	municipal	61.65	coal	2.58	849,506
Hartford	87,863	private	80.00	coal	3.00	.....
Indianapolis	196,033	private	109.50	coal	4.15	350,000
Jersey City	219,462	private	70.95	coal	2.85	45,000
Kansas City	173,064	private	70.00	coal and water	4.00	1,900,000
Louisville	215,402	private	74.00	water	....	.....
Lowell	100,150	private	97.50	water	....	.....
Lynn	72,350	private	65.00	coal	3.00	.....
Memphis	113,669	private	84.00	coal	....	.....
Minneapolis	214,112	private	120.45	coal	....	.....
Nashville	82,711	municipal	98.55	....	....	.....
New Bedford	68,955	private	85.00	....	....	.....
New Haven	114,600	private	94.00	coal	5.00	.....
New Orleans	360,625	private	45.00	coal	1.79½	200,000
New York	3,766,189	private	98.55	coal	....	845,000
Omaha	113,861	private	82.12½	coal	3.75	1,000,000
Paterson	113,267	private	77.00	coal	3.25	.....
Portland, Ore	98,655	private	146.00	coal	....	85,338,000
Providence	189,742	private	94.50	coal	....	.....
Reading	85,051	private	101.00	water	....	.....
Richmond	86,148	private	63.60	coal	3.80	5,000,000
Schenectady	43,538	private	109.50	coal	1.75	.....
Scranton	107,026	private	85.00	coal	2.91	.....
Seattle	92,020	private	84.00	water	....	80,000
St. Joseph	110,479	municipal	72.12	coal	1.25	300,000
St. Paul	172,088	private	66.00	water	....	.....
St. Louis	612,279	private	95.00	coal	1.60	102,000
Toledo	145,901	private	98.00	coal	2.00	10,000,000
Trenton	76,766	private	83.00	coal	2.05	....
Troy	75,567	private	118.62	water and coal	....	2,000,000
Utica	60,097	private	116.18	coal	2.50	2,000,000
Washington	293,217	private	85.00	coal	3.00	.....
Wilmington	81,300	private	.....	coal	5.00	.....
Worcester	128,552	private	108.00	coal	4.75	600,000
Yonkers	52,701	private	109.50	coal	....	200,000

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Automatic Numbering Machine.

The new model automatic numbering machine illustrated herewith embodies the most recent achievements in the art of numbering-machine construction. In its design there have been many departures from the usual plan. Instead of the customary iron or brass frames and brass cases, all metal parts are made of steel, contributing rigidity and strength with minimum weight.

It is only necessary to move the indicator until the word representing the class of numbering desired appears in the window of the front plate. When set "Consecutive" the number advances "1" to "999,999," changing all the wheels automatically. When set "Duplicate" each number is printed twice and is then advanced consecutively. When set "Repeat" the automatic mechanism is de-

123456

FAC SIMILE IMPRESSION

AUTOMATIC NUMBERING MACHINE.

tached and the number is repeated continuously.

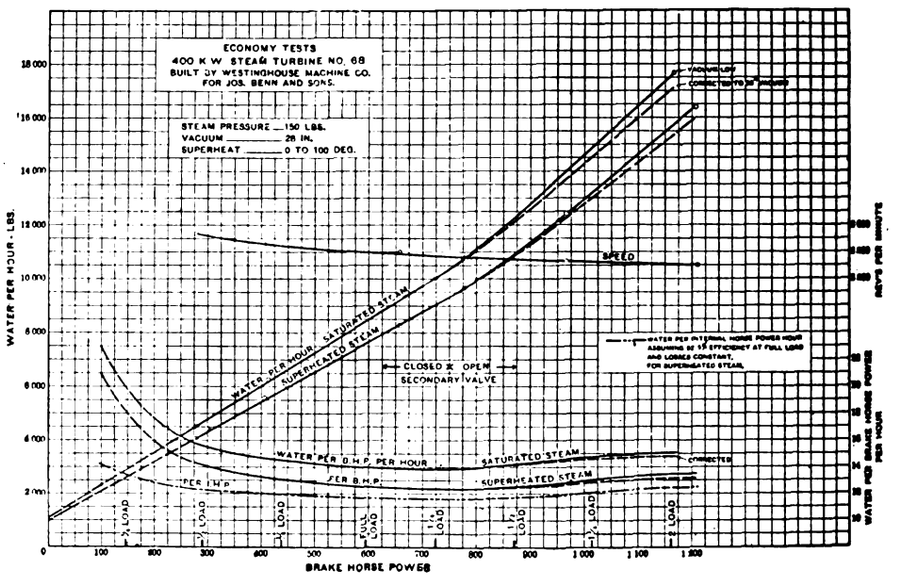
Only the standard size and style of figures shown under the illustration are furnished in the stock machines.

The wheels and ratchets are divided into equal tenths, assuring accuracy of movement. "Drop-ciphers" with their springs and pins have been eliminated and the wheels themselves are made depressible to provide the necessary spaces preceding the unit wheel. The plunger, which is made of Bessemer steel, is shielded from view when in its normal position. All machines of this model are made with six wheels with a numerical capacity of from "1" to "999,999," and may be reset to commence at any desired number. The frame is substantial, made of drawn steel, one-fourth-inch thick, well finished and blued. The machine weighs fourteen ounces and is operated noiselessly and with great speed and accuracy.

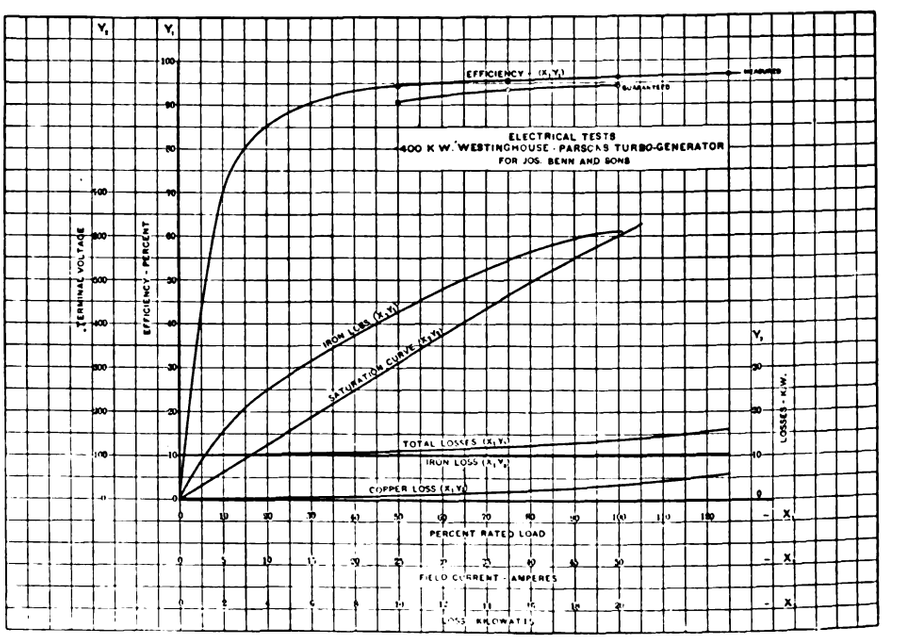
This machine is made upon the latest patents of Edwin C. Bates, and is manufactured by the Bates Machine Company, with general offices at 346 Broadway, New York, and branches at 315 Dearborn street, Chicago, 63 and 64 Chancery lane, London, W. C., and 2 Cooper street, Manchester, England.

Efficiency Tests of a 400-Kilowatt Steam Turbine.

The Westinghouse Machine Company, East Pittsburg, Pa., has reprinted the results of an efficiency test of a 400-kilowatt Westinghouse-Parsons steam turbine installed at the plant of Joseph Benn & Sons, Providence, R. I. The test was made under the direction of F. P. Sheldon & Company, engineers.



CURVE SHEET NO. 1.—RESULTS OF ELEVEN ECONOMY TESTS.



CURVE SHEET NO. 2.—TURBO-GENERATOR CHARACTERISTICS AND EFFICIENCY.

The object of the tests was to specifically determine the fulfilment of the builder's guarantee of the steam consumption at various loads, and under various conditions, and, incidentally, to observe the

Digitized by Google

general sufficiency of the steam turbine for its intended work. The equipment ordered by Joseph Bemm & Sons comprised a turbo-generating unit consisting of a 600 nominal horse-power Westinghouse-Parsons steam turbine direct-connected to a 400-kilowatt Westinghouse-Parsons generator of the revolving-field type. Both turbine and generator are of the standard construction employed by the builder for machines of this size.

A comparison of the builder's guaranteed steam consumption, with the results obtained under the various operating conditions with superheated steam and with saturated steam, is shown in the accompanying table:

pressure, and as the results are over ten per cent better than the guarantee, it is reasonable to suppose that, if the required steam pressure had been available, the guaranteed economy would have been exceeded still more.

The foregoing tests are for the turbine alone. The generator was tested separately. Its characteristics are as follows:

Type—turbo, revolving-field, 3-phase, 2-pole.
Excitation, separate..... ..... 100 volt.
Rated full-load capacity..... 400 kw.
Full load current per terminal (100% power-factor)..... 527 amp.
Voltage, normal..... 440
Frequency (alternations per minute) ..7200
Speed (revolutions per minute).....3600

The measurements included iron loss in armature, resistance of armature, resistance of field, saturation curve, and insulation tests. From these data the efficiency is calculated. As the losses due to bearing friction and windage are small, and are not easily segregated from other losses, they have been neglected. Curve sheet No. 2 shows the results of these tests, together with the efficiency curves.

COMPARISON OF STEAM CONSUMPTION AT VARIOUS LOADS.

SUPERHEATED STEAM.

Steam at 150 Pounds Pressure and 100° F. Superheat, Vacuum 28 Inches.	Lbs. Steam per Brake H.P. per Hr.		
	Full Load	¾ Load.	½ Load.
Guaranteed water rate in pounds per electrical horse-power per hour..	14.8	15.5	16.9
Guaranteed generator efficiency.....	94.5%	93.5%	91.0%
Equivalent water rate in pounds per brake horse-power per hour	13.98	14.49	15.38
Pounds steam used per brake horse-power during test.....	12.48	13 45	14.34
Percentage better than guarantee.....	10.9%	7.2%	6.7%

SATURATED STEAM.

Dry Saturated Steam at 150 Pounds Pressure. Vacuum 28 Inches.	Lbs. Steam per Brake H.P. per Hr.		
	Full Load.	¾ Load.	½ Load.
Guaranteed water rate in pounds per electrical horse-power per hour..	16.4	17.2	18.7
Guaranteed generator efficiency.....	94.5%	93.5%	91.0%
Equivalent water rate in pounds per brake horse-power per hour	15.5	16.8	17.0
Pounds steam used per brake horse-power during test.....	13.89	15.05	15.86
Percentage better than guarantee.....	10.3%	10.4%	7.0%

It was particularly desired to determine the efficiency of the turbine independent of the generator; consequently separate tests were made on the steam turbine and the generator. To ensure accuracy, brake tests were made on the turbine. The exhaust steam from the turbine was condensed in a surface condenser, and the condensed steam weighed.

The results of the eleven official economy tests made upon the turbine are shown in the graphical curve sheet No. 1.

The tests have shown that the turbine carried an overload of 108 per cent with excellent economy. This desirable feature is brought about by an automatic secondary governor valve, with which the turbine is fitted. This valve begins to operate only when the load on the turbine is about 700 horse-power, or about fifteen per cent overload.

The conclusion of the engineers is that the tests show a high efficiency in the use of steam, generous overload capacity, and close speed regulation. The builder's guarantee of economy was made under 165 pounds gauge pressure at the throttle. The tests were made under 150 pounds

Fort Wayne Prepayment Wattmeters.

In the article in last week's issue, describing Fort Wayne prepayment wattmeters, a typographical error on page 949 reads: "it can be readily adjusted for any rate up to twenty per cent per kilowatt-hour." The whole paragraph should read: "The flexibility of this meter will at once attract the interest of the central station manager. It can be readily adjusted for any rate up to twenty cents per kilowatt-hour."

The Pennsylvania Railroad Company is constructing an experimental electric locomotive, for use in the New York tunnel. It is being built at Altoona.

New Recording Voltmeter for Both Direct and Alternating Current.

The importance of maintaining uniform voltage in the generation and distribution of electricity for light and power has long been appreciated by both the producer and the consumer.

A variation of comparatively a small percentage in the voltage of an incandescent lighting circuit from the standard for which the lamps are designed causes loss in the life of the lamps and results in wide fluctuations in the efficiency and candle-power. In the application of electric power, as, for instance, on an electric railway, it is of great importance that the voltage be maintained regardless of the variations in the load.

The recording voltmeter has proven itself to be of great value, and is an indispensable part of a modern electric plant, since it accurately, automatically and continuously furnishes a written record of the slightest variation of the voltage. The recording voltmeters manufactured by The Bristol Company, of Waterbury, Ct., have been extensively adopted, but up to the present it has been necessary to furnish the instruments with entirely different current coils, according as they were to be employed upon alternating or direct-current circuits.

FIG. 1.—NEW FORM OF RECORDING VOLTMETER FOR BOTH DIRECT AND ALTERNATING CURRENT.

In many electric plants both alternating and direct current are generated, and if the same voltmeter can be used equally well for recording either kind of current it is quite evident that a valuable advance has been made.

This has been accomplished. Fig. 1 illustrates the standard station or switchboard design. In Fig. 2 a special portable form of the instrument is shown. The case is provided with a handle and

Digitized by Google

leveling screws for convenient transportation and adjustment. The door is open, showing the construction and manner of operation.

The novel features and improvements to this new voltmeter are, first, it is equally applicable to both alternating or direct circuit; second, it requires only one-third as much current to operate as that necessary for the older design for alternating currents; third, it is more sensitive to very slight variations of voltage; fourth, the chart graduations are nearly uniform on both sides of the working range; fifth, the portable form of the instrument in its carrying case is only half the size and weight that was formerly required.

The solenoids shown in Fig. 2 are connected so that when current is passing through them in series, the movable solenoid will be repelled from, instead of being attracted toward the stationary one.

The movable solenoid is mounted on a frictionless knife edge multiplying device, which transmits its motion to the pen arm, carried by the knife edge blade.

This simple multiplying device permits the solenoids to be located very near each other, and consequently the magnetic field of force is uniform throughout the motion of the solenoid, resulting in the desirable scale divisions of the chart.

By making the constructions of the solenoids so that there is repulsion instead of attraction, the mutual inductance between them is neutralized, thus making the same instrument suitable for recording either alternating current or direct current. The instrument is independent of the frequency and is compensated for changes of atmospheric temperature.

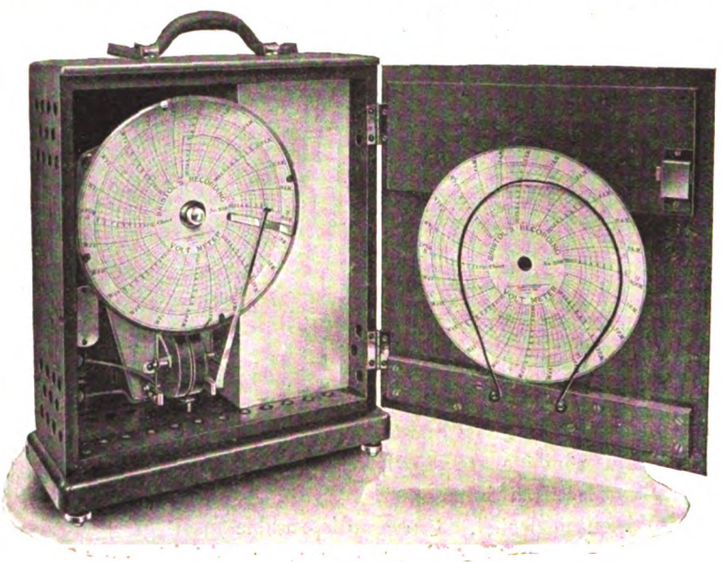


FIG. 2.—PORTABLE RECORDING VOLTMETER FOR BOTH DIRECT AND ALTERNATING CURRENT.

New Mine Conductor Line Material.

The accompanying illustration, Fig. 1, shows a new General Electric Company mining suspension in which several improvements have been embodied. The upper surface of the new suspension is

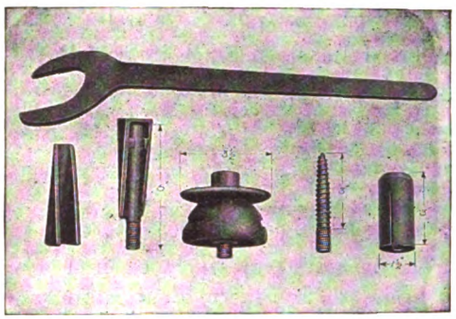


FIG. 1.—NEW MINING SUSPENSION MATERIAL.

three and one-half inches in diameter, making the device equally well adapted for curve or straight line construction, whereas the old device does not maintain a vertical position on curve construction, owing to the fact that the upper surface which bears against the mine roof is of insufficient area. The holes in the roof are usually drilled one and one-half inches in diameter, and on curve construction the edge of the hole is liable to become broken away, allowing the suspension to be pulled into a slanting position so as to interfere with the trolley wheel. On opposite sides of the new suspension there are two grooves or recesses designed to engage and support a spanner wrench, the use of which ensures a thoroughly stable support for the trolley wire. For convenience in using the wrench, which is shown in Fig. 1, the handle is bent to form a slight angle with the jaws. The old suspension is not adapted for the application of a wrench and is usually screwed up by hand. It is furthermore difficult to remove the old suspension and practically impossible to redeem the bolts and wedges, since the bolt becomes rusted into the suspension and turns with it.

The illustration of the new suspension shows the means of attaching by a bolt and wedges, and by a taper lag-screw and wooden plug. In using the former method of attachment, the manner in which the bolt is locked in the upper wedge is clearly shown. It will be observed that any turning of the bolt is effectually prevented. In order to remove the suspension, it is simply necessary to unscrew it with a wrench and then disengage the wedges by giving the bolt a light tap on the lower end.

The bolt and wedges are designed for a hole in the roof five and one-half inches deep, the length of the bolt being five inches. In many mines, however, the roof is sufficiently hard and firm to render such a deep hole unnecessary, and under such conditions the taper lag-screw and wooden plug may be conveniently employed. The wooden plug is driven into a hole in the roof one and one-half inches in diameter and four inches deep, and the expansion of the plug as the lag-screw enters gives a stable support, which is further ensured by the swelling of the plug due to the absorption of moisture.

With the taper lag-screw, this suspension is well adapted for attaching to cross timbers in place of the ceiling suspension, so that only the one style need

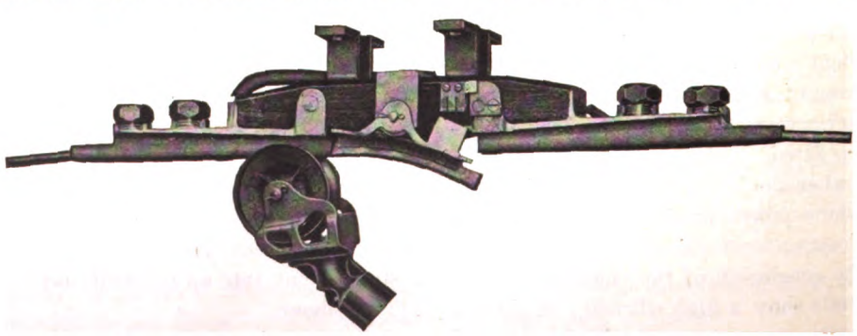


FIG. 2.—AUTOMATIC SECTION INSULATOR FOR MINE LINE CONSTRUCTION.

Digitized by Google

be carried in stock at the mine. When the suspension is attached in this manner, a hole is counterbored for its shank in order that the upper surface may be drawn by the lag-screw to a firm bearing against the timber.

In the operation of electric mine locomotives, it is frequently desired to permit only the section of the trolley line in which a locomotive is operating to be "alive." For example, a coal mine usually consists of a main entry and several branch entries or gangways, and it may be desirable that the trolley wires on some of the branch entries shall be "alive" only when actually transmitting power to a locomotive.

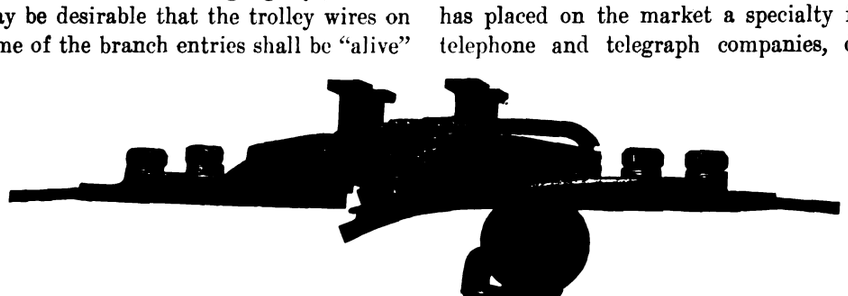


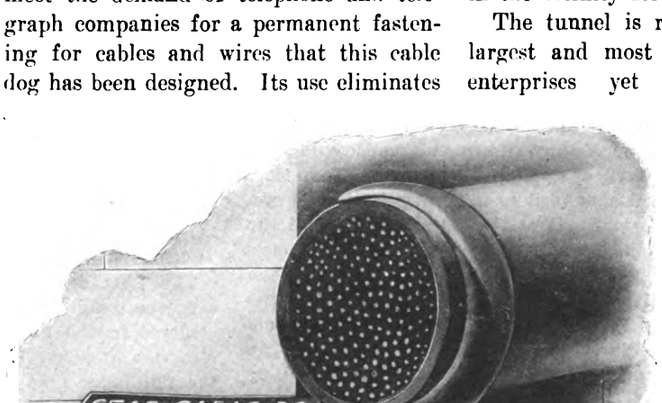
FIG. 3.—AUTOMATIC SECTION INSULATOR FOR MINE LINE CONSTRUCTION.

To meet the demand thus indicated for an automatic section insulator, the device shown in the illustrations, Figs. 2 and 3, has been developed. One terminal is connected to the "live" trolley or feeder and the other to the section of the trolley line to be isolated. The wheel, in passing, actuates a special single-pole single-throw switch, thereby connecting or disconnecting the normally isolated section according to whether the locomotive is entering or leaving the section. The switch contact is clear of the rocking segment, thus eliminating a prolific source of trouble, namely, the burning of the switch clip by the arcing of the trolley wheel. In the older form, the switch clip, which was depended upon to hold the rocker in one or the other of its two positions, was situated at a point exposed to arcing. The clip, therefore, failed to hold the rocker when burned, and allowed the rocker to hang in an intermediate position, thereby causing trouble. As shown clearly in Figs. 2 and 3, the new design overcomes this difficulty, and the rocker is effectually maintained in operative condition. Fig. 3 also shows the jumper which connects the switch blade with the live side of the circuit. It is obvious that the device can be used only for the control of sections on which but one locomotive would be in service at a given time. If installed as a safety precaution, lamps should be located at frequent intervals to indicate when the trolley is alive, as otherwise the uncertainty which would be introduced might be a source of danger.

Although primarily intended for mining construction, this automatic section insulator may be used advantageously in electric industrial haulage.

A New Type of Cable Dog.

The Star Expansion Bolt Company, 147-149 Cedar street, New York city, has placed on the market a specialty for telephone and telegraph companies, designated as the "Star" cable dog. It is to meet the demand of telephone and telegraph companies for a permanent fastening for cables and wires that this cable dog has been designed. Its use eliminates



ADJUSTABLE CABLE DOG.

structures of wood or any other easily rotted material.

A small hole is required for its insertion, the principle of the dog being such that, when inserted, a positive expansion occurs on the inner end. It is easy to install, a hole being drilled just large enough to insert the shank, and the wedge part is then hammered in. The construction is such as to allow of easy removal. Pressure with a hammer or chisel will loosen the wedge, thus releasing the hold. The dog can in this manner be used an indefinite number of times.

Water-Power Tunnel on Vancouver Island.

United States Consul Dudley, Vancouver, British Columbia, reports that the enterprise undertaken by the British Columbia Electric Railway Company (Limited) to furnish electric power is now approaching completion. About sixteen miles from the city there is a small lake covering about 300 acres. This is called Lake Beautiful and lies about 400 feet above high-water mark. A power plant has been established at the foot of the mountain, and water is brought down in large pipes, having a fall of 390 feet in 1,600 feet. But this lake does not contain sufficient water to meet the demands in the dry season, and therefore it was decided to bring down the water of Lake Coquitlam, which lies about thirty-five feet higher and has an area of about 2,000 acres. To bring the water from Lake Coquitlam to Lake Beautiful required the construction of a tunnel almost the entire distance, some two and one-half miles, through solid rock. Sufficient water has thus been secured to produce all the electrical power that is likely to be needed in the vicinity for many years.

The tunnel is regarded as one of the largest and most successful engineering enterprises yet undertaken in the province, and the following are facts concerning it: cost, $320,000; total length, two and one-half miles; size, nine by nine feet, with rounded corners; area of normal cross-section, seventy-three square feet; number of men employed on construction, 100 to 175; average rate of progress per day, between fifteen and sixteen feet; explosives required, over 200 tons of dynamite, gelegnite, and blasting gelatine; fuse used in blasting, 500,000 feet, or nearly 100 miles; candle-power required to light the work, 175,000.

The consulting engineer was Mr. Wynn Meredith, an American, who has been employed upon great works at several points in the United States.

The Toctos Medical Company, No. 1 Corso Romana, Milan, Italy, writes Harlan W. Brush, consul at Milan, Italy, wishes catalogues and prices from American manufacturers of electric apparatus for medical use, particularly body apparatus.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW STOCK ISSUE OF THE UNITED LIGHT COMPANY, OF SPRINGFIELD, MASS.—The United Light Company, of Springfield, Mass., has been authorized by the gas commission to issue 2,000 shares of new stock at $160 per share. The proceeds of 820 shares are to be devoted to paying off notes, and of 1,180 shares to meet the expenses of additions to the plant.

NEW TELEPHONE COMPANY IN NEW YORK CITY—The Atlantic Telephone Company has applied for a franchise in the city of New York. The company is capitalized at $25,000,000, and proposes to issue $15,000,000 worth of bonds. The company states that it has contracts for 75,000 telephones, and that it will offer a call rate of five cents throughout Greater New York.

SALE OF POWER, LIGHT AND RAILWAY PROPERTIES IN MISSOURI—The properties of the United Water, Gas and Light Company and the Sedalia Rapid Transit Company, in Sedalia, have been sold to B. S. Whaley, of Boston, Mass., and other eastern capitalists. The price paid was about $700,000. It is probable that the new company will also take over the Sedalia Gas Company's property.

SALE OF ELECTRIC LIGHT PLANTS IN MEXICO—All the electric light and power plants in the city of Mexico, Mexico, have been purchased by the Mexican Light and Power Company, a Canadian concern. The amount paid is said to be about $11,000,000, of which amount the Mexican Gas and Electric Company received $5,000,000, and the Ildefonso company $4,000,000 in stock and $2,000,000 in bonds. The new company contemplates improvements which involve an expenditure of $40,000,000.

HARLEM RAILROAD TO BE CHANGED OVER FROM STEAM TO ELECTRIC POWER—The Harlem Railroad Company intends to begin immediately the work of changing its system from Mott Haven to Wakefield from a steam road to a four-track electric system. Wakefield will be the terminal of the electric road until the line from that station to White Plains has been prepared for electrification. All grade crossings in the towns through which the road passes will be abolished, and trains will run below the street level. The company is purchasing the right of way from Mount Vernon to White Plains, in order to enable it to lay two additional tracks. The company expects to operate the road by electricity in 1906.

REDUCTION OF CAPITAL OF THE YORK STATE TELEPHONE COMPANY—The York State Telephone Company, Binghamton, N. Y., will reduce its capital from $2,500,000 to $1,250,000. When the company was formed it was anticipated that the former amount of capital would be needed, but the growth of the independent telephone business of New York and northern Pennsylvania has been so rapid that the officers believe a reduction of fifty per cent in the capital stock will be of advantage to the corporation. Of the authorized capital stock, 8,230 shares of the par value of $100 each have been issued. Under the plan for the reduction of the capital it is proposed that each stockholder shall surrender his present shares and accept in exchange an equal number of shares of the par value of $50 each.

DEVELOPMENT OF WATER POWER IN GEORGIA—It is reported that the Etowah Power Company has purchased the water power of the Etowah river, near Cartersville, from the Etowah Development Company. The purchase includes two dams, twenty-five acres of land at each dam for the location of a power plant, forty acres of land for a park, and the right of way for an electric road. The power company purposes beginning at once the development of the water power, which is estimated to be a minimum of 4,500 horse-power. Storage dams, however, may be built, which will increase the capacity of the plant to 8,000 horse-power. The current generated will be used to furnish light and power to Cartersville. The total expenditure involved is about $725,000. The president of the company is A. J. Warner.

DISSOLUTION OF THE FEDERAL TELEPHONE COMPANY—It is announced that the dissolution of the Federal Telephone Company, of Cleveland, Ohio, will soon take place. The constituent companies owe about $3,000,000, and to liquidate the company will be forced to make an assessment of $30 per share on the stock, which has a par value of $10 per share. The assets of the company will be sold to the stockholders, and the money will be used to pay the debts. The assets comprise a controlling interest in ten companies, including the independent exchange in Cleveland, the Cuyahoga Telephone Company, the Long-Distance Independent Company, and the United States Telephone Company. The Federal Telephone Company is capitalized at $1,000,000, and has no funded debt. The company originally held the securities of twenty-two companies, twelve of which have been sold.

MORTGAGE OF THE UTAH LIGHT AND RAILWAY COMPANY—The Utah Light and Railway Company, Salt Lake City, Utah, has given a deed of trust for $10,000,000 to the Bowling Green Trust Company, New York city. The deed covers all the property of the light and railway company in Salt Lake County, Weber County and elsewhere. The object of the mortgage is to take up $6,350,000 of outstanding bonds. In addition to this $1,000,000 of improvement bonds will be issued. The money received from these bonds will be expended in putting up a $250,000 steam plant on the Jordan river, and building a $100,000 reservoir and making other improvements at the mouth of Big Cottonwood Cañon The company also proposes to extend its lines from Murray to Sandy, and from Calders to Holliday. The company also proposes to replace all its thirty-five-pound rails in the street railway system with seventy-five-pound rails, and about fifty new cars are to be purchased.

RAILWAY CONSTRUCTION IN THE PHILIPPINE ISLANDS—The Bureau of Insular Affairs, Washington, D. C., has issued a prospectus giving the details of the railways which are to be constructed in the Philippine Islands. The scheme involves the construction of about 1,233 miles of railway in the various islands of the Philippine group. The Philippines government will have entire control of the handling of bids and of concessions, and will decide later whether the motive power is to be steam or electricity. Bids will be received only from individual citizens or copartnerships of the United States or of the Philippines, or from railroad corporations duly organized and existing under the laws of a state, the United States government, or that of the Philippines. Bids must be either in the hands of the Philippines government at Manila or at the office of the Bureau of Insular Affairs, Washington, D. C., at 9 A. M., November 1, 1905. Bidders may bid on the entire system or on the four proposed lines on the island of Luzon. Bids must be accompanied by a check for $500,000 if a bid is made on the whole system; for $250,000 if the bid is made on the lines in Luzon; for $250,000 if a bid is made on all remaining lines; or for $100,000 for each line if made for lines not included in either of the specified groups. It is required that surveys be begun within sixty days after the demand of the governor-general. Successful bidders must, when the final route is planned, put in operation within eighteen months 200 miles of road, and 200 miles more each successive year, so far as the system as a whole or the Luzon portion of it is concerned. The roads are to be exempt from all taxation, but there must be paid to the Philippines government an amount equal to one-half of one per cent of the gross earnings for thirty years, one and one-half per cent for fifty years thereafter, and subsequently an amount to be fixed by the Philippines government.

Digitized by Google

TELEPHONE AND TELEGRAPH.

WILKESBARRE, PA.—A telephone line is being constructed from Farr Hollow to Jenningsville.

LYONS, KAN.—The Prosper Rural Telephone Company will shortly complete its line to Bushton.

READING, PA.—The Conestoga Telephone and Telegraph Company has voted to increase its capital stock to $15,000.

AKRON, OHIO—The Central Union Telephone Company is rebuilding the line between Barberton and Doylestown.

DUNKIRK, N. Y.—The Home Telephone Company has secured new quarters in the Merchants' National Bank Building.

CHESTER, PA.—The Keystone Telephone Company has a force of men at work constructing a new line from Darby to Norwood.

JERSEY CITY, N. J.—The Erie Railroad has installed and is now operating a new telephone system in the Jersey City, Bergen and Weehawken yards.

NEW YORK, N. Y.—At the annual meeting of the stockholders of the Mexican Telegraph Company only routine business was transacted, and the old board of directors was reelected.

SALT LAKE CITY, UTAH—The Rocky Mountain Bell Telephone Company will extend its switchboard facilities at a cost of $20,000. The extension will have a capacity of 1,000 subscribers.

FAYETTEVILLE, W. VA.—The Southern Bell Telephone is extending its line to Logan *via* Salt Rock and Hamlin. The line will later be constructed to Pineville, the new county seat of Wyoming.

READING, PA.—The Pennsylvania Telephone Company is building two trunk lines between Reading and Tamaqua and two to Pinegrove. The company will also build a line from Pinegrove to Lebanon.

CHEYENNE, WYO.—The Rocky Mountain Bell Telephone Company has announced that it will build a line to Lusk and Manville, Converse County. The branch will leave the main line at Orin Junction and will be forty-five miles in length.

FRANKLINVILLE, N. Y.—A movement is on foot to form a new stock company with $100,000 capital to acquire the telephone exchanges at Ellicottville, East and West Salamanca, Elkdale, Great Valley, Humphrey Centre, Red House and Ashford Junction.

BUTTE, MONT.—Within a short time the Rocky Mountain Bell Telephone Company will begin the work of burying the wires in the business district of Butte. Plans are being prepared, and as soon as these have been perfected contracts will be let and the work commenced.

DES MOINES, IOWA—To secure a loan of $100,000 and cover an indebtedness of $300,000 the Mutual Telephone Company has filed a trust deed of its entire plant in favor of the Equitable Life Insurance Company, of Iowa. The loan is advanced to provide for the further improvement of the plant.

JACKSON, MICH.—The Alpena Mutual Telephone Company has leased for five years all telephone property belonging to the Michigan State company, in the locality of Alpena, including suburban lines, cables, etc. The Mutual company will now complete lines to Spruce, Hubbard Lake and other towns.

HALIFAX, N. S.—It is announced that contracts have been signed by the Canadian government for the establishment of two new stations, one to be located at Cape Sable, Nova Scotia, and the other at St. John's, New Brunswick. It is said that both of these will be completed before the end of September.

UTICA, N. Y.—The Herkimer County Home Telephone Company has opened a branch telephone exchange at Newport, which will be of service to the residents of Middleville, Poland and Cold Brook as well as Newport. The exchange at Newport will connect with the Herkimer County Home Telephone Exchange.

JERSEY CITY, N. J.—The Jersey City street and water board has passed a resolution directing the trolley, telephone and telegraph companies to place all their wires underground within one year after Mayor Fagan shall approve the resolution. The board also ordered that all poles and rails shall be removed from streets where cars are not run.

BATAVIA, N. Y.—The Bell Telephone Company will commence work on a line running from Stafford through Morganville to South Byron. At present South Byron is reached by way of Elba and Byron Center. Another new line soon to be built will run from the Oakfield exchange south to the Batavia-Oakfield town line and west along it to Union Corners.

EMPORIA, KAN.—The Bell and the Independent Telephone companies have completed a deal by which the two offices have been consolidated. The Independent company will discontinue the use of all its long-distance wires outside of Lyon County, and will use the wires of the Bell company. W. W. Finney will be the manager of the merged companies.

WHEELING, W. VA.—The Cameron Telephone Company is making extensive preparations to improve its lines through Marshall County. In this connection it is proposed to build a line extending from Cameron to Pleasant Valley and Sherrard, connecting with the National Telephone lines to Wheeling, and extending from Pleasant Valley to Moundsville.

WHEELING, W. VA.—The National telephone lines will soon be connected up with West Alexander, through the Claysville Telephone Company's lines. The Claysville Telephone Company has connections with both the Wheeling and Pittsburg companies, has exchanges at Claysville and Taylorstown, and is widely connected throughout Washington County. A switchboard is soon to be installed at West Alexander.

DAVENPORT, IOWA—Arrangements have been practically completed, whereby the Central Union company will connect its lines with those of the Crescent Telephone Company in the east end of the county. Among the towns which can be reached without calling long-distance will be Hampton, Rapids City, Fort Byron, Cordova, Hillsdale, Erie, Joslin, Barstow, besides a large percentage of the farm houses throughout the upper end of the county.

LEONARDTOWN, MD.—The Southern Maryland Telephone Company has made connection with the Chesapeake & Potomac Company at Brandywine, and Leonardtown now has communication with Baltimore and Washington. The local company will devote its energies to extending its lines through St. Mary's County. The Morganza and Bushwood extensions will soon be in commission.

ROCHESTER, N. Y.—At the annual meeting of the Red Jacket Telephone Company, of the town of Manchester, the following directors were chosen: William H. Burke, Clifton Springs; Carlos P. Osgood, M. Osgood and John H. Pratt, Manchester; Oliver S. Titus, Robert B. Peck and Willis C. Ellis, Shortsville. The directors have chosen the following officers for the coming year: president, Carlos P. Osgood; vice-president, Robert B. Peck; secretary, Willis C. Ellis; treasurer, Oliver S. Titus. The affairs of the company are reported to be in a flourishing condition.

SCRANTON, PA.—The Centremoreland and Northern Lackawanna Telephone companies consolidated at a meeting in Waverly recently. All the telephones in the territory extending from Tunkhannock to Waverly, and from Harvey's Lake to Nicholson, are now under the control of one company. There are exchanges at present at Centremoreland, Dallas, Factoryville, Nicholson, Tunkhannock and Dalton. Arrangements are to be made with the Bell Telephone Company, to provide for connection with Scranton, and the long-distance service of the Bell company.

DOVER, DEL.—The stockholders of the Diamond State Telephone Company met in Dover on May 31 to consider an agreement for the merger and consolidation of the Diamond State Telephone Company, the Eastern Shore Telegraph and Telephone Company, of Caroline County, Md.; the Delaware Telegraph and Telephone Company, of Wicomico County, Md.; the Onancock Telephone Company and the Atlantic Telephone Company, of Accomac County, Va., and the Peninsular Telephone Company, of Northampton County, Va. By a unanimous vote, with all but 95 of the 8,040 shares of stock represented in person or by proxy, the consolidation was approved. The officers of the Diamond State Telephone Company were elected for the consolidated concern as follows: president, Harry A. Richardson, Dover; secretary, W. S. Piersol, Philadelphia; treasurer, Du Pont Walker, Dover; general manager, W. H. Baker, Dover.

Digitized by Google

ELECTRIC RAILWAYS.

ST. PETER, MINN.—The St. Peter council has granted a franchise to the Mankato & St. Peter Railway and Lighting Company.

LOUISVILLE, KY.—The contract for the construction of the Shelbyville & Ohio River Electric Railroad has been let to Luther H. Leber.

GENEVA, IND.—In a called session of the Geneva city council a franchise was granted the Fort Wayne & Springfield Railway Company.

EASTON, PA.—The Delaware Street Railway Company has commenced the construction of its trolley road from Easton to Martin's Creek.

WILMINGTON, DEL.—The directors of the street and sewer department have granted to the Wilmington City Railway Company a franchise to extend its line in Mt. Vernon avenue to the Country Club.

MILLIS, MASS.—Preliminary plans are being made for a street railroad between Millis and Natick. The new line, as proposed, will be built from Thornes' Corner through Sherborn and South Sherborn to Natick.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company will build a seventy by seventy-five-foot brick extension to the power-house at Third street and Wyoming avenue, at an estimated cost of $20,000.

BUFFALO, N. Y.—Work will soon begin on the Buffalo, Batavia & Rochester trolley road. The State Railroad Commission has given its approval. This road will connect the Buffalo & Williamsville road and a line running into Batavia.

BLOOMDALE, OHIO—The Bloomdale council has granted a franchise to the Fostoria, Bloomdale & North Baltimore Electric Railway, giving it the privilege of using the streets and alleys of the village for the construction of a street car line.

INDIANAPOLIS, IND.—It is announced that the Indianapolis & Martinsville traction line, operating thirty miles of track, has been sold to the Stone & Webster syndicate of Boston. The price was $150,000, the purchasers assuming one-third of the bond issue of $750,000.

YORK, PA.—The officials of the York County Traction Company have decided to extend the Red Lion and Windsorville suburban line from Windsorville to Bittersville, a distance of two miles. It is the intention of the company to ultimately extend this line to Long Level and the river.

SACRAMENTO, CAL.—The San Francisco board of public works has adopted a resolution instructing the city engineer to prepare and submit at once plans and specifications for the conversion of the Geary street railroad into an underground conduit electric system. The finance committee has already provided $350,000 for the purpose.

DAYTON, OHIO—The Cincinnati, Dayton & Toledo Traction Company has leased to the Cincinnati Northern Traction Company the remainder of the franchise period, the rental being $279,000 per year, with yearly increases reaching $366,500 by 1913, with taxes, bonus on volume of business and on all roads, cars and plants of the company.

PONTIAC, MICH.—At a meeting of the Pontiac council an extension of ninety days was granted L. A. Rockwell, secretary of the Detroit & Bay City Traction Company, on the time for commencing work on the road. The contract for the construction of the road has been awarded the Ross Construction Company, of Chicago, and work will be commenced at Detroit and Bay City at the same time.

MILWAUKEE, WIS.—Preparations are said to be under way for the construction of the electric line between Wauwatosa and West Allis by the Milwaukee Electric Railway and Light Company. The right of way for this line was secured two years ago, and runs along Greenfield avenue, from a point on the Wells street line, in Wauwatosa, to a point on the Waukesha line near the Soldiers' Home.

JEANNETTE, PA.—Officials of the Jeannette-West Newton trolley line have signed a contract with the New England Construction Company to build the road. Work will be commenced as soon as machinery and men can be assembled. The line will be about fourteen miles long and will run through Adamsburg, Edna, Madison and Herminie. In Jeannette it will connect with the Pittsburg-Greensburg line.

DAYTON, OHIO—The final survey of the route of the Interstate Traction Company, which proposes to connect Dayton and Connersville, Ind., is now in progress, and the actual work of construction will begin about July 1. The road is said to be well financed. This line will connect Connersville, Camden, Farmersville and other points throughout a section heretofore isolated from electric railway transportation.

SPRINGFIELD, ILL.—Articles of incorporation have been filed for the Roodhouse & Virden Railway Company. The principal office is at Roodhouse. It is proposed to construct an electric interurban railroad from Roodhouse through Scottville and Modesto to Virden. The incorporators and directors are Charles W. Payne, of Roodhouse; James Walker, of Scottville; James A. Fletcher, of Modesto; Henry C. Simmons, of Virden, and Burke Vancil, of Springfield.

NORFOLK, VA.—A new electric railroad is to be built along Hampton Roads, from Ocean View to Pine Beach, connecting the Norfolk Railway and Light and Atlantic Terminal lines running to these two places. Those behind the new road are Herbert L. Smith, J. W. Perry and others. The power is to be furnished by the Norfolk Railway and Light Company, and the new move is said to be simply the first of a general move for a consolidation of a number of properties. The new company is to be capitalized at $300,000.

GREENSBURG, PA.—Work has been started on the construction of the new trolley line from Irwin to McKeesport. The road will pass through Hahntown and then go west, following the valley of McKeesport. It will open up a new country as far as trolley and steam roads are concerned. New York, Pittsburg and Irwin men are behind the enterprise. The line will be about nine miles long and will cost $25,000 a mile. A branch will be run to Herminie, passing through the new coal towns of Hillton, Edna No. 2, Madison and on to Arona.

HYATTSVILLE, MD.—Engineer William H. Benton, of the Anacostia, Surrattsville & Brandywine Electric Railway, states that preliminary surveys have proceeded beyond Silver Hill, Prince George's County, to Henson's branch, and that practically all of the rights of way have been secured. This road begins in Anacostia and leaves the District of Columbia line at Walker's road. It passes Silver Hill, Camp Springs, Surrattsville, T B and terminates at Brandywine. Work of construction will have to be started in the District of Columbia within six months. In all the road will be practically twenty miles in length.

CLARKSVILLE, TENN.—A mortgage for a sum not exceeding $200,000 has been executed by the Clarksville Railway and Light Company to the United States Trust Company, of Louisville. The mortgage is for forty years at an interest rate of five per cent, and is made to secure the issuance of improvement bonds to the amount of $40,000 or more. These transactions are the result of a consolidation of the Clarksville Electric Street Railway Company and the Queen City Light Company for the purpose of making improvements and extensions. The extension of the electric car system to New Providence and Dunbar's Cave is understood to be included in the plans of the company.

LAPORTE, IND.—In accordance with an order of sale made by Federal Judge A. B. Anderson, Edward Daniels, of Indianapolis, master in chancery, sold at public sale in this city the interurban line between Laporte and Michigan City, owned by the Chicago & South Shore Railway Company, as a result of foreclosure proceedings brought by the Royal Trust Company, of Chicago, trustee, for $362,000 worth of bonds. The road was bid in by T. L. Spence, of Milwaukee, and A. D. Mallory, of Batavia, Ill., representing the bondholders' committee, at $450,000. There were no other bidders. As soon as possible after the sale has been confirmed and the deed placed in the hands of the Laporte & Michigan City Traction Company, which is the name of the organization of bondholders, the capital stock will be assigned to the Indiana Railway Company under a contract made six weeks ago.

Digitized by Google

ELECTRIC LIGHTING.

MONROE, MICH.—The city council is considering offers to lease the municipal electric light plant.

ALDEN, IOWA—The franchise for a lighting system at Alden has been granted to the Peterson Heat, Light and Water Company, of Des Moines.

BOSTON, MASS.—The city council of Woburn has passed an order transferring the franchise of the Woburn Light, Heat and Power Company to the Edison Electric Illuminating Company.

DALLAS, ORE.—The electric light plant in Dallas has been sold to B. S. Thompson. It is understood that many improvements will be made immediately, notably the installing of larger engines.

ELLICOTT CITY, MD.—The Patapsco Electric and Power Company has purchased a site on which to erect another power-house, utilizing the water power of the Patapsco river at Ellicott City.

NEW ORLEANS, LA.—The Consumers' Electric Light Company will erect a new station at Claiborne avenue and Willow and Euphrosine streets. The company will also build a substation on South Ramport street.

TONAWANDA, N. Y.—The Tonawanda Power Company has received the contract for lighting the city for a period of five years. The rate will be seventy dollars per arc light per year, and about 120 lamps will be in operation.

NEWARK, N. J.—The Princeton Lighting Company's plant and real estate have been sold at receiver's sale for $100,000. Herman Dowd, of New York, chairman of the committee of bondholders of the company, made the purchase.

MONTREAL, QUE.—A new building to be erected by the Montreal Light, Heat and Power Company, on Marie Anne street, and is expected to cost $10,000. The company is planning to erect a coke briquetting plant to cost about $20,000.

SANTA BARBARA, CAL.—The citizens of the city have voted to continue the plans for a mutual electric light plant, which is to be turned over to the municipality when it is in successful operation. The plant will cost $50,000 to build.

TROY, N. Y.—The Waterford Electric Light, Heat and Power Company has executed a mortgage for $500,000 in favor of the Troy Trust Company. The mortgage is given to secure bonds to the amount named. The bonds are $1,000 each, and the term is fifty years.

ELKTON, MD.—William T. Warburton, of Elkton, has purchased the Gilpin falls at Bay View and will build an electric light plant to light the towns of Elkton, North East, Rising Sun and Chesapeake City. The fall is 126 feet in height, and a large amount of horse-power can be developed.

YONKERS, N. Y.—The Northern Westchester Lighting Company has organized to furnish light to the villages of Ossining, Briar Cliff and Croton-on-the-Hudson. The company has acquired the plants of the several companies now operating in the above towns. Mr. F. A. Stratton, president of the Westchester Lighting Company, is president of the new concern.

SALT LAKE CITY, UTAH—Surveyors are now at work on an electric light and power site located in Alpine canyon, which is owned by Messrs. Stephen L. Chipman, Don Strong, James H. Clarke and Abel J. Evans. The Alpine canyon is very steep and enables the owners of the electric site to get a fall of over 1,200 feet in a distance of 4,000 feet.

NEW MANUFACTURING COMPANIES.

PENSACOLA, FLA.—The Pensacola Electrical Company has been organized by John Massey, Jackson Brandon and T. D. Adams, to engage in electrical work.

RICHMOND, VA.—The Capital Electric Company, composed of F. J. Whybrew, J. J. Tresnon and W. B. Jennings, has been organized. General electric work is the purpose of the new firm.

AUGUSTA, ME.—The Electrolytic Process Company has been organized with a capital of $300,000. The directors are Samuel S. Lightbody and Cyrus W. Davis, Waterville, and Frank W. Gifford, of Fairfield.

NEW YORK, N. Y.—The Knapp Electric and Novelty Company has been incorporated with a capital of $50,000, to manufacture electrical novelties. The directors are D. W. Knapp, F. F. Thul, New York; T. G. Grier, Chicago, Ill.

JERSEY CITY, N. J.—The Schenectady Insulator Company has been incorporated to manufacture electrical appliances. The company is capitalized at $75,000. M. O. Caldwell, J. J. Caldwell and H. D. Story are the incorporators.

GUTHRIE, OKLA.—The International Automatic Telephone Company, of Chicago, Milwaukee and Guthrie, has been organized with $100,000 capital stock. The incorporators are George G. Gunther and William C. Snow, of Chicago, and G. V. Pattison, of Guthrie.

BALTIMORE, MD.—The Whittingham Manufacturing Company has been incorporated, for the purpose of engaging in the electrical business, by Wm. C. O'Brien, John Watson, Jr., George H. Whittingham, Randolph Barton, Jr., and Richard C. Stewart. The capital stock is $3,600.

JERSEY CITY, N. J.—The Hydrotherm Electrical Company has been incorporated to manufacture and deal in electrical machinery. The capital is $1,000,000, and the incorporators are L. L. Winton, E. M. Treat, Charles F. Bates, Robert H. Williams, S. M. Heil, Edward Sills, C. T. Westlake and T. T. Price, all of Jersey City.

SCRANTON, PA.—A new company has been organized in Scranton and incorporated under the name of the Scranton Electrical Switch and Signal Company, with a capital of $50,000, for the purpose of manufacturing a switch and signal device invented by B. S. Wakerman, the rights to which have been purchased by the company.

CHATTANOOGA, TENN.—The Electric Company has been formed by R. H. Williams, G. D. Lancaster, Norris Headrick, Bruce Forshee and Bartow S. Strang, with a capital of $10,000. The object of the company, as stated in the articles of incorporation, is the construction and building, for other persons than themselves, of railroads, street railways, incline railways, locks, dams, houses or any other private buildings or improvements. It is provided in the charter that the company shall have no right to own or operate any such railways except while in course of construction.

LAPORTE, IND.—The Edwards Electric Headlight Company has filed articles of incorporation for $250,000 and taken possession of the Laporte plant, patents and property of the Edwards Railroad Electric Light Company, of Cincinnati, which was recently bid in by M. K. Northam for the new company at the receiver's sale. The incorporators are the bondholders of the old company, capitalists of Cincinnati, Chicago and Milwaukee. The directors for the ensuing year are Charles A. Goodyear, John H. Keaszle, B. Wygard, William H. Allis, M. K. Northam, H. J. Leffingwell and John H. Miller.

LEGAL NOTE.

GENERAL ELECTRIC COMPANY LITIGATION—In the "End Play Apparatus" case brought by the General Electric Company, complainant, *vs.* the Bullock Electric Manufacturing Company, defendant, Judge Cross filed an opinion in the United States Circuit Court, District of New Jersey, on May 29, in favor of the complainant. In the "Delta-Connected Voltage Regulation" case brought by the General Electric Company, complainant, *vs.* the Allis-Chalmers Company, *et al*, defendants, the same judge filed an opinion in the United States Circuit Court for the District of New Jersey, on May 29, dismissing the demurrers of the defendants. In the first case the patents involved were the Rice patent No. 625,806, the Lunt patent No. 671,287, and the Hewlett patent No. 661,049. In the second case the patent involved was the Armstrong and Woodbridge patent No. 726,391. In the United States District Court for the Western District of Pennsylvania, in the suit for infringing upon claim 8 of United States letters-patent No. 412,155, issued to Albert Anderson for improvements in trolleys for electric railway service, a preliminary injunction was issued by Judge Acheson, on June 10, directed to George R. Metcalf, Benjamin J. Walker, Martin Steiner and the Erie Trolley-Wheel Company, enjoining and restraining them, and each of them from infringing, as alleged in this suit.

Digitized by Google

NEW INCORPORATIONS.

EL PASO, TEX.—Pass City Electric Company. $8,000. Incorporators: Frank Gates and George Harper.

JOLIET, ILL.—Joliet Power Company. $5,000. Incorporators: Fred Bennitt, T. A. Mason and Cory E. Robinson.

ERMA, N. J.—The Citizens' Local Telephone Company. $10,000. Incorporators: Edward A. Wells, H. V. Sonets and Luther Ingersoll.

ALBANY, N. Y.—Hydraulic and Electric Power Company, Potsdam. $50,000. Directors: G. W. Sisson, R. L. Sisson and C. H. Sisson, Potsdam.

CAMDEN, N. J.—Pleasantville Electric Company. $125,000. Incorporators: Frank C. Metter, Charles E. Machold, Augustus H. Riddell and Howard F. Morgan.

NASHVILLE, TENN.—Big Buck Telephone Company, Greene County. $200. Incorporators: Cleveland Justice, Samuel Malone, George Neal, J. F. Brown and G. P. Weems.

SPRINGFIELD, ILL.—Rockford & Interurban Long-Distance Telephone Company, of Rockford. $30,000. Incorporators: John H. Camlin, Edward W. Brown and T. M. Ellis.

RICHMOND, VA.—Ballard Telephone Company, Incorporated, Ballard. $5,000. Officers: E. J. Hylton, president; J. E. Hylton, secretary, treasurer and general manager, both of Vesta.

INDIANAPOLIS, IND.—Huntington, Upland & Matthews Traction Company. $25,000. Directors: Orlando S. Stout, J. A. Shafer, D. L. Horner, O. W. Reed, H. R. Miles, C. F. Knowlton and A. Y. Stewart.

COLUMBUS, OHIO—The Defiance, Wauseon, Adrian, Ann Arbor & Detroit Traction Company, of Wauseon. $70,000. Incorporators: W. W. Campbell, Charles E. Bennett, Jay H. Miller, M. P. Pinrod, K. V. Haymaker and F. J. Spencer.

NASHVILLE, TENN.—Gallatin & Suburban Railway. For the purpose of constructing a line of railway from Gallatin to the Cumberland river. $50,000. Incorporators: C. H. Fidler, G. N. Guthrie, T. D. Holder, H. T. Lucus and J. D. G. Morton.

ALBANY, N. Y.—All-Counties Gas, Electric Lighting, Power, Heating and Illuminating Company. To carry on operations, particularly in the county of Kings. $10,000. Directors: Edwin R. W. Potter, of Flatbush, and Henry E. Gates and Alfred C. Cooper, of Brooklyn.

POUGHKEEPSIE, N. Y.—Dover Local Telephone Company. $400. Directors: Sanford Hoag, Pawling; Fred Coleman, Wing Station; Charles Hoag, Pawling; Charles Coleman, South Dover; John D. Coleman, Pawling; George Baker, South Dover; Myron Tabor, Dover Furnace, and Elihu Hoag, Dover.

ALBANY, N. Y.—The Churchville Light and Heating Company; $5,000; incorporators: William L. Ormrod, Rochester; Frank W. Potter, Hiram C. Davis and others, Churchville. Anderson Power Transmission Company; $15,000; incorporators: John P. Brooks, A. Warner Brooks, Charles S. Hoose, all of Albany.

LITTLE ROCK, ARK.—White Sulphur Springs Railroad Company. To build an electric line from Van Buren to a point in Crawford County, a distance of about fifteen miles. $150,000. Directors: Joseph Hansen, Frank W. Russell, Joseph A. Fullerton, John H. Van Brunt, John G. Parkinson, R. P. Allen, J. L. Rea, J. E. Powers, E. L. Matlock, R. Comstock and T. F. Wood.

ALBANY, N. Y.—The Economy Light, Fuel and Power Company, to operate in Lockport, Buffalo and other places in Erie and Niagara counties; $250,000; directors: Henry G. Eddy, of Chicago; B. F. Seadler, of New York, and Isaac H. Babcock, of Lockport. The Adirondack Power Company, of Queensbury, Warren County; to erect dams across the Hudson river and its tributaries in Saratoga, Washington, Warren, Essex, Fulton and Hamilton counties, to develop electricity to supply throughout the state, for light, heat and power purposes and to establish a steam plant also for the purposes of generating electricity; $200,000; incorporators: George R. Finch and Jeremiah T. Finch, of Glens Falls, and George F. Underwood, of New York. The Racquette River Transportation Company; to furnish electricity in the Adirondacks and the Mohawk and Hudson River valleys; $50,000; directors: C. H. Van Slyck, of New York; Lorenzo N. Rider, of Bath, and Leroy T. Bradford, of Broadalbin.

EDUCATIONAL.

COMMENCEMENT OF THE POLYTECHNIC INSTITUTE OF BROOKLYN—The commencement exercises of the Polytechnic Institute of Brooklyn, N. Y., will be held in the Majestic Theatre on Wednesday evening, June 14, at 8.15. The address will be delivered by Frederick J. E. Woodbridge, LL. D., of Columbia University. His subject will be "Liberal Education."

THOMAS S. CLARKSON MEMORIAL SCHOOL OF TECHNOLOGY—The April issue of the *Clarkson Bulletin*, published by the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y., contains descriptions of the courses in engineering and home economics offered at the school. The excellent equipments contained in the different laboratories are outlined, as well as an explanation of the several student organizations of a social and literary character. The third session of the summer school will begin July 6, extending for six weeks. A course is offered in the care, operation and construction of automobiles and boat engines, for which a number of standard cars have been provided. Courses are also offered in history and literature, languages, mathematics, home science and manual training.

ENTRANCE EXAMINATIONS FOR THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The entrance examinations for the Massachusetts Institute of Technology will be held at the Rogers Building, Boston, Mass., Wednesday, Thursday, Friday and Saturday, June 28 to July 1. A second series of examinations will be held on September 19, 20 and 21. Applicants for advanced standing must pass the June or September examinations, and must present themselves for further advanced examinations in September. The schedule of these examinations will be sent upon application. Examinations will also be held by the college entrance examination board at many points in the United States and in foreign countries. Further information may be obtained from Thomas S. Fiske, secretary, college entrance examination board, post office substation 84, New York city.

LECTURES AT THE STEVENS INSTITUTE OF TECHNOLOGY—Special lectures have been delivered to the senior class during May and June of the present year. The lecturers and subjects are as follows: John W. Lieb, Jr., M. E., "The Generation and Distribution of Electricity in New York City"; Philip Torchio, "Principles Governing the Design of Systems for Electrical Distribution"; Dr. Louis Duncan, "The Development of the Electric Railway"; Charles E. Downton, "Shop Methods and the Apprenticeship System of the Westinghouse Electric and Manufacturing Company"; C. J. H. Woodbury, "Telephone Line Engineering"; William R. Baird, M. E., L.L. B., "Patent Law"; William O. Ludlow, M. E., "Architectural Engineering"; George C. Hill, C. E., "Form and Surveying," "Building and Cost Keeping"; Professor William H. Bristol, M. E., "Recording Instruments for Pressure, Temperature and Electricity"; E. R. Douglas, M. E., "Motor Drive for Machine Tools."

PROGRAMME FOR COMMENCEMENT WEEK AT THE STEVENS INSTITUTE OF TECHNOLOGY—The programme for commencement week at the Stevens Institute of Technology, Hoboken, N. J., is as follows: Sunday, June 18, 10.45 A. M., baccalaureate sermon by the Rev. J. Clayton Mitchell at the Trinity Protestant Episcopal Church. Monday, June 19, 8 P. M., cremation of calculus on the Institute campus. Tuesday, June 20, 4 P. M., Lacrosse game between alumni and Stevens varsity teams at the St. George cricket grounds; 7 P. M., reserved for alumni class-reunion banquets. Wednesday, June 21, 10.30 A. M., class day exercises of the graduating class, Castle Point campus; 4 to 7 P. M., reception of President and Mrs. Humphreys to the trustees, faculty, alumni, graduating class and undergraduates at the Carnegie Laboratory of Engineering; 8 P. M., meeting of the Alumni Association in the Institute auditorium. Thursday, June 22, 10.30 A. M., thirty-third annual commencement in the Institute auditorium; 3 P. M., baseball game between faculty and seniors at the St. George cricket grounds; 8 P. M., farewell reception tendered by junior class to the graduating class in the Carnegie Laboratory of Engineering.

Digitized by Google

PERSONAL MENTION.

MR. C. H. EDWARDS has been appointed division superintendent for the Northwestern Telephone Exchange Company, with headquarters at Fargo, N. D.

MR. HOMER J. WHITE has resigned as chief electrical engineer of the Hoosick Falls Electric Company, and will take a similar position with the Keene, N. H., Gas and Electric Company.

MR. GEORGE R. BLACK has resigned his position in the toll tariff department of the Southern Bell Telephone Company, to take a more responsible position in Oklahoma City, Okla., with the toll department of the Pioneer Telephone Company.

MR. E. M. O'BRIEN has resigned as manager of the Des Moines (Iowa) exchange of the Iowa Telephone Company. Mr. O'Brien has been with the Iowa Telephone Company for the past nine years, beginning as manager of the company's exchange at Iowa Falls. For the past five years he has been in charge of the Des Moines exchange.

MR. FRANK C. WRIGHT, formerly superintendent of the Edison company at Lebanon, Pa., has resigned to accept the position of general manager of the York & Windsor Electric Light Company and the Elizabethtown & Marietta Electric Light Company. These companies operate in eleven towns in York and Lancaster counties. Mr. Eli L. Nissly is president, and Mr. E. R. Heisey secretary and treasurer of the companies.

MR. GEORGE WESTINGHOUSE, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has agreed to serve as one of the three trustees to hold the majority stock of the Equitable Life Assurance Society recently acquired by Mr. Thomas F. Ryan and associates. The other members of this distinguished board are the Hon. Morgan J. O'Brien, chief justice of the Supreme Court of the State of New York, and the Hon. Grover Cleveland, ex-president of the United States.

MR. W. S. HEGER has been appointed assistant to the vice-president and general manager of the Allis-Chalmers Company. Mr. Heger was born in 1857 at Fort Simcoe, Washington Territory. He received his education both in this country and Europe, spending seven years in Vienna, Austria. He received the degree of M.E. at Stevens Institute of Technology in 1879. His business career began in the mechanical drafting room of the Edgemoor Iron Works, shortly before this company undertook the contract for the construction of the Brooklyn bridge. Mr. Heger was placed in charge of putting this work through the drafting room, the shops, and the testing and inspection departments. In 1885 Mr. Heger went into business on his own account as a contractor and electrical engineer, later becoming sales agent and constructor for the Edison company for isolated lighting in the states of Delaware, Maryland, the Virginias and the Carolinas. In 1889 he was sent to San Francisco as district manager for the Pacific coast territory for the Edison company and the Edison United Manufacturing Company. He built up the organization there which exists to-day under the General Electric Company. In 1890, owing to the serious illness of a daughter, Mr. Heger gave up all business. He resumed active work in 1892, accepting the position of general manager of the Wilmington City Railway Company, Wilmington, Del. He spent three years rebuilding and operating this road. Returning to the Pacific coast in 1895, Mr. Heger became district manager for the Westinghouse Electric and Manufacturing Company, with headquarters in San Francisco. Mr. Heger's work here was particularly successful. He resigned his position with the Westinghouse company in April. His headquarters will be at the general offices of the Allis-Chalmers Company, Milwaukee, Wis.

MR. W. S. HEGER.

ELECTRICAL SECURITIES.

The latter part of the week in the stock market was one of greater buoyancy than has been noticed for several months. There were a number of things to account for this. One was the radical move made to effect a settlement of the insurance scandal, which has been, to a large extent, a dominating factor in finance for some weeks. Another important consideration was the evidence pointing to at least a cessation of hostilities in the far east. Whatever may be the ultimate result of President Roosevelt's note to the two warring powers, the very agreeable reception of this note by both of these powers has done much to strengthen the market both at home and abroad. Crop prospects also have materially improved, the weather conditions having been more favorable, particularly as regards grains and cotton. The industrial situation reflects nothing but continued stability. Recent statements of railroad earnings have been very favorable, and the increase in the dividend of the Interborough Rapid Transit Company has done much to stimulate interest in local tractions.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 10

New York:	*Closing.*
Brooklyn Rapid Transit	64⅜
Consolidated Gas	187½
General Electric	173⅝
Interborough Rapid Transit	204
Kings County Electric	200
Manhattan Elevated	163½
Metropolitan Street Railway	122⅞
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	190

A dividend of $2 per share will be paid on July 15 to stockholders of the General Electric Company of record at the close of business hours on Monday, June 19. The transfer books will not be closed.

The gross earnings of Brooklyn Rapid Transit gained more than $110,000 in May. The gross earnings for Decoration Day were unprecedented in the history of the company, being above $71,000.

The guaranteed quarterly dividend of 1¾ per cent on the capital stock of the Manhattan Railway Company will be paid by the Interborough Rapid Transit Company, as trustee, on and after July 1, to stockholders of record at the closing of the transfer books on June 16.

Directors of the Interborough Rapid Transit Company have declared a dividend of 2 per cent, placing the stock on an 8 per cent basis. This dividend is payable July 3 to holders of voting trust certificates on June 12.

Boston:	*Closing.*
American Telephone and Telegraph	140½
Edison Electric Illuminating	245
Massachusetts Electric	59
New England Telephone	137
Western Telephone and Telegraph preferred	98

Philadelphia:	*Closing.*
Electric Company of America	11⅝
Electric Storage Battery common	75
Electric Storage Battery preferred	75
Philadelphia Electric	9½
Philadelphia Rapid Transit	27⅞
United Gas Improvement	96⅜

Union Traction directors have declared a semi-annual dividend of $1 a share payable July 1 as registered June 9.

Chicago:	*Closing.*
Chicago Telephone	134
Chicago Edison Light	158
Metropolitan Elevated preferred	64½
National Carbon common	62½
National Carbon preferred	116
Union Traction common	7⅜
Union Traction preferred	33

Chicago Telephone directors have declared the regular quarterly dividend of 2½ per cent, payable June 30. Books close June 26 and reopen July 1. The company's net gain for May was 2,560 telephones, making the total now in use 127,914.

Digitized by Google

INDUSTRIAL ITEMS.

THE LOCKE INSULATOR MANUFACTURING COMPANY, Victor, N. Y., has started a second addition to its factory. This addition will be 40 by 100 feet, and will be devoted exclusively to cementing together the parts of multipart porcelain insulators.

ROSSITER, MacGOVERN & COMPANY, INCORPORATED, 17 Battery place, New York, has issued a list of machinery for sale by it. This includes generators, motors, lamps, transformers, storage batteries, gas and steam engines, air compressors, condensers and street railway equipment, including cars.

THE MANUFACTURERS' ADVERTISING BUREAU, 126 Liberty street, New York city, is distributing a booklet entitled "Advertising for Profit," in which is described the work the company is now doing. Its method of doing business, together with the results accomplished, are given in detail, and a long list of clients is printed in the back of the book.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: McLain, Kan.; Oregon, Ill.; High Point, N. C.; Campsville, Ill.; Cowden, Ill.; Plainville, N. Y.; Stanley, N. Y.; Mexico City, Mexico; Seattle, Wash.; Adrian, Mich.; Furley, Kan., and Ebling, Kan.

DODGE & DAY, Philadelphia, Pa., in bulletin No. 175, publish a number of illustrations showing the results of management work at the plant of the Jeanesville Iron Works, Hazelton, Luzerne County, Pa. Dodge & Day were the engineers for the rehabilitation of this plant, and make a specialty of undertaking commissions to increase the efficiency of existing properties.

THE AMERICAN TOOL WORKS COMPANY, Cincinnati, Ohio, announces that it has appointed Mr. George M. Chandler, 7 North Illinois street, Indianapolis, Ind., selling agent for its line of lathes, planers, shapers, upright drills and radial drills. Mr. Chandler is a practical, as well as a business man, and will be prepared to answer enquiries in a thoroughly intelligent manner.

THE F. BISSELL COMPANY, 226-230 Huron street, Toledo, Ohio, has issued a new specialty catalogue, No. 125. This catalogue covers a group of devices for telephone construction work which are thoroughly practicable and reliable in operation. This catalogue will be mailed upon application. The company will also be pleased to send complete sets of estimate blanks, which are very convenient for figuring new work.

THE TEA TRAY COMPANY, Newark, N. J., has issued a catalogue of carbonic acid gas hand fire extinguishers. This extinguisher is included in the list of fire extinguishers under the standard of the National Board of Fire Underwriters and by the National Fire Protection Association, and approved for use. The extinguisher is made in several sizes. The company is also calling attention to its incandescent street fixtures, hoods, shades and reflectors in a 100-page catalogue.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY has issued No. 39 of the *Four-Track* series. This is entitled "Map of the Underground Railway of New York," and gives a large amount of information with regard to the subway, both as to the location of lines and stations and the time between different points. On the opposite side of the folder is a map of New York city from the Battery to One Hundred and Forty-first street. With this map is given an alphabetical list of seventy-seven hotels, seventy-eight clubs and forty-nine theatres.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., distributed an interesting bulletin, entitled "The Vital Subject Is Lighting," at the National Electric Light Association's convention, at Denver, on June 7. This distribution was contemporaneous with the bronco-busting exhibition given in honor of the delegates. The cover shows a bucking bronco making a desperate attempt to unseat his rider. The Denver office of the company extended a cordial greeting to the delegates, and offered the use of the office as a stopping place for the delegates and extended all the courtesies at its command.

THE MOBILE ELECTRIC COMPANY, 30 Lawrence street, Newark, N. J., in bulletin No. 1, describes the Mobile changeable signs. This is a type of sign which permits the wording to be changed while the sign is in place. The sign is made in two types, A and B, respectively. Type A forms a letter fifteen inches high with five lamps in the vertical. The outside dimensions are fifteen and three-quarters by nineteen and one-quarter by three inches thick. The type B sign forms a letter eighteen inches high with five lamps in the vertical. The outside dimensions are nineteen and seven-eighths by twenty-three and five-eighths by three inches thick.

THE CENTRAL ELECTRIC COMPANY, 207-211 East Jackson Boulevard, Chicago, Ill., is calling attention to the Candee patented potheads and cable terminals. This pothead is guaranteed water and moisture-proof, and prevents the destructive attacks of water and moisture upon paper cables. The conductors extending from one end of the pothead or plug are insulated with "Okonite." Those from the other end are cotton-covered. After the moisture has been thoroughly extracted, the conductors are sealed in a lead sleeve to protect them from dampness. The sleeve is subsequently removed and used for making a permanent joint between the pothead and the lead cover of the paper or fibre cables.

THE HARTMAN CIRCUIT-BREAKER COMPANY, Mansfield, Ohio, is distributing bulletin No. 6, describing oil-switches and circuit-breakers. The switches are made in three types, designated as A, B and C, respectively. The type A switch is designed to rupture loads which, under emergency conditions, can not exceed 4,000 kilowatts, three-phase, at potentials not exceeding 6,600 volts. The type B switch is designed for circuits where the ultimate break capacity of the switch can not exceed 850 kilowatts, three-phase, at potentials not exceeding 2,500 volts. The type C switch has a maximum capacity of 8,500 kilowatts, three-phase, at potentials not exceeding 22,000 volts.

THE OHIO BRASS COMPANY, Mansfield, Ohio, suffered the partial destruction of its plant by fire on May 24. The office, finishing, machine and copper shops of the insulating building and pattern vault were not destroyed. The company announces that its force is continuing work in the uninjured buildings, and that a large amount of work is being done in the temporary sheds which have been erected on the grounds. The moulders are kept busy in adjacent plants which have been loaned to the company. The bond department will continue working in a neighboring factory, pending the completion of new permanent buildings which the company will erect at once to replace those which were burned. The company is making every effort to avoid inconveniencing its customers, and states that it intends to break all records for quick recovery from the effects of fire.

FRANK B. COOK, Chicago, Ill., the well-known manufacturer of telephone apparatus, has recently received a patent upon a door-hanger. This door-hanger is of the type in which internally arranged hanger rolls travel upon a tubular track which is supported by internally arranged brackets or supporting devices. The track is slotted longitudinally, and the supporting brackets project through the longitudinal slot at any suitable or desired points along its length. The combination of a longitudinally slotted track with externally arranged rolls and internally arranged brackets not only provides a suitable track, but also makes possible the employment of any suitable or desired number of brackets at any number of points along the length of the track without varying the construction of the track in any manner. It also permits the use of brackets of a uniform character.

THE PEERLESS ELECTRIC COMPANY, Warren, Ohio, reports an unusually busy season. It has been necessary to operate the factory day and night. In addition to the present rush, a good lot of orders is booked for some time ahead. In the fan-motor department the output of regular lines has largely increased. In addition to the regular line there is a new type of Peerless oscillating fan which is being well received by the trade. A special high-voltage testing transformer of the well-known Peerless type has been furnished to the Jefferson Physical Laboratory of Harvard University, duplicating a transformer recently supplied to Johns Hopkins University. The contracts on hand ensure weeks of steady operation in the Peerless motor department. New machinery is being added to take care of the growth of this branch of the business. Among other large orders recently installed are the complete equipments, with individual motors, of the planing mills of the Warren Manufacturing Company and of the Western Reserve Lumber Company, both at Warren, Ohio.

Digitized by Google

ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. XLVI. No. 25. NEW YORK, SATURDAY, JUNE 24, 1905. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . ASSOCIATE EDITORS
ROBERT THURSTON KENT . . . . . ASSOCIATE EDITORS

PUBLISHING OFFICE . . . . . 13-21 Park Row, New York
WESTERN OFFICE: Fisher Building, Chicago, Ill. . LUCIEN W. MARSHALL, Manager
BOSTON OFFICE: 161 Devonshire Street . . . . . M. W. BARBER, Manager
EUROPEAN OFFICE: 42 Old Broad Street, London, E. C. . . HENRY W. HALL, Manager

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

TO ADVERTISERS

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

SUBSCRIPTIONS

One Year, United States and Canada $3.00
One Year, Foreign Countries 5.00
Single Copies, each 10

CONTENTS.

EDITORIAL:
The Use of Automatic Appliances . . . 999
A Municipal Ownership Setback . . . 999
The Three-Phase Railway System . . . 1000
Electric Heating . . . 1001
Electric Elevators . . . 1001
Convention of the National-Interstate Telephone Association . . . 1002
Death of the Hon. S. P. Sheerin . . . 1002
Production and Value of Copper, Lead and Spelter in the United States During 1904 . . . 1002
New York Electrical Society . . . 1002
Convention of the American Institute of Electrical Engineers . . . 1003
Book Review . . . 1004
Electric Tramways in Lima . . . 1004
Can a Steam Turbine Be Started in an Emergency Quicker than a Reciprocating Engine of the Same Power? by A. S. Mann . . . 1005
Fundamental Features of Electric Elevators, by E. R. Carichoff . . . 1006
The New Electric Locomotive for the Valtellina Road . . . 1008
Counterweights for Large Engines, by D. S. Jacobus . . . 1011
Progress in Electric Heating; Electric Power in Factories; District Heating . . . 1014
Convention of the American Railway Master Mechanics' Association . . . 1020
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 1022
Purifying Drinking Water by Electricity . . . 1023
The Celebes-Guam Cable . . . 1023
INDUSTRIAL SECTION:
New Method of Testing Lubricants . . . 1024
Ganz System of Three-Phase Alternating-Current Electric Traction in the United States . . . 1024
Typo-Telegraph, by Frederick J. Swift . . . 1025
New York Telephone Company's New Telephone Directory . . . 1028
New Ignition Timing Apparatus . . . 1028
Consolidation of the Ingersoll-Sergeant Drill Company and the Rand Drill Company . . . 1028
CURRENT ELECTRICAL NEWS . . . 1029

THE USE OF AUTOMATIC APPLIANCES.

The ease with which apparatus may be controlled electrically at a distance and may be made to perform certain definite operations in a prescribed way, is demonstrated by the increasing tendency to use automatic apparatus. This tendency leads not only to greater convenience, but is actually safer. The motorman of the modern electric car only starts the car; the controller itself decides the rate at which the car accelerates. The same is true in elevator practice and in many other lines of motor application.

The tendency to use automatic apparatus more and more in central station operation is also doing much to improve the service of these plants and to increase their reliability. We have automatic switches, automatic alarms of various kinds, and now we have an automatic synchronizer, a device which performs the delicate operation of coupling alternators together with a celerity and surety which can not be expected of the human operator.

A MUNICIPAL OWNERSHIP SETBACK.

When Mr. James Dalrymple, the managing expert of Glasgow's street railway system, arrived in this country, at the call of the mayor of Chicago, the advocates of municipal ownership of public utilities welcomed him with open arms. His opinions were quoted everywhere, and the report of the investigation he was to make of conditions in Chicago was awaited with impatience, it being thought that his report would allay the fears of those timid ones who hesitate to commit their cities to expensive undertakings, the outcome of which is doubtful. Mr. Dalrymple said, to quote his own words: "I see no reason why Chicago or any other city in this country should not be able to own its street railways and run them with as much success as we have achieved in Glasgow." Theoretically, perhaps he was right, although the wisdom of extending the functions of the government may be questioned. But at the present time the most pressing question is whether our governments are ready to take up new cares. Chicago was not alone in being deeply interested in the subject, for the same question was being agitated in a number of the larger cities.

Fortunately for all of us, or at least for those who are not yet convinced that municipal ownership will accomplish all that is being claimed for it, Mr. Dalrymple is an honest and disinterested expert. He has investigated the conditions, not only in Chicago but in New York and elsewhere, and he is thoroughly convinced that municipal ownership would not be successful in our cities. Mr. Dalrymple not only believes that political conditions, as they exist to-day, would make municipal ownership a failure, but he holds that a strict application of the principles of civil service would be almost as disastrous. Civil service rules could not be applied successfully because, in his opinion, an examination on paper can not decide the suitability of a man for the position of motorman or conductor; and, moreover, the superintendent of the road must have the power to discharge an employé if he is incapable.

That Mr. Dalrymple's opinion will carry weight may be expected, since he has nothing to gain and may fairly be considered to be impartial and to be speaking from conviction. In fact, there seems to be a healthy reaction against municipal ownership, at least on the part of the conservative and influential daily papers. They see the perils ahead, and do not hesitate to point them out. It seems strange, indeed, as the New York *Times* remarks, that municipal ownership should be advocated so readily by political organizations having at heart the betterment of our governments. These bodies do not seem to realize that to give a city government control of the public utilities would be only adding powerful weapons to the already well-armed practical politicians—the men who govern us for themselves.

Digitized by Google

THE THREE-PHASE RAILWAY SYSTEM.

The work of driving a railway car or train is peculiar in several respects: motors must operate successfully under varying conditions of load and of power supply; they must be rugged, able to stand sudden and severe overloads, and require not much attention, even though exposed to unfavorable conditions. The experience of the first few years in street railway work showed that the simplest type of motor was the best for conditions as they then existed, hence the adoption of the direct-current series motor. But as electric traction was extended to wider fields and applied to heavier work, the limitations of the direct-current motor were recognized, and other types were considered to see whether their characteristics would make them more suitable for newer problems. At the present time every type of electric motor known has been proposed and tried for railway service, and several new types have been developed in the effort to secure a machine which will meet the requirements of railway work as they are now understood.

The direct-current shunt motor, although abandoned after a brief trial in the early days, has since been considered again, but has not met with much favor among railway men. Its chief claims for recognition are greater range of speed variation, and the possibility of returning power to the line when braking or descending grades.

Among the alternating-current motors a greater selection is offered. Of the types available previous to the last three years, neither appealed to the American engineer. The synchronous motor could not be used without auxiliary apparatus, and the induction motor, as then constructed, had characteristics which did not seem to suit it to the work. But the convenience and economy of alternating-current transmission were thought by some to overbalance the poorer characteristics of the motor for traction service when comparing it with the direct-current type. In Italy the three-phase induction motor was supplied for the Valtellina road. The system has been in operation for a number of years, and recently several new locomotives have been added to this equipment, a description of which will be found on another page of this issue. Mr. B. J. Arnold, who persistently urged the application of alternating currents to railway work, has devised an ingenious gearing system which enables him to operate a locomotive by means of a single-phase, alternating-current motor, whether it be of the induction or synchronous type.

The newer types of alternating-current motor partake of the character of the series direct-current motor, but are more complicated in that it is necessary to add a compensating winding, or to adopt some other device for improving the power-factor of the motor. There are several types of these motors. All employ a commutator, and all have two or more field windings, which may be in series with the armature or in shunt and in series with the armature. The repulsion type, with compensating windings, has been tried, but is thought to be less suitable than the series type. Certain types are, in fact, a combination of the series and the repulsion types. Of these various types, some must be the more suitable. Which they are time alone will tell.

The new Valtellina locomotive differs principally from the older types in the design of the motor. Each driving unit is in fact a double motor, the two parts of which may be connected in concatenation for obtaining a reduced speed. The method of transmitting power from the motor to the axles is also different from that used in any recent electric locomotive. The earlier locomotives were of the gearless type, with the axle passing through the hollow shaft of the rotor. This construction presented certain mechanical difficulties, and did not permit easy inspection. But instead of adopting gears, as would naturally have been expected under the circumstances, it was decided to use the coupling and connecting rods of the steam locomotive. This design made it imperative that the speed of the motor should be no higher than that of the locomotive axles, hence large motors were required, and all the space available between wheels was needed for the motor proper, and the designers were forced to place the slip rings used in controlling the speed on a return crank outside of the main driving crank. It is questionable whether this method of driving does not offset largely the reduction in the size of the motor which might have been possible since the high voltage of the line is applied directly to the motors. The method of driving also produces certain unbalanced forces. As the speed of the Valtellina locomotive will not be high—at the most not over thirty-eight miles an hour—it may be that this pounding effect will be of little consequence.

A noteworthy feature of the new locomotive is the method of control. This is accomplished by means of compressed air, which operates the various switches, collecting devices and the regulating resistances. The engineer from his position in the cab by this means has control of all the apparatus in the locomotive.

The distributing system requires two overhead conductors, and is somewhat more complicated than the single-phase systems which are being tried elsewhere. The locomotive itself is fully as complicated as those equipped with single-phase motors. There seems to be no gain in this respect; indeed, rather the reverse. The efficiency of operation, as far as regards starting and normal running, is probably no better than that which can be obtained with the commutating types of motor. The speed regulation is no better than that which can be secured in the newer types with series-parallel control; in fact, it permits of but two speeds, while certain of the single-phase systems can run efficiently at a number of speeds. One advantage possessed by the system is the ability to return power to the line when braking or when descending grades; but it is not the only alternating-current system which possesses this advantage. However, the characteristics of the induction motor, resembling as they do those of the direct-current shunt motor, have seemed to certain engineers to make this machine particularly suitable for heavy long-distance hauls, and the results of the operation of the new machines on the Valtellina road will probably throw much light upon the suitability of this type for main-line service.

Digitized by Google

ELECTRIC HEATING.

A correspondent who is fortunate enough to have some 300-horse-power, hydraulic horse-power, more than he needs contemplates disposing of this for heating purposes, and writes for information concerning electric heaters.

An electric heater is essentially a simple device. By far the greater number of heaters are of the so-called resistance type, in which a conducting path of fairly high resistance is provided for the current so that the latter, in its passage through the heaters, converts all of its available energy into heat. However the shape of the heating element itself, and the material of which it is made, may vary within wide limits; the shape of the complete heater may also vary greatly, and is largely determined by the purpose for which it is intended.

If a heater is to be supplied for warming a room, it will, in general, be rather large, and the temperature which it acquires not excessively high. As the heat is conveyed throughout the room by the air, and not by direct radiation, the surface of the heater must be such as to give up its heat readily to the surrounding air. The conducting material through which the current is passed, and which becomes hot for that reason, may consist of a metallic wire, or the electrical conductor may consist of an exceedingly thin layer of metal supported by a non-conducting strip or plate. In one well-known type of heater the heating elements are merely special forms of incandescent lamps. These, in addition to heating the surrounding space, are thought to be more cheerful because of the accompanying glow. For temporary purposes an excellent heater can be made of coils of iron wire strung on a frame, iron wire being preferable to copper because of its higher specific resistance. In a new type of heater the conducting material takes the form of a powder distributed over a non-conducting support. When metallic wires are used they are frequently surrounded by an inactive powder, which protects them from the air and thus avoids oxidation.

Heaters for cooking purposes must develop fairly high localized temperatures, hence they are in general smaller than heaters for warming rooms. The heater of an electric stove is generally arranged so as to give off practically all the heat in a small space, upon which the cooking utensil can be placed; or the cooking utensil itself may contain the heating element. Herein lies one of the great advantages of electric stoves. There is practically no loss of heat, all that developed by the stove or the cooking utensil being given to the substance to be heated. The other desirable features of electric cooking stoves are the convenience, cleanliness and absence of smoke and foul gases. The stove is started by merely turning a switch and in a moment or two it reaches its full temperature. Any degree of regulation can be secured, and this without loss, for all of the electrical energy delivered to the heater is converted into heat.

The advantages given here for the electric stove apply equally as well to heaters for other purposes. They are instantly and easily controlled, and, when properly installed, they are good fire risks. When installing them, however, it should be remembered, as is true of steam and hot-water heating systems, that ventilation must be provided for the room, since the heater itself does not supply fresh air.

The energy supplied to the heater can be measured in kilowatt-hours or in horse-power-hours. The first corresponds to 3,412 British thermal units, or to an evaporation of 3.53 pounds of water per hour from and at 212 degrees Fahrenheit. If electrical energy is measured in horse-power, one horse-power-hour is equivalent to 2,544 British thermal units, and will evaporate 2.64 pounds of steam from and at 212 degrees Fahrenheit. The temperature attained by the heater depends, of course, upon many things: upon the power supplied; upon the size and material of which the heating element is made; upon the kind and shape of the enclosing case—if any be used—and upon its position with regard to surrounding objects. Any temperature may be attained in the heater up to that required to melt the most infusible metals.

The art of electric heating is well developed, though the use of these appliances for heating rooms and cooking is not as great as could be desired. The fault here lies not in the heaters themselves, but in the fact that in generating electrical energy from coal great losses take place. The method is roundabout, and the only system available to-day is, unfortunately, inefficient. First, we burn the coal and transfer as much as possible of the heat developed by this process to water. The steam thus generated is then passed to some type of engine. The engine drives an electric generator, which, in turn, develops electric current. This current must then be transmitted, through conducting wires, to the point where it is to be utilized, where its energy is reconverted into heat. At every step, except the last, losses take place, not so much due to our apparatus as to the system itself. But, in spite of these losses, there are so many desirable features possessed by electric heating apparatus that it is confidently expected its use will increase every year. Many electric generating stations to-day encourage the use of electric heaters by supplying the current for them at reduced rates.

ELECTRIC ELEVATORS.

On another page of this issue appears an article by Mr. E. R. Carichoff, entitled "Fundamental Features of Electric Elevators." This is the first of a number of articles which Mr. Carichoff is writing for the ELECTRICAL REVIEW. The series will cover the field of electric elevator service. The various systems will be described, and the method of control and the various safety devices employed will be explained in detail.

Mr. Carichoff is a recognized authority upon electric elevators. He has been actively employed in elevator work for many years past, having been among the first to engage in the development of the electrically controlled system. He was associated with Mr. Frank J. Sprague in 1893. In 1900 he accepted a position as consulting engineer with the Otis Elevator Company, and at the present time he is consulting engineer for the National Elevator and Machine Company. His wide experience makes him familiar with all elevator systems, and his series of articles will not only be authoritative, but, we believe, will be the first to discuss fully and satisfactorily this exceedingly important application of the electric motor and the electrically operated elevator controller.

Digitized by Google

THE ANNUAL CONVENTION OF THE NATIONAL-INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION.

THE HON. S. P. SHEERIN DIES WHILE DELIVERING THE RESPONSE FOR THE ASSOCIATION.

[*Special Telegram to the* ELECTRICAL REVIEW.]

CHICAGO, ILL., June 20—The first annual convention of the National-Interstate Independent Telephone Association opened at the Auditorium, Chicago, Ill., at 10.30 A. M. City Prosecutor Taylor, representing the mayor of Chicago, welcomed the delegates. The Hon. S. P. Sheerin, president of the Indianapolis Telephone Company, arose to respond for the association. In the middle of his address he paused and, stepping to Chairman Powers, said: "I beg your pardon, Mr. Chairman, but I am faint." Colonel Powers immediately sprang to his feet and caught Mr. Sheerin, who sank slowly to the floor. He expired in about half an hour. The cause was apoplexy. The meeting adjourned until three o'clock in the afternoon.

The executive committee held a meeting at noon, and decided to hold one later in the afternoon. At that time a committee on resolutions will be appointed to take proper action on the demise of Mr. Sheerin. The convention will then adjourn until Wednesday at 9 A. M., when, after proper resolutions have been presented, and necessary business undertaken, the convention will adjourn out of respect for Mr. Sheerin.

The exhibits were closed for the day, and the banquet has been abandoned.

The committee in charge of the convention gave out the following announcement at noon:

The Hon. S. P. Sheerin suffered a fatal attack of apoplexy at 11.15 A. M., while in the convention hall responding to the address of welcome. Medical attendance was had after some delay, and the physician reported Mr. Sheerin dead. The remains will be taken to Indianapolis tonight for interment. Mr. Sheerin was fifty-nine years of age, and president of the New Long-Distance Company, of Indianapolis. He had long been identified with the work of the Independent Telephone Association, and was one of the most prominent financiers and operators in the field. He had been secretary of the National Association, and had served on all the advisory committees of the association since its organization. From 1880 to 1886 he was clerk of the Supreme Court of Indianapolis. From 1888 to 1896 he was secretary for the national executive committee of the Democratic party. Mr. Sheerin was one of the heaviest investors in independent telephone properties, and, with a few associates, controlled the independent telephone properties of Indianapolis. The deceased leaves a wife and eight children. Thomas D. Sheerin, the eldest son of Mr. Sheerin, was attending the convention with his father, and was present at the meeting when his father was stricken. L. W. M.

New York Electrical Society.

The New York Electrical Society held its twenty-fourth annual meeting at the Café Boulevard, on June 14. The meeting was preceded by a dinner to which eighty members and their friends sat down. In the absence of President F. J. Sprague in Europe, Vice-President F. C. Bates presided. Mr. Bates, in a short but most effective speech, touched on some of the special features of the season, and their evidences of the wider representation which the society is now securing. Mr. Bates noted as of pleasing significance the fact that one of the tables containing over twenty guests was occupied almost entirely by telephone men. Furthermore, members of nearly every branch of electrical industry were to be found in the company present. There was, however, one most important section, that of street railway work, which ought to be more fully represented in the membership of the society, and it was gratifying to believe that in this direction the placing of the name of Mr. H. G. Stott on the nomination list was a happy augury. The finances and the membership list of the society were in sound and vigorous condition, and there were even now signs that the coming year will be the most successful in the history of the society. More than half of an exceptionally fine series of lectures had already been arranged for, and the organization of plans for an active campaign in the adding of new members was well on the way. Mr. Bates concluded by congratulating the society not only on its most encouraging present, but also on its possibilities in the near future.

The secretary's report showed that forty-six members had been elected during the season; the loss by death had been four, by resignation twenty-five, ten had been dropped, and the total existing membership was 636.

The report of the treasurer showed a steady improvement in the finances of the society.

The officers elected were:

President, W. S. Barstow.

Vice-presidents, H. G. Stott, Putnam A. Bates, Max Loewenthal.

The vice-presidents elected in 1904 for two years are Albert F. Ganz, Louis B. Marks, W. S. Rugg.

Secretary—George H. Guy.

Treasurer, H. A. Sinclair.

The excellent musical programme was admirably supplemented by the artistic singing of Mr. Charles Stuart Phillips.

Production and Value of Copper, Lead and Spelter in the United States During 1904.

Mr. Charles Kirchhoff, special agent of the United States Geological Survey, has computed the quantity and value of the copper, lead, and spelter produced in the United States during 1904. He has in preparation detailed reports of these industries, which will be published in the Survey's forthcoming volume "Mineral Resources of the United States, 1904."

A very considerable increase took place in the production of copper during 1904. The production amounted to 812,537,267 pounds, valued at $105,629,845. The production for 1903 was 698,044,517 pounds. The most noteworthy increase occurred in Arizona, where both the Bisbee and Globe districts added largely to the product. The imports in ore and matte amounted to 38,947,772 pounds; the imports in bars, ingots, and old bars to 142,344,433 pounds. The exports of copper amounted to 564,544,880 pounds, a noticeable increase over the exportation of 1903, which was only 320,322,627 pounds. The amount of copper consumed in the United States during 1904 was 485,284,592 pounds, a decline from the figure for 1903, which was 566,429,885 pounds. In spite, however, of this decrease in consumption, it was necessary to draw upon the stocks in producers' hands to the extent of nearly 56,000,000 pounds.

To arrive at the production of merchant lead obtained from the mines of the United States is a complicated problem. A careful study of the figures justifies the statement, however, that it amounted to 307,000 short tons in 1904, valued at $26,402,000. The yield in pig lead from ores smelted by works that treat argentiferous material is estimated, after undergoing the smelting, desilverizing, and smelting operations, at ninety-five per cent of the contents of the ores. The result is a tonnage of 218,000 for 1904 as contrasted with 199,000 short tons for 1903. To these figures are added 89,169 tons of soft lead for 1904 and 83,444 tons of soft lead for 1903, making an approximate total of 307,000 short tons for the lead production of the United States in 1904, as compared with 282,000 short tons for 1903.

Returns from all the producers of spelter in the United States show that the production for 1904 amounted to 186,702 short tons, valued at $18,670,200. The production of 1903 was 159,219 short tons. This extraordinary increase in output was due chiefly to the growth of the industry in Kansas, where a number of new plants built in 1903 were in full operation. A partial report of the stock carried by producers of zinc shows a reduction from 10,538 short tons on January 1, 1904, to 6,521 short tons on January 1, 1905.

Digitized by Google

The Twenty-second Annual Convention of the American Institute of Electrical Engineers.

Asheville, N. C., June 19 to June 23.

By Telegraph to the Electrical Review.

ASHEVILLE, N. C., June 19—The twenty-second annual convention of the American Institute of Electrical Engineers opened at Asheville, N. C., June 19, under exceptionally pleasing circumstances. The greater number of the 200 who have so far arrived reached Asheville about three o'clock Sunday afternoon, and were met at the station by Chairman C. E. Waddell and other members of the local committee. Open cars were provided for conveying the visitors to their hotels, the headquarters being established at the Battery Park Hotel.

Sunday evening was given up to resting. All of the visitors were greatly delighted by the beautiful surroundings and the magnificent scenery. The local committee was most solicitous for the comfort and pleasure of its guests.

MONDAY MORNING SESSION.

On Monday the members of the Institute assembled in the ladies' ballroom at the Battery Park Hotel for the first session of the convention.

President John W. Lieb, Jr., called the meeting to order at 9.30 A. M., and introduced Chairman Waddell of the local committee. Mr. Waddell introduced Mayor A. S. Barnard, who welcomed the guests to Asheville. He said, in part: "The duty which devolves upon me is a pleasurable one, as I esteem it a great privilege to meet the members of an organization which is doing so great a work. The South is rapidly developing, manufactures are spreading, and the Institute comes at an opportune time. The work of such organizations is fast obliterating those barriers imagined to exist between this and other sections of the country. The South has not been backward in adopting electrical methods. Asheville was one of the first cities to install an arc-lighting system."

He then extended a hearty welcome to the members of the Institute, saying that, although the formal act devolved upon him, the citizens themselves had assumed the responsibility for the proper care of their visitors.

President Lieb thanked the mayor for his kind words, on behalf of the Institute, and then presented the annual address. This takes up the question of Institute development, dealing particularly with classification of members, and comparing the Institute rules with those of the other national engineering societies. He makes a number of valuable suggestions for raising the standing of the Institute, and suggests a new class of membership for those who have distinguished themselves in their profession, but who are not practising engineers.

At the close of the address Professor W. E. Goldsborough, of New York city, offered resolutions referring the suggestions made to the board of directors. The resolution was seconded by Dr. C. P. Steinmetz, of Schenectady. Calvin W. Rice offered an amendment that the secretary be directed to bring the address to the attention of the board at the first September meeting. The resolution was adopted as amended.

The formal reading of papers was then taken up. Dr. Steinmetz read his paper, entitled "High Power Surges in Electrical Distribution Systems of Great Magnitude." This was followed by a paper presented by Mr. Percy H. Thomas, on "An Experimental Study on Commercial Transmission Lines of the Rise of Potential Due to Static Disturbances Such as Switches Grounding, Etc."

These two papers were discussed by H. G. Stott, of New York; P. N. Nunn, Niagara Falls; S. M. Kintner, Pittsburg; F. A. C. Perrine, New York city; H. W. Fisher, Pittsburg; J. W. Lieb, Jr., New York city, and Dr. Samuel Sheldon, Brooklyn.

Dr. Steinmetz read his paper on "The Constant-Current Mercury Arc Rectifier." This was discussed by J. W. Howell, Harrison, N. J.; Dr. E. F. Northrup, Philadelphia; P. H. Thomas and F. A. C. Perrine, New York city.

During the afternoon carriages were provided which took the guests through Biltmore, the beautiful estate of Mr. George W. Vanderbilt.

MONDAY EVENING SESSION.

In the evening a second business session was held, at which Mr. H. W. Fisher read a paper on "Data Relating to Electric Conductors and Cables." This paper was discussed by H. G. Stott, C. W. Rice, C. O. Mailloux, F. A. C. Perrine and C. P. Steinmetz.

Mr. S. M. Kintner read a paper on "Methods of Measurement of High Electric Pressure," which was discussed by C. P. Steinmetz, Samuel Sheldon, C. O. Mailloux, H. G. Stott, E. F. Northrup and C. A. Perkins.

J. W. Howell read a paper on "Comments on the Remarks Made by Colonel R. E. B. Crompton before the International Electrical Congress at St. Louis." There was no discussion on this paper.

C. E. Waddell read a paper, which was illustrated by lantern slides. W. H. B.

Evening Courses in Electric Transportation.

The Polytechnic Institute of Brooklyn, Brooklyn, N. Y., has announced a series of evening courses in physics and electrical engineering at the Polytechnic Institute, 85 Livingston street, for the season 1905-6. The lectures will start promptly at 7.30 in the evening, with the exception of the course in electric transportation. The fee for the course in electric transportation, including tests, is $15. When taken in connection with the course in transportation offered by the department of mechanical engineering, the fee for the two courses is $25. The fees for the courses are at the rate of forty cents an hour for ten hours or under, thirty-five cents an hour for 100 to 200 hours, and thirty cents an hour for 200 or more hours. The course includes fourteen two-hour lectures and five extensive tests on electric transportations, fifteen lectures on electric train movements, fifteen two-hour lectures on alternating currents, fifteen two-hour lectures and recitations on mechanics and heat, and twenty two-hour laboratory tests on alternating-current generators and motors.

A folder entitled "Where Health and Pleasure Wait" has been issued by the passenger department of the New York Central & Hudson River Railroad Company. The folder is intended to give an idea of the hundreds of places which are served by this system. The folder contains many illustrations of lake, mountain and sea resorts, all of which are easily reached. Copies of this folder will be sent to any address upon receipt of a two-cent stamp, by George H. Daniels, general passenger agent, Grand Central Station, New York city.

Digitized by Google

BOOK REVIEW.

"The Steam Engine." Robert C. H. Heck, M.E., assistant professor of mechanical engineering, Lehigh University. New York. D. Van Nostrand Co. Cloth. 391 + viii pages. 6¼ by 9¼ inches. 188 illustrations. Supplied by the ELECTRICAL REVIEW at $3.50.

The objects of this book are, as stated by the author in the preface, "to set forth clearly the fundamental principles of the steam engine, to give a broad description of constructive practice, to explain fully the working of the machine in its several departments, and to show how to find its efficiency in performance. Manner of presentation and order in development of the subject have been strongly influenced by the fact that it is intended to be a text-book for the use of students; but with this has gone the purpose of making it a complete engineering treatise in which the theory of the steam machine shall be put into a shape convenient of practical application, and which, on the descriptive side, shall lay a solid foundation for the more special and detailed information which must be gained from experience and from the technical press." The author proposes to present the subject in two volumes, of which this is the first. He takes up in order a general view of the subject, including the steam power plant and a description of typical high-speed engines. Immediately following the description of the engines is a treatise on the elementary thermodynamics of the heat engine. The ideal heat engine is described, and the theory of the steam engine is next taken up. The theory of the steam engine includes a discussion of steam constants and relations, the different states of steam, including a short discussion on superheated steam and the adiabatic behavior of steam. Following this the Carnot cycle is introduced and a comparison of the Carnot cycle with the actual cycle of the steam engine is made and the differences of the two are clearly shown. The limits of the performance of the steam engine with saturated steam are mathematically discussed and a table of limit values for non-condensing and condensing engines is given. The results shown in this table are much better than those which can actually be secured in practice. Following this the indicator diagram is taken up and numerous comparisons are made with the ideal diagram of the engine and the different effects of compression, cut-off, clearance, etc., are discussed. There is also a very thorough treatise on the effects of cylinder condensation; formulæ are derived and tables are given which are both calculated from formulæ and derived from the results of tests on actual engines. The economy of the steam engine is well taken care of and the various effects due to differing constructions are shown. This includes a discussion of compound engines, the effects of steam jackets and of reheating steam in the receivers of compound engines. Diagrams of compound engines are given, and the methods of combining and calculating the steam per horse-power-hour are well shown. Chapter v, comprising seventy pages, is entitled "The Dynamics of Steam," and treats of the steam jet. Numerous curves and tables are given in this connection, and the form and influence of the nozzle and the determination of the adiabatic jet and the effect of conditions beyond the nozzle are shown. The latter part of the chapter deals with the applications of the steam jet, *viz.*, the throttling calorimeter and injector, together with a very short discussion of the steam turbine. Chapter vi discusses the entropy-temperature diagram quite fully and clearly. Chapter vii deals with the mechanics of the engine and takes up forces existing in the different parts of the engine and their various effects. A very thorough discussion of the kinematics of the engine mechanism is given and the discussion is both mathematical and graphical in character. The determination of crank effort from the indicator cards is shown very clearly and the effect of flywheels is well treated. The latter part of the chapter deals with the construction and efficiency of the engine and counterbalancing. There are two appendices to the book, the first consisting of steam tables and tables of other constants. The second appendix is a short discussion of the properties of superheated steam. The author has adopted what seems to us an unfortunate arrangement of the book in several respects, and to have erred in the introduction of new terms to take the place of old and thoroughly established ones. For instance, he speaks of the "steam-force" acting on the piston and the "force-action" of the engine. He also uses the term "stroke line" in place of the generally accepted one "centre line." The arrangement may be criticised in introducing thermodynamics so early in the work (the second chapter) and the interjection of the chapter on the steam jet in the midst of the discussion of the steam engine. This might more properly have been placed more toward the end of the book. In some cases the discussion is rather incomplete. In one place the author states that it is necessary to go through quite a complex analysis in order to determine the forces on the bearings and the stresses on the shaft of the side crank engine. The analysis is not given and the reader is left in doubt as to what method is to be followed in order to determine these stresses. After a formula is derived, very often its application is not shown. On the whole, however, the book is well written, the theoretical discussions in most cases being supplemented by graphical demonstrations and in many cases being illustrated by numerical examples. In our opinion, however, the book would have been improved if the various deductions drawn had been illustrated by examples of constructions in actual use in modern practice. This is particularly true of the discussion on counterbalancing. This discussion is quite long and very thorough, but the application of the various formulæ derived is not given nor are any of the modern systems of counterbalancing spoken of. The book is entirely too heavy for use as a text-book for students whose ideas on the subject are at first necessarily vague, and it would be improved for their use if more profuse illustrations from practice had been given. The book, however, is a good reference book, and is well worth placing on the shelves of the engineer's library. The author proposes to make the second volume a treatise on the performance and design of the engine, and states that he will take up the quantitative and synthetical side of the subject, giving a digested result of the large number of tests now available in works of reference and setting forth methods of engine testing. He also proposes to develop as far as possible a logical scheme of design, especially of the thermodynamic design of the engine. It might be advisable that he should correct in the second volume such errors of omission as have occurred in the first.

Electric Tramways in Lima.

A contract has been entered into between the Ferrocarril Urbana de Lima and the provincial council, substituting the overhead trolley for horse traction on all the street railways of Lima (about sixteen miles in extent). The new system is required to be in operation within two years from the signing of the contract. A new company, representing American and local capital, has succeeded the old one, and the electric and other new material is being ordered from the United States.

Digitized by Google

CAN A STEAM TURBINE BE STARTED IN AN EMERGENCY QUICKER THAN A RECIPROCATING ENGINE OF THE SAME POWER.[1]

BY A. S. MANN.

If a large steam turbine is cold and at rest how quickly can it be started? Can it be brought up to speed as readily as can a good cross-compound engine that is cold all over?

Most station men would have doubts as to the adaptability of the large turbine, say 1,500 kilowatts or 2,250 horse-power, for emergency work. So much has been written about the sensitiveness of a rotating disc to the changes of temperature and the effects of unequal expansion that it is easy to imagine difficulties in the rapid start. The possibilities of an engine with a sixty-two-inch low pressure cylinder in starting practically cold and coming up to synchronous speed are well understood. A station manager would criticise an engineer who would open his throttle as fast as he dared without wrecking his piping system and let his machine jump into her work. One turn at a time on the throttle is about all that is considered safe, and even then a close watch is kept for groaning valves and cold back bonnets.

Every time the starting valve is moved to increase the steam flow the engine is allowed to take its full increment of speed, due to that particular throttle position, before the supply valve is moved a second time. There are ten large oil cups, and frequently more, that must be opened and adjusted before the machine moves at all, besides whatever oiling is to be done about the air pumps and other auxiliary apparatus.

This question makes itself very prominent when the steam station is operated as an auxiliary to a large source of high-tension power, which is itself in the construction stage and has a large overload capacity of its own to carry, supplying all sorts of apparatus that use electric power, railway, lighting and power circuits simultaneously.

At such a time all sorts of accidents will happen to the high-tension water-driven plant, most of them due to the necessarily temporary character of many of the electrical connections. It takes months before an intricate system of wiring can be thoroughly relied upon, for it takes months before the temporary work of construction can be replaced.

The station at present under consideration is equipped with three Curtis turbine-driven alternators, forty cycles, 10,000 volts, each of 1,500 kilowatts normal capacity. During the summer months the station is operated as an auxiliary to a water-power plant, taking all sudden overloads.

A signal has been arranged, a three-fourths-inch whistle, so that it can be blown instantly should the power fail. A blast of that whistle means—cut in two turbines and bring the third up to speed. The load will be heavy, and all auxiliary apparatus must be in regular operation.

Each turbine has a surface condenser and there are three or four pumps to be started for each pair of turbines; one circulating pump, one combined hot well and feed pump, one pressure pump for the step bearings and one dry air pump, all of which are motor-driven. The exciter is driven by a steam engine and must be started also, for it supplies current to a portion of the auxiliary apparatus.

The boiler room has steam up at all times, supplying a system for manufacturing purposes other than power, and slow fires are kept in enough boilers to make steam needed for the normal load. Forced load means forced fires. The boilers have underfeed stokers, equipped with pressure blast, and will respond quickly to a fifty per cent excess call for steam. The operating force for this is about equivalent to a force for an engine-driven plant. Engineers and oilers, however, are busy about the building on construction work, installing new apparatus and taking such work as their regular occupation when the turbines are not running.

At the sound of the whistle the water tender starts a blower on the extra row of boilers: all blast dampers are opened up and all stokers are allowed to feed at the maximum rate. Each fireman dumps his free ash and bars over his red fire.

The man in charge of the coal and ash conveyer starts the pressure pump for step bearings. One of the turbine men starts the exciter which supplies current to the auxiliaries beside its field current; a second turbine man starts the circulating pump and then his turbine. The hot well pump and the air pump are started by the oiler. These movements take place simultaneously. The force is organized upon the lines that obtain in a fire station; each man has his specific duty, and after performing it looks to see that there is nothing more for him to do. Only a few seconds elapse between starting the first pump and starting the first turbine.

The turbine throttle is opened as fast as an eight-inch steam valve can be opened without endangering the steam piping system. It is not considered advisable to open the throttle valve as fast as a man's strength will permit; but if nothing unusual occurs in the pipe line, sentiment does not spare the turbine.

One electrician attends to the switchboard and telephone. As soon as the machine approaches speed, the synchronizing system is cut in and the main switches are got ready. One and one-half minutes will do all the work here outlined, including the time taken in mustering the crew from various parts of the building, itself not a trivial matter.

Manipulating an engine regulator so that it shall be at a precise speed and at an exact phase relationship from some other machine, not more than 1-1500 part of a second removed from it, is no matter that can be hurried, and one minute is fast time on such work. But the whole thing, phasing-in and all, has been done in two and one-half minutes, including full load on the turbine, which started from a standstill.

This performance has been gone through a great many times, and our record book shows that out of forty-three such calls, ten starts were made in two and one-half minutes, eighteen in three minutes and fifteen in three and one-half minutes.

We have taken the time in a number of instances when all the auxiliaries have been in motion and it only remained to start the turbine and phase it in on the line: the only valves to open in such cases are the throttle and one small oil valve. The two quickest starts have been made in forty-five seconds and seventy seconds, respectively, including phasing-in. Others range between one minute ten seconds and one and one-half minutes. These two quickest starts were made on a turbine which had stood for twenty-four hours with the throttle valve shut tight, though there was a slight leakage past the seat. After the throttle valve is off its seat it is not more than thirty seconds before the turbine is up to speed. A cross-compound reciprocating engine of the four-valve type, 2,250 horse-power capacity, can be brought up to speed from a standstill in five minutes if it is hot all over. This five minutes is to be compared with the seventy seconds required for the similar turbine operation.

A reciprocating engine, which is turning over slowly with the throttle valve just off its seat or with by-pass open and having all its oil cups open and regulated, can be brought up to speed, say seventy-five turns, in two and one-half minutes. This can be compared with the thirty seconds necessary for bringing the turbine up under the same conditions; that is, about one-fifth the time necessary for bringing up the engine.

If the engine is cold all over and has all its oil cups shut tight, all its auxiliaries quiet, fifteen minutes is called a rapid start. Starts have been made under such conditions in twelve minutes. When we start a cold turbine, we open up the valve and let her turn, and in two minutes we are ready to bring her up to speed and she will be at speed in two and one-half minutes, dividing the engine's time by more than four.

[1] Paper presented at the Scranton meeting, June, 1905, of the American Society of Mechanical Engineers.

Digitized by Google

FUNDAMENTAL FEATURES OF ELECTRIC ELEVATORS.

BY E. R. CARICHOFF.

It is probable that eighty per cent of the elevators installed in the United States every year are electric, and of these practically all are of the drum type; in this type, the elevator car is raised and lowered by winding or unwinding wire ropes on a grooved drum, which is revolved slowly by an electric motor through worm gearing encased in an oil reservoir.

The machine is usually placed at the bottom of the shaft with the drum extending slightly into same, so that the ropes may be led up the sides to sheaves supported on framework overhead and thence to the car which moves between wood or steel guide rails.

The car, consisting of its cage and framework, owing to various conditions of size, load and specifications, may weigh from 1,500 to 3,500 pounds empty; and ordinarily part of its weight is balanced by masses of iron which may be as much as two-thirds the weight of the car.

These counterweights are attached to the end of ropes leading from the car over sheaves at the top of the shaft, and are held securely in a frame which moves in separate guide rails.

Care should be taken that the counterweight frame shall bottom before the car reaches the overhead works, and it must also be provided that the car shall rest on its buffers at the bottom of the shaft before the weights reach the framework overhead. Lack of care on this point and absence of a properly protecting frame for the weights may result in the falling of the weights upon the top of the car.

The weight on the hoisting ropes tends to rotate the drum and produces an end thrust on the worm shaft which is usually taken on ball bearings.

As the car ascends, the unbalanced weight, the live load, and friction load must be overcome by the motor; as the car descends the weight tends to turn the motor in the opposite direction and to make it a dynamo, delivering current back to the source of supply.

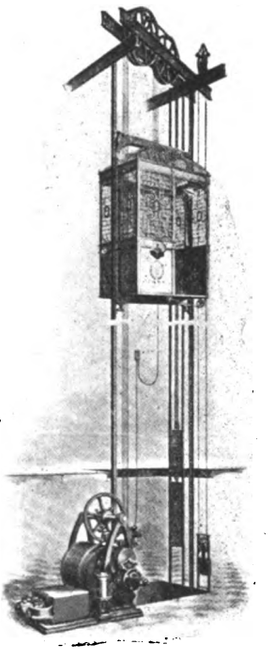
The maximum current that may be generated by a given weight on the drum descending and driving the motor through worm gearing as ordinarily used, is about one-third as much as will be required by the motor to lift the given weight under the same conditions.

With efficient gearing a load of 1,000 pounds can usually be made to start and drive the motor as a generator.

If the motor be supplied with current through a variable resistance on the up-motion and short-circuited through a similar resistance on the down-motion, it is evident that any speeds from zero to maximum can be obtained either up or down.

This gravity method of control is used on the Sprague-Pratt screw machines and corresponds to the method now used for operating hydraulic elevators, but it is not used on drum elevators.

If an unbalanced weight of 1,000 pounds is required to bring the car down, this amount plus the live load in car must be lifted when the car goes up. This requires a larger hoisting machine, a larger motor and a greater maximum current than are necessary when what is known as the overbalanced method is used.



TYPICAL ELECTRIC ELEVATOR.

In the overbalanced system a set of ropes is anchored to the drum and wound in a direction opposite to that of the car ropes, and to the end of these ropes is attached a mass of cast iron called the drum counterweight. As the two sets of ropes move in opposite directions, one set is wound into the grooves left free by the unwinding of the other set.

The drum counterweight usually exceeds the unbalanced weight of the empty car by an amount equal to the average load to be lifted in the car, so that with this load in the car the machine is balanced and the current taken by the motor is the same for both directions of travel.

To get the maximum lifting capacity in the car, the drum counterweight is made to exceed the unbalanced weight of the car by one-half the maximum load.

For example, suppose the motor is capable of driving against a pull of 1,000 pounds on either side of the drum. With an excess counterweight of 1,000 pounds and the car empty, the motor does its maximum duty as the car descends. With 2,000 pounds in the car, the excess of 1,000 pounds is on the other side of the drum, and the motor does its maximum duty as the car ascends. In this way it is possible to take in a car a weight twice as great as the machine would be able to lift if this weight were suspended from a rope around the drum and no counterweights were used.

The gravity system would require the motors to lift 2,000 pounds plus the down driving weight of 1,000 pounds or 3,000 pounds total in one direction.

With an overbalanced system the excess pull is sometimes on one side of the drum and sometimes on the other, as the loads vary, and the thrust on the worm shaft must be taken in both directions by properly constructed thrust bearings.

If the car and its load are just equal to the total counterweight, it is evident that the motor will require in either direction, up or down, the same amount of current, and that this is only what is sufficient to overcome the inertia of the mass and the friction when starting, and while moving to overcome the friction of moving parts in the hoistway, to bend the ropes, and to provide for the electrical and mechanical losses of the hoisting machine. With more load in the car the current going up is increased and the current going down is decreased. With still more load in the car the down current may become zero or the motor may have to act as dynamic brake to prevent excessive speed.

As an extreme illustration the following proposition may be true of a group of efficient machines making long runs and connected to the same source of supply.

Suppose there are six elevators which run two-thirds of the time and stand idle one-third of the time. Assume that two are ascending fully loaded, two descending fully loaded, and two are standing. Under such conditions the two descending cars may generate enough current for one of the machines lifting its full load, and only one machine remains for which it is necessary to supply current. Thus for running conditions the six elevators require a generator of sufficient capacity to supply only one elevator taking its maximum load current. The larger the plant

Digitized by Google

the nearer the assumed running conditions may be attained.

Owing to the fact that overbalanced drum machines, on account of variations of load, may take or return current in either direction of travel, the motors are best connected through a controller to constant potential mains and run at fixed speeds determined by the shunt winding, the strength of which may be changed to give several speeds ranging from the maximum to one-half of it.

Evidently a machine under such varying conditions of load which takes more or less current or returns more or less current can be regulated and kept within safe limits on a constant potential circuit only by a shunt motor.

It is also evident that the speed of a motor operating as aforesaid can not be regulated by varying the resistances in the armature circuit independently. With no resistance in circuit the speed will not differ much whether the maximum load is being lifted or lowered, and this speed may be called the normal full speed. But with resistance in circuit the speed on the first resistance point is lowest with maximum load up, and the speed on the same point is highest with maximum load down. Under the latter conditions the car shoots down rapidly, at a speed much above normal, and slows up to full normal speed as the resistance is reduced to zero. Therefore devices that pretend to give variable speeds by variation of the armature resistance are deceptive and may be even dangerous.

An elevator starts and stops so frequently that the total energy per day consumed in starting may be 100 per cent or 200 per cent greater than the energy consumed while running.

The friction of worm gearing when starting is much greater than when running, the inertia of the moving parts must be overcome during acceleration, and to meet these conditions the motor must be capable of great starting effort. With a given field-strength the necessary torque may be produced by a large armature current. Half of the energy of this current is wasted in heating the starting resistances. If, however, the field-strength of the motor is doubled, only one-half as much armature current is needed and only one-quarter as much energy is wasted in the starting resistance. Besides, owing to smaller fluctuations of current there is less disturbance produced in the line potential, which is very important under certain circumstances.

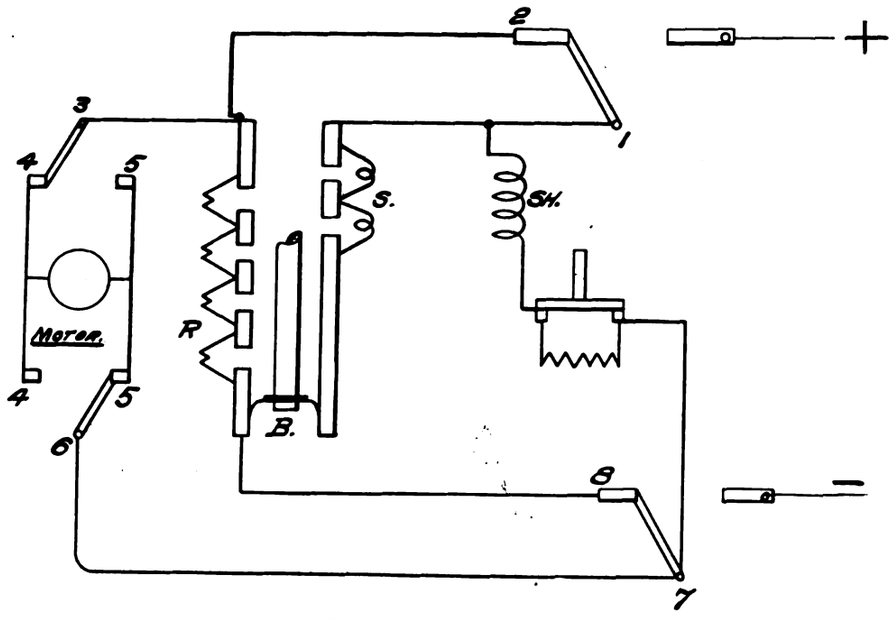


Fig. 2.—Motor Circuits.

Therefore, it is desirable to have for drum elevators a motor with a wide field variation—not less than two to one and more if possible.

The field of the motor should not be kept excited when the elevator is standing on account of the waste of current. If the excitation is begun at the moment of starting through a shunt winding, some seconds may elapse before full strength is attained. In the meantime the armature takes excessive starting current with the attendant losses and disturbances. The best results are obtained by using a strong series field at the moment of starting, and this must be cut out when full speed is attained of the car descending with a heavy load will run away.

Evidently all devices to remove resistance and series field-windings from the circuit must be controlled by the motor as it comes up to full speed, and not by some independently operated device, in order to guard against unsafe speeds and prevent the car from being wrecked at one end or other of its travel.

It has been stated that a full load descending will drive the motor and supply current to the line. Now, in order to stop this load promptly and smoothly, the motor must be turned into an electrodynamic brake to assist the friction brake. Ordinarily the current generated can be returned to the line only by strengthening the shunt field.

This variation should be such as will slow the car to half speed.

To make a full stop, the motor must be disconnected from the line and turned into a self-exciting electrodynamic brake.

Some machines are stopped by the friction brake only, but this method is not satisfactory.

Some have the armature circuit closed through a resistance and depend upon the residual field for generating a braking current.

Some retain a small field current at all times. But this is objectionable on account of the waste of current which may in extreme cases amount to as much as the total current otherwise required.

Another advantage of the self-exciting electrodynamic brake appears when the friction brake fails from any cause.

Indeed, it is well to specify that an elevator for medium and large loads and fast speed shall be able to run and stop and start in either direction, and with any load, with the friction brake held off, as this quality adds an important element of safety.

The movement of the operator's handle in the car should meet with immediate response at the controller, so there will be no delay or sluggishness in starting or stopping.

The time of acceleration may be three seconds or less. The first rush of current should start the machine to prevent loss of time and waste of current in the resistance. Since the machine will attain full speed more quickly under one condition of load then another, it is obvious that the controller should act automatically to meet the varying requirements.

The starting resistances should be removed at a rate proportional to that of acceleration, and, as before stated, the series field must be removed before full speed is attained, or in cases when the machine generates current the series field will act in opposition to the shunt field and excessive speed will result.

With proper attention to the principles given very satisfactory results can be obtained for starting, running and stopping, including changes of speed from full speed to one-half speed, when overbalanced drum elevators are connected to constant potential circuits.

Limit switches should be operated by the machine to slow down before reaching the extremes of travel and to disconnect the motor and convert it to a self-exciting electrodynamic brake and to drop the friction brake at the extremes of travel.

Digitized by Google

The New Electric Locomotive for the Valtellina Road.

ON OCTOBER 15, 1902, the Southern Italian Railway asked for bids on a four-axle electric locomotive for the Valtellina road, in which gears should not be used. Ganz & Company, having in mind the success of the direct-connected type of locomotive in which the driven axles pass through the hollow shaft of the rotor, and in which the driven wheels are connected to the rotor by links, suggested this type. In the course of the correspondence, the Rete Adriatica proposed that the motors be placed between the pairs of axles, and that the axles be driven by means of connecting rods and coupling rods.

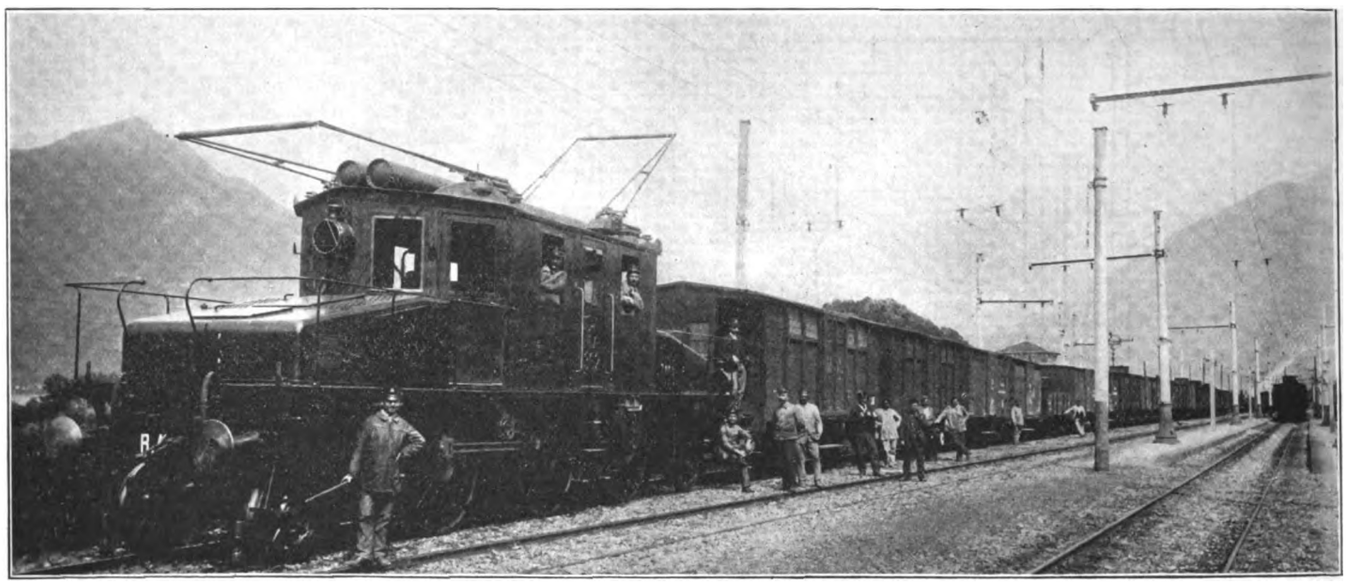
However, before this wish had been expressed, Ganz & Company had already under consideration this method of driving, which, in fact, had been suggested by Herr Carl Gölsdorf, superintendent of construction of the Austrian railway department, who had looked into the Valtellina system, and who objected to the method of driving because of the difficulty of getting at the links, and because the construction of that type was troublesome. The system of driving suggested was worked up by Herr Kandó, with some modifications. Kandó placed the central line of the motors above that of the axles by a distance equal to the length of the driving cranks, and this design was accepted by the Rete Adriatica, which ordered three locomotives of this type from Ganz & Company.

It was required in the specifications that the weight on the leading axles should not be more than ten tons, and on the driving axles, more than fourteen tons. Further, two running speeds were required: one of from thirty to thirty-five kilometres per hour, and one of from sixty to seventy kilometres. At the first, the drawbar pull was not to be less than 6,000 kilogrammes; at the latter, not less than 3,500 kilogrammes, measured at the periphery of the wheels.

The locomotive is carried on two four-wheel and one two-wheel trucks. The four-wheel trucks are at each end of the locomotive and each consists of a pair of driving wheels and a pair of leading or trailing wheels, as the case may be. The four-wheeled trucks are swiveling. This construction has been tried by the Southern Italian Railway in twenty steam locomotives, which have been found to take easily the sharpest curves and run quietly at the highest speeds. The construction of the mechanical part of the locomotives was done at the shops of the Hungarian State Railway in Budapest, and the electrical equipment was made by Kolomann von Kandó at Ganz & Company's factory.

In the view of the completed locomotive, it will be seen that the two motor cranks are connected together by a side bar which drives the crank of the central axle. To this side bar the cranks of the two outer driving wheels are connected by side bars. The crank-pin box of the central axle is allowed vertical play in the motor connecting-rod head because the motors are spring-suspended. The crank-pins of the motors have spherical bearings, on account of the play allowed. All three of the driving wheels are equipped with Westinghouse air-brakes, and the locomotive is provided with a Brüggemann compressed-air track sander. The cab is constructed entirely of sheet iron, and has two side doors and two doors at each end, by means of which communication is had with the train.

The collecting device designed in 1901 for the first locomotive has proved so satisfactory that but slight changes have been made in it. To increase its rigidity, the porcelain insulators supporting the base of the collector have been replaced by cast-iron stands lined with porcelain. The collecting roller consists of two metallic cylinders mounted on the same spindle, but insulated from each other. The carbon contacts have been increased in cross-section on account of the larger size of the locomotive and the heavier currents which must be handled. The collecting device is elevated by means of a dashpot filled with glycerine, into which compressed air is admitted. The pressure of the collector on the wires is controlled by means of an air cylinder containing two pistons. When the locomotive is standing still or moving at the lower velocity, air is admitted to one of these pistons, which is driven forward until it comes up against a stop, thus forcing the collector against the wire with a definite pressure. When the speed of the locomotive is increased, air is admitted automatically to the second piston, which

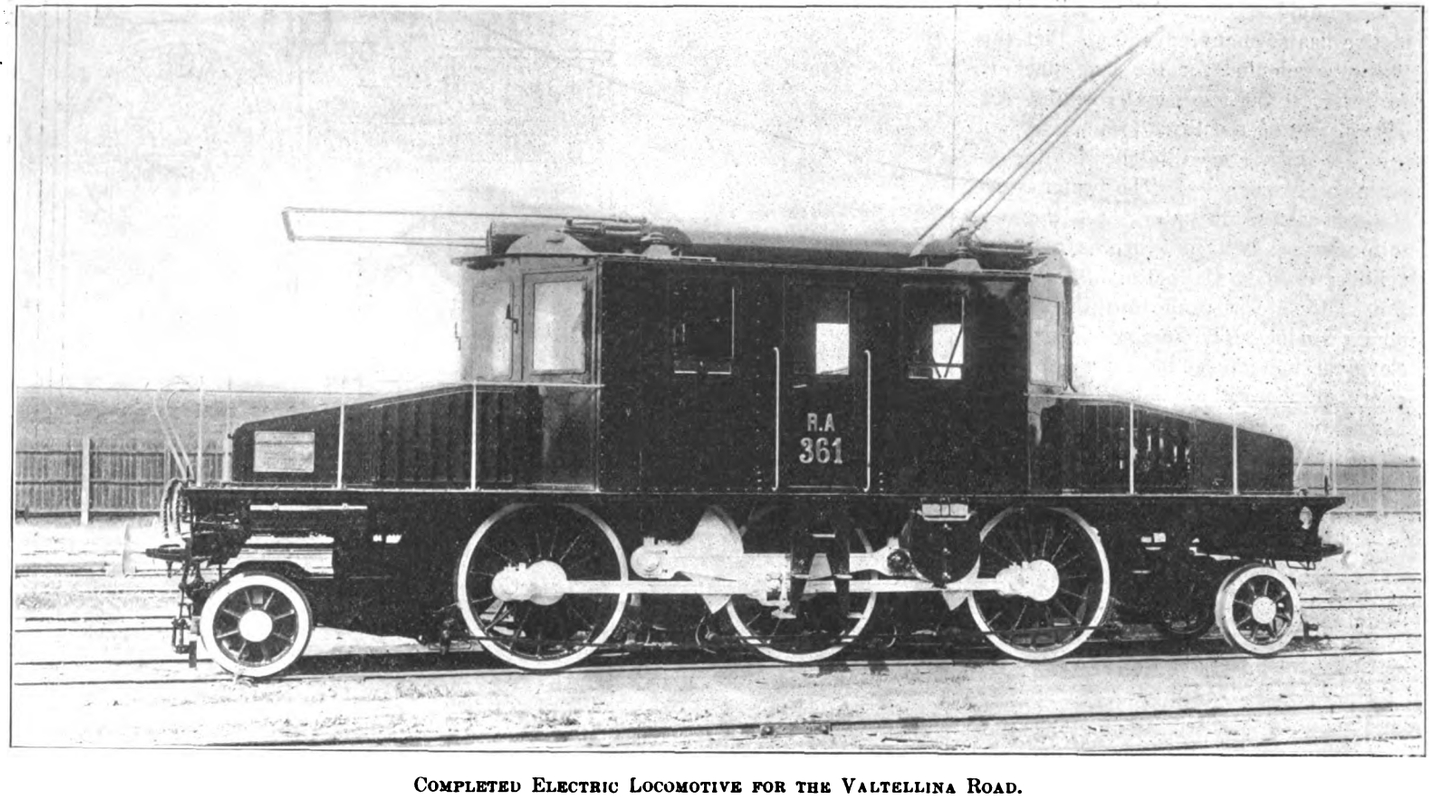


NEW ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD, WITH TRAIN.

Digitized by Google

thereby increases the tension on the controlling springs and thus presses the collecting cylinders against the wires with increased force. When the collector is lowered, it automatically opens a knife switch, which disconnects it from the wiring within the car, thus making it safe to handle.

The position of the collectors is controlled by a five-way air cock mounted in the cab. With this handle placed at right angles to the axis of the locomotive, both collectors are down. Throwing it forward through an angle of fifty degrees raises one collector (the locomotive has two, one at each end). Throwing this handle backward through an equal angle raises the other collector. If the handle be thrown through ninety degrees either way, both collectors are raised against the wires.



COMPLETED ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD.

The locomotive is equipped with two motors. Each is a double machine having high-pressure and low-pressure rotor and stator windings. Some details of these motors were given in the ELECTRICAL REVIEW for February 25, 1905, page 322. Each double motor is contained in one housing. Each stator is supported by four rods with spiral springs between the heads and the stator lugs. The rotor is held central by self-oiling bearings in the stator, but there is no force exerted on these bearings other than that due to the weight of the rotor. For convenience of inspection, the rotor slip rings are supported by a return crank outside of the driving crank. The wires from these rings are led into the rotor through an opening in the return crank, through the hollow crank-pin, back through the driving crank and the hollow shaft. This arrangement, in addition to its convenience for inspection and repairs, enables the entire space within the truck to be devoted to the motor proper, making possible the use of a larger machine than would be the case were the slip rings placed between the rotor bearings. The brushes are of carbon, and are carried on a frame supported from the motor axle. This frame and the slip ring are enclosed in a sheet-iron housing, which is opened along a central line, swinging both ways, leaving free access to the brushes and rings. The windings are carefully insulated, it being required that they be submitted to a testing voltage five times the normal. They were tested at 15,000 volts.

The specifications required that the locomotive should develop 800 horse-power when running at sixty kilometres an hour and that it should develop 1,200 horse-power for one hour, and 1,600 horse-power for a short time. Another requirement was that the locomotive should bring a 400-ton train up to thirty kilometres an hour in fifty-five seconds on a straight track with a grade of not more than 0.1 per cent. It should also bring a 250-ton train from rest to sixty kilometres an hour in 110 seconds on the same grade. The locomotive should drag a train of 250 tons up a two per cent grade, and bring it to forty kilometres per hour. These performances should be obtained with a line voltage of 2,700.

The motor, the rheostats and all the electrical equipment were required to operate without mishap, and without excessive warming, thirty successive times when drawing a 400-ton train, there being a period of two minutes between each application of the power. This test was to be made on a curve with a radius of 180 metres, and a grade of three per cent. An overload of 100 per cent must be supported for 200 seconds without any part breaking down or the temperature rising more than forty degrees centigrade above that of the surrounding air. The temperature rise while supporting an overload of fifty per cent must not be above that just mentioned. It was required that a test should be carried out in the laboratory, in which the motors should be operated at full speed for ten hours without the temperature of the windings or any other part rising more than sixty degrees above that of the surrounding air; and at the conclusion of this test the insulation should be tested with a voltage of 10,000.

The high-potential switches of the previous locomotive had proved satisfactory,

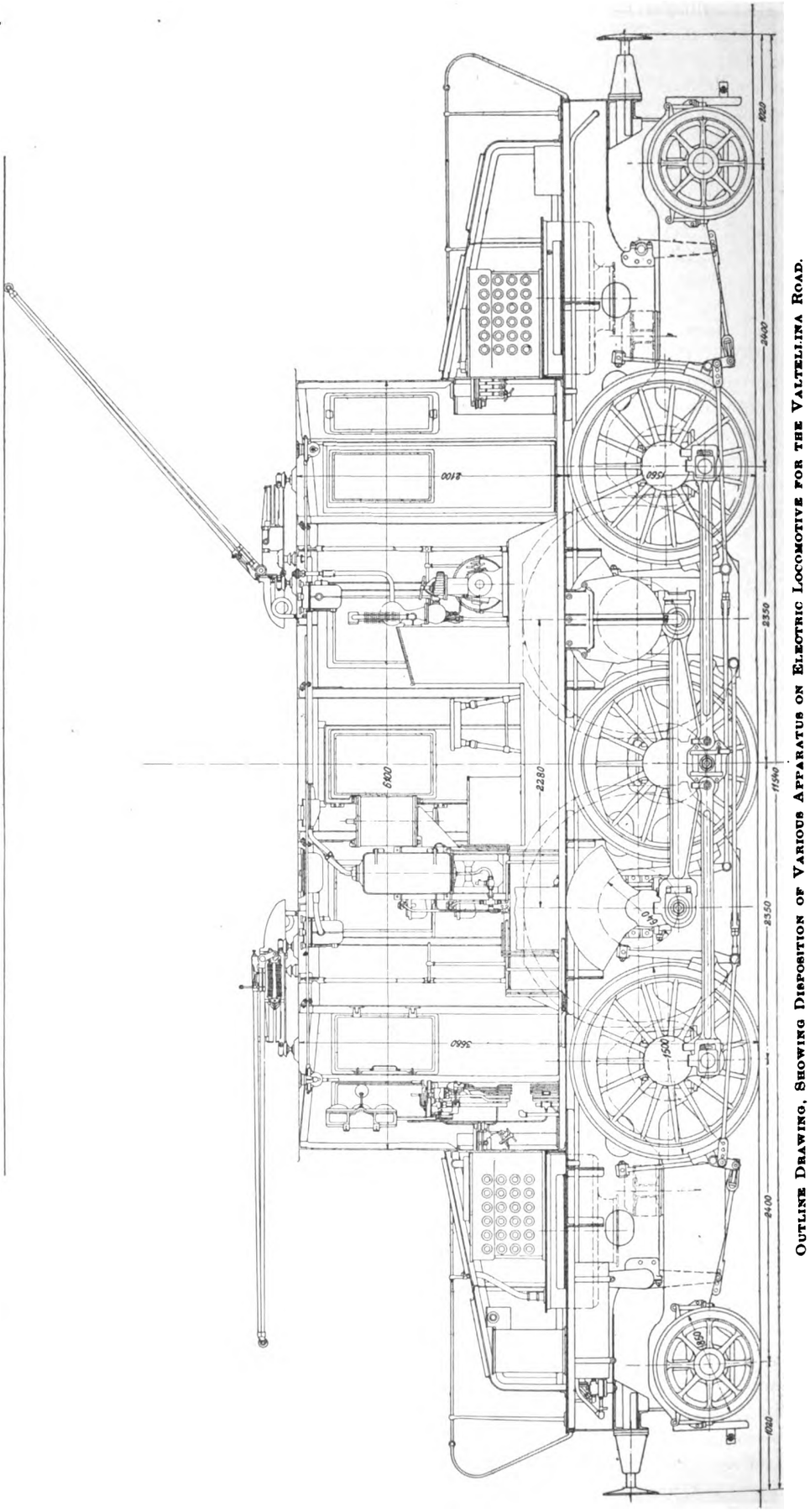
Digitized by Google

so that the same type was adopted for this one. This is a plunger switch consisting of three double-break plunger switches arranged in the form of a hexagon around the operating rod. They are opened or closed by air pressure, and there are, in addition, two small air cylinders which serve to revolve the switch through sixty degrees. This motion which is controlled by a small lever in the cab reverses the direction of rotation of the motors. The low-potential switch is also operated by compressed air. In this the contacts are made by means of brass springs.

The liquid rheostat of the earlier locomotive has so many advantages that this type was adopted for the new machine. However, at the request of the Rete Adriatica, one of the three locomotives was provided with a metallic rheostat for experimental purposes. The water rheostat consists of an outer sheet-iron containing-vessel, within which is a second cylinder open at the bottom. The rheostat plates are suspended within this inner cylinder. The outer cylinder is closed at the top, and compressed air is admitted above the liquid. This forces down the surface of the liquid in the outer vessel so that it rises within the inner and establishes a circuit between the three electrodes. The higher the surface of the liquid within the inner cylinder, the lower the resistance; and when the level liquid has reached a definite point, the rheostat is automatically short-circuited by a metallic switch.

The rate at which the liquid rises within the inner cylinder of the water rheostat is governed by a controlling valve, which is regulated by the current flowing into the motors. The air supply to the rheostat is controlled by a double diaphragm valve, to which air is admitted inside and outside. There is, in addition, an electromagnet which controls the opening of the valve. When the master controller handle is moved through one notch, this valve is opened and air admitted, at a rate depending upon the load, to the water rheostat. The water then rises until a definite position is reached, when it stops. Further movement of the controller handle admits more air, and raises the level of the water again and so on until the rheostat is short-circuited.

The metallic resistance is built of a number of small units suspended so as to allow free circulation of the air. This rheostat is controlled by a series of brushes and contact points, the latter being arranged cylindrically around the spindle on which the brushes are mounted. The overload switch is controlled by an electromagnet which operates a valve in the air pipe. At the time that this switch acts the water is driven out of the inner cylinder of the rheostat, the main circuit is opened.



Outline Drawing, Showing Disposition of Various Apparatus on Electric Locomotive for the Valtellina Road.

The master controller for the two locomotives equipped with water rheostats

Digitized by Google

has three handles. One controls the direction of motion, one operates the rheostat, and the third changes the motors from cascade to simple connection. When running in this way the low-potential motor is cut out, and the connections from the high-potential motor are short-circuited. The master controller for the metallic rheostat has two handles and a hand wheel, the latter for operating the rheostat switch. The air pump for the older locomotive was objectionable on account of the noise. In the new type this has been overcome by means of a cylindrical slide valve. The compressor operates quietly. It is automatically controlled by means of the pressure in the air tanks.

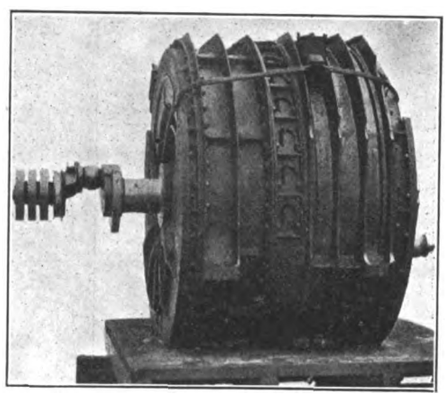
The lightning arrester is formed of a number of small spark-gaps connected in series with the high resistance. The whole is mounted on porcelain and enclosed in a cast-iron box.

In starting the locomotives, if there is no air in the air tanks, a valve in the pipe leading to the collectors is closed, and by means of a small hand pump, air pressure is supplied to the air cylinder of one of the collectors, thereby bringing it in contact with the trolley wire. As soon as this is done, the air-compressor motor may be started, and when the pressure in the tanks is sufficient, the valve may be turned to the normal position.

In general, when the locomotive is to be started, the first operation is to open the air valve, which brings one collector into contact with the overhead wire. Next, the handle controlling the direction of motion must be thrown, and, last, the handle controlling the supply of current to the motors. This is moved around step by step, each step corresponding to a definite height of liquid in the water rheostat. When the last step is reached, the rheostat is short-circuited. The next step is to bring this handle back to the zero position, and to throw the handle which cuts out the cascade connection of the motors. Then the process is repeated.

During the trials, the locomotive dragged a train weighing 286 tons, first up a 1.24 per cent grade, then up a 1.36 per cent grade, and finally up a 1.7 per cent grade, at a velocity of sixty kilometres per hour, developing at this time 1,464 horse-power. While drawing a 250-ton train up a two per cent grade, the drawbar pull was 6,000 kilogrammes, and the tractive effort at the periphery of the wheels, 8,000 kilogrammes—that is to say, the tractive effort was nineteen per cent of the traction load. In one case the tractive effort at the drawbar was 9,000 kilogrammes, which is computed to be equivalent to 12,000 kilogrammes at the periphery of the wheel. This is equivalent to 27.8 per cent of the traction load of the locomotive.

An interesting comparison was made between this locomotive and several high-duty steam locomotives belonging to the Rete Adriatica. These vary in total weight from 92 to 108.55 tons. The electric locomotive complete weighs sixty-two tons. The tractive load of the steam locomotives varies from 42 to 43.5 tons; that of the electric locomotive is forty-two tons. It is computed that, with velocities of thirty-one kilometres per hour, the available drawbar pull of one of the larger steam locomotives will be 350 tons on a one per cent grade, and 152 tons on a two per cent grade. The electric locomotive, on the same grades, will give 460 and 250 tons, respectively. At velocities of sixty-four kilometres per hour, the same



MOTOR FOR ELECTRIC LOCOMOTIVE FOR THE VALTELLINA ROAD.

steam locomotive gave drawbar pulls of 207 and sixty-eight tons on one and two per cent grades, respectively. The electric locomotive would give 270 and ninety tons under the same conditions. The difference in favor of the electric locomotive, therefore, varies from thirty to sixty-four per cent.

This locomotive was constructed for hauling passengers and express matter—not for freight. On this account it was necessary to add the two pony trucks to secure quiet and safe running. Had the locomotive been designed for freight, a fourth driven axle would have been supplied in place of the two pony trucks. If the locomotive had been constructed on this plan, the traction load would have been fifty-six tons, and, assuming an adhesion coefficient of twenty per cent, a drawbar pull of 11,000 kilogrammes would be obtained.

COUNTERWEIGHTS FOR LARGE ENGINES.[1]

BY D. S. JACOBUS.

The writer was called upon to investigate the problem of lessening the vibration of the engines at the new power plant at the Manchester street station of the Rhode Island Company, Providence, R. I., and working conjointly with Mr. Fred N. Bushnell, the chief engineer of the company, he recommended that certain counterweights be added in addition to those already on the engines. These counterweights which were exceptionally large were adopted and gave satisfactory results.

In addition to the problem of lessening the vibrations certain electrical problems arose regarding the effect of the counterweights in increasing the variation in angular velocity of alternating-current generators run in parallel with each other. A number of measurements were made to determine the action of the counterweights, both as affecting the vibration of the building and the tendency of the alternating-current generators to break apart when run in parallel.

The counterweights were applied to three engines, all of which were of the same cylinder dimensions and had the same weights of reciprocating parts. The engines were built by the Filer & Stowell Company, of Milwaukee, Wis., and were of the horizontal cross-compound type directly connected to electrical generators. Two of the engines, designated as Nos. 1 and 2, were connected to 1,500-kilowatt alternating-current generators, and one, designated as No. 3, to a 1,600-kilowatt direct-current generator.

After inspecting the plant the writer constructed an apparatus on the principle of the seismograph for measuring the amount of vibration. On a second visit to the plant the horizontal shake of the foundation was measured with this instrument with engine No. 3 running, and found to be 0.01 inch at the engine. This may not seem to be a large amount, but as the entire mass of the building foundation shook, the movement of parts of the temporary wooden building was magnified in many places so as to be very evident to the eye. Furthermore the ironwork of the boiler house shook considerably. That the entire mass of the foundation shook could be appreciated by feeling the vibration through the feet and also by measuring the actual amount at different points

[1] Abstract of paper presented at the Scranton meeting, June, 1905, of the American Society of Mechanical Engineers.

Digitized by Google

with the special apparatus. At a point near the extreme end of the foundation where the No. 1 engine was located the foundation was found to shake 0.008 inch. Measurements made near the top of the chimney, which was then erected to the height of about 175 feet above the ground, showed that the maximum shake with the engine running at its ordinary speed of ninety revolutions per minute was about 0.02 inch. After measuring the vibration of the chimney with the engine running at its ordinary speed the engine was shut down and a marked result took place when its speed fell in harmony with the time of vibration of the chimney. When this occurred, the chimney shook to such an extent that the motion was beyond the range of the special instrument. The total movement of the pointer of the instrument was such that the chimney was shown to move more than one-eighth of an inch.

As the entire plant shook laterally on top of the piles, and as there could be no vertical movement, it appeared evident that the best plan would be to place counterweights on the engines of such sizes that they would diminish the horizontal shaking forces to nearly a minimum irrespective of the vertical shaking forces which might be produced. This would give much larger counterweights than are ordinarily used, but on carefully considering the conditions which existed it was deemed best to adopt them. The counterweights originally on the engines were comparatively small and it was found impossible to place large enough weights on the crank discs to carry out this plan. It was therefore decided to place counterweights on the flywheels in addition to placing as heavy counterweights as possible on the crank discs. A counterweight in the flywheel acts just as efficiently as one placed on the crank disc in eliminating the shaking forces tending to translate the bed of the engine, but with such a counterweight there remain forces which act as couples and tend to shake the engine by rotating it about its centre of mass. The horizontal forces tending to produce translation were, however, the most important in the case under consideration, and these were considered irrespective of the forces tending to produce rotation.

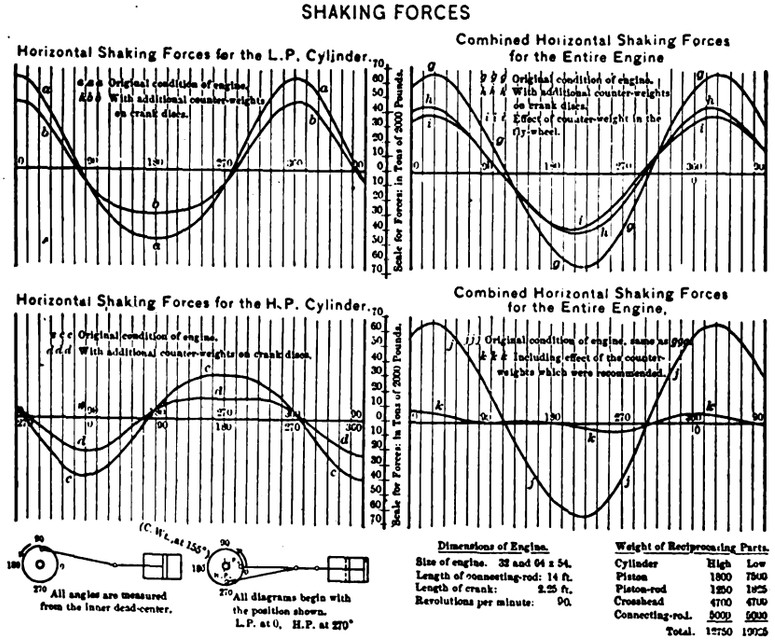

SHAKING FORCES
Horizontal Shaking Forces for the L.P. Cylinder.
Combined Horizontal Shaking Forces for the Entire Engine
Horizontal Shaking Forces for the H.P. Cylinder.
Combined Horizontal Shaking Forces for the Entire Engine.
All angles are measured from the inner dead-center.
All diagrams begin with the position shown. L.P. at 0, H.P. at 270°
Dimensions of Engine.
Size of engine. 32 and 64 x 54.
Length of connecting-rod: 14 ft.
Length of crank: 2.25 ft.
Revolutions per minute: 90.
Weight of Reciprocating Parts.
Cylinder High 1800 Low 7500
Piston 1800 7500
Piston-rod 1250 1925
Crosshead 4700 4700
Connecting-rod. 5000 5000
Total. 13750 19025

FIG. 1.—POSITION OF COUNTERWEIGHTS, AND SHAKING FORCES.

The weight of the counterweights recommended to be added in addition to those already on the No. 3 engine was 4,995 pounds on each of the crank discs and 3,600 pounds in the flywheel, the distance of the centre of gravity of the weights on the crank discs from the centre of the shaft being 2.38 feet and for the weight in the flywheel 7.67 feet. The counterweights originally in each crank disc amounted to a net weight of 1,740 pounds at 2.05 feet.

The position of the flywheel counterweights and the shaking forces with and without the additional counterweights are shown in Fig. 1. Mr. Bushnell designed counterweights for the No. 3 engine to conform with the above sizes. The counterweight is shown in Fig. 2. The counterweights finally placed on the engine were somewhat lighter than called for, but not enough so to produce any great difference in the results.

On starting up the No. 3 engine with the counterweights it ran without appreciable vibration and operated with entire satisfaction.

Counterweights were then placed on engines Nos. 1 and 2, driving the alternating-current generators. As the dimensions of these engines and the weights of the reciprocating parts were the same as for the No. 3 engine, the same size of counterweights was used as for the latter, but those placed in the revolving fields were necessarily of a different form than that

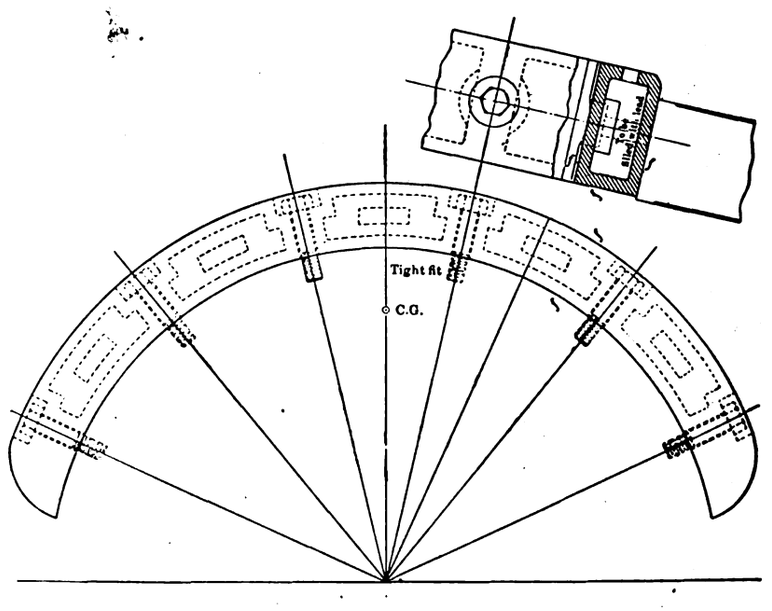


FIG. 2.—COUNTERWEIGHT FOR NO. 3 ENGINE.

Digitized by Google

employed in the flywheel of the No. 3 engine.

On a third visit to the plant a vertical engine directly connected to a 2,500-kilowatt generator had been erected and was running in addition to the three horizontal engines. It was found that the greatest shaking that could be noticed occurred on the switchboard platform which was anchored to one of the side walls of the building at a point some distance above the floor. When engines Nos. 1 and 2 driving the 1,500-kilowatt alternators were run in parallel with the counterweights opposed they produced but little vibration. When run with the counterweights together there was a greater vibration. The maximum shake occurred when the counterweights of the three engines Nos. 1, 2 and 3 fell together, which would take place about once every fifteen seconds, as the two engines running the alternators ran at about ninety-four revolutions per minute and that driving the direct-current machine at ninety revolutions per minute. The amount that the floor shook was measured and was found to be extremely small and less than 0.002 inch.

The ground was frozen during the above test and it was decided that it would be best to make a final set of observations of the amount of shaking after the frost was entirely out of the ground. Furthermore, some questions arose as to the possible danger of the alternating-current generators breaking out of step when run in parallel with their field counterweights opposed, because when so run, the ammeters attached to the generators swayed considerably, indicating fluctuations in the current.

On looking through the magnets of the revolving fields of one of the alternating-current generators at the revolving field of the other the angular variation back and forth was apparent. This was carefully estimated and under the ordinary conditions of running was found to amount to from about six to eight pole degrees total variation or from about three to four pole degrees for each machine. The amount of this angular variation with the machines running in parallel was about the same irrespective of the position of the counterweights with reference to each other, but when the counterweights were opposed the variations occurred every stroke or about ninety-four times per minute; whereas, when the counterweights were together, or nearly so, the variations occurred at less frequent intervals, the total number of such variations then being from about thirty to forty per minute. As the total displacement of the two fields from their true position, as observed by looking through the magnets of one revolving field at the other, was about the same irrespective of the relative positions of the two counterweights, it follows that this displacement was produced as much through governor action as through any variation in speed during a single stroke.

When the two alternating machines were operating in parallel there was a swaying of the ammeters in the machine circuits. This swaying was, however, of an entirely different frequency from that of the strokes of the engines. The amount of this swaying was noted for different relative positions of the counterweights of the engines. The engines were operating at the time under light loads. The voltmeter reading was also noted and found to be steady in every instance.

It appeared that the fluctuations in the current generated by the two alternating machines had but little influence on their efficiencies and that they were working successfully when connected in parallel.

On a joint visit of Professor Ganz and the writer observations of the angular displacement of the rotating fields and electrical readings were again taken and these observations led Professor Ganz to conclude that there was no apparent danger of the alternators breaking out of step while operating in parallel with the counterweights in any relative position.

Careful measurements were also made at this time of the amount that the engines shook the building. Observations of the angular displacement of the revolving fields when run in parallel bore out in a general way those made on my previous visit.

In order to study more thoroughly the effect of the counterweights in increasing the angular variation, diagrams of crank efforts were laid off corresponding to indicator cards taken from the engines and from these curves of crank effort the angular variation in pole degrees was determined, as shown in Fig. 3. From this figure it may be seen that the variation for a single machine without the addition of the counterweights in the revolving fields would be 1.8 pole degrees, and with the counterweights 3.2 pole degrees. The latter value is the one to be compared with the variations observed by looking through one of the revolving fields and observing the other, and it agrees with the amount which was observed, which varied from three to four pole degrees.

It appears from Fig. 3 that by placing the counterweights in the revolving fields the angular variation during a single stroke is made about twice what it would have been without the counterweights. It, however, appears that the increased angular variation during a single stroke due to employing the counterweights does not introduce any great disadvantage as the alternators can be safely run in parallel at practically the same efficiency as would exist should there be less angular variation.

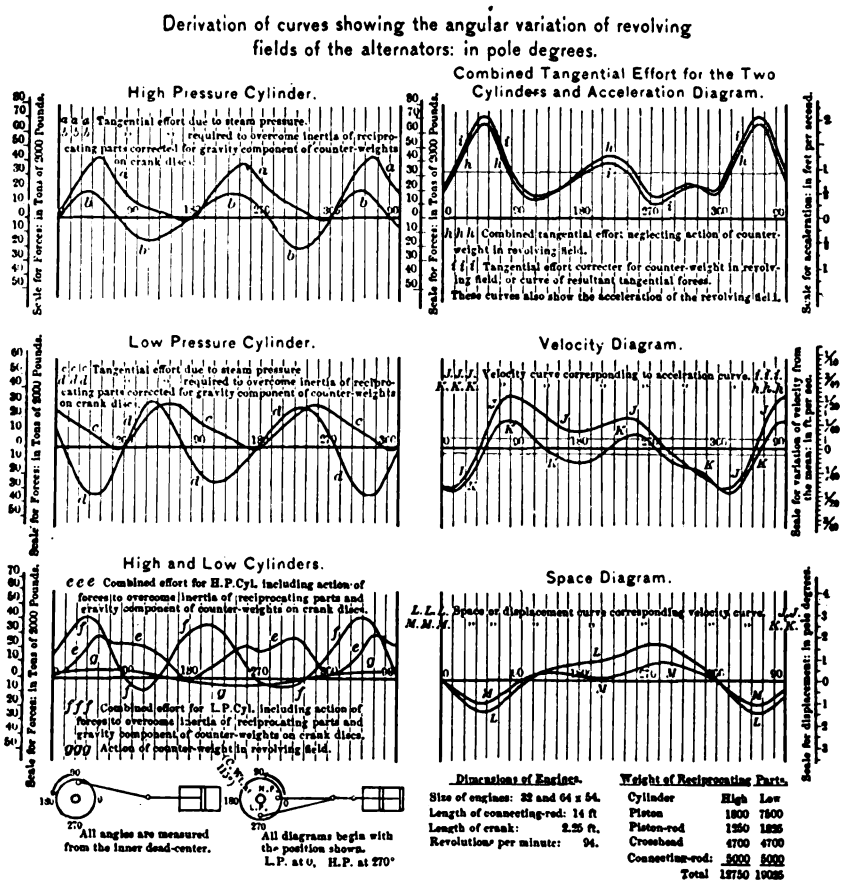

Derivation of curves showing the angular variation of revolving fields of the alternators: in pole degrees.
High Pressure Cylinder.
Tangential effort due to steam pressure.
required to overcome inertia of reciprocating parts corrected for gravity component of counter-weights on crank discs.
Combined Tangential Effort for the Two Cylinders and Acceleration Diagram.
Combined tangential effort neglecting action of counter-weight in revolving field.
Tangential effort corrected for counter-weight in revolving field, or curve of resultant tangential forces.
These curves also show the acceleration of the revolving field.
Low Pressure Cylinder.
Velocity Diagram.
Velocity curve corresponding to accelation curve.
High and Low Cylinders.
Combined effort for H.P.Cyl. including action of forces to overcome inertia of reciprocating parts and gravity component of counter-weights on crank discs.
Combined effort for L.P.Cyl. including action of forces to overcome inertia of reciprocating parts and gravity component of counter-weights on crank discs.
Action of counter-weight in revolving field.
Space Diagram.
Space or displacement curve corresponding velocity curve.
All angles are measured from the inner dead-center.
All diagrams begin with the position shown. L.P. at 0, H.P. at 270°
Dimensions of Engines.
Size of engines: 32 and 64 x 54.
Length of connecting-rod: 14 ft
Length of crank: 2.25 ft.
Revolutions per minute: 94.
Weight of Reciprocating Parts.
Cylinder High 1800 Low 7600
Piston 1250 1825
Piston-rod 4700 4700
Crosshead 5000 5000
Connection-rod:
Total 17750 19025

FIG. 3.—CURVES OF CRANK EFFORTS.

Digitized by Google

Progress in Electric Heating; Electric Power in Factories; District Heating.

AT THE recent convention of the National Electric Light Association three reports were presented, each having a most important bearing upon the economy of central stations, although, in fact, they represent slight departures from the ordinary service of these plants. These reports have been abstracted and follow, supplemented by some further opinions upon these subjects, as brought out during the discussion:

PROGRESS OF ELECTRIC HEATING.

JAMES I. AYER.

With the thought that expressions from the members of the association indicating their experience and methods pursued would be of the most value touching this subject, a set of questions was mailed to all central station members. As may be expected in such cases, all returns were not as complete as could be wished, but many of them, and a number above the average in such cases, show a lively interest in the subject developed by their appreciation of this application of electricity.

The questions seem to have shown the following:

That about one-third have no heating apparatus on their lines, mostly those who have no day service. With those who have, there is a growing interest. Generally sell apparatus at or about cost. About one-half keep such a record as they may from sales, inspection permits, meter records, etc.

That a comparatively small per cent make special rates (twenty-one per cent of those reporting).

With a few, there is a strong impression that the cost for service is high and a serious handicap. With others, that this does not apply to many useful devices, that the introduction of heating goods is important as broadening the field of usefulness of electric service among existing customers, and where rates can be made sufficiently low, material additions in day loads develop.

That the best methods of extending the use is by office exhibits and demonstrations, loaning articles for trial, and personal solicitations.

That there are some material loads of a desirable character added from service to laundries, clothing factories, and other industrial establishments in fifty-two cases; that those customers found the service more satisfactory though in some cases at a higher cost for heat than by other methods.

That the cost of apparatus was a factor in limiting the sale.

The average critic does not always appreciate that an electrically heated tool or device is materially different in its makeup from its fellow of older acquaintance. Aside from producing a device as like as possible to the one it displaces, it must contain a heat generator made to withstand use and abuse in unskilled hands while operating at high temperature, thus calling for great care in design, construction and selection of material. Of the number made compared with articles of like character in common use they are as one to many thousands. The cost of selling is also quite high as compared with articles better known and of wider application, because the field, generally, is restricted to those using electricity who may be persuaded to discard some familiar well-known method and device and buy the new.

Some few stations report failures in efforts to successfully introduce apparatus under conditions where others succeed. This is generally due to the lack of a proper understanding of requirements, methods and apparatus.

While it seems a simple matter to substitute an electric-iron for a gas-iron with equal or better results, and it can generally be done, yet there are kinds of work, kinds of operators, and kinds of irons differing in their individual characteristics which must harmonize when properly combined; all of which means that a thorough acquaintance with the devices you are introducing is essential.

There are favorable conditions where electric lighting is cheaper than gas, unit for unit, where you may not have to include compensating advantages to equal an unfavorable difference in first cost, but you do not find the extension of business possible under such conditions only. On the contrary, you have taught the public that a better thing is worth more, and they know it.

The electric heater in many of its forms comes to you as a compensating advantage to-day to assist in further extending that belief by supplying a service that in some cases can not be obtained by any other means at any price. It meets many household demands better, and usually more cheaply than they can be met by any other means. With the many household, shop and office conveniences available, the electric heater is, except for long continued service, a medium more attractive, convenient, safe and sanitary than any other, and can be operated cheaply enough to furnish an additional reason for taking on or maintaining electric service from a central station.

A. L. SELIG.

Our company has been paying considerable attention to this branch of the business for some time but did not do it systematically. A year ago we possibly had upon our system a dozen flat-irons in residences. About that time we began a campaign for the introduction of a flat-iron as a necessity rather than as a luxury, with the result that we have on the system to-day more than 600 irons consuming possibly seventy-five to ninety cents each, and in our case, being a water power company, adding absolutely nothing to the expense except office expenses we have introduced these irons in laundries, supplying about eight laundries, the installation varying from fifteen to forty irons. We have displaced gas-irons in a town where gas is sold at ninety cents a thousand cubic feet upon a basis of three cents for the electricity. We find that three cents for electricity in an ordinary flat-iron is equivalent to gas at about $1 a thousand, and our experience has taught us that laundries and families or any one else having to do with the particular apparatus will pay from ten to twenty-five per cent more for convenience, quickness and cleanliness in the use of electricity as against ironing by any other method.

We have also—and I regret to say that I have not had time to tabulate this particular investigation—for a year past been experimenting with complete kitchen outfits in one of our towns, selling the current for this particular outfit at four cents per kilowatt-hour, with the distinct understanding that the family was to keep a daily record of what they cooked, how long it took to do it, and to read their meter before and after each piece of work, so that this, I take it, will be a somewhat valuable record for this association to have when the results of the experiment are tabulated. We find that the particular family which was given this advantage for the purpose set forth is satisfied with the result, and will from now on

Digitized by Google

continue using this apparatus as against gas which it can buy at $1.50 per 1,000. The question was raised by one of the local companies as to the possible utility of using electricity in laundries in ironing. It seems to me that the experience of that company must have been particularly unfortunate, because this question has not been raised with any of the laundries upon our system. We have been supplying some of these laundries now for about a year, and, as stated, they prefer electricity to any other method of doing their work, and in fact two or three of them are now equipping their mangles with electrical devices, cutting out the gas for that particular use, and on a three cents per kilowatt-hour basis.

We have endeavored to introduce electricity for heating space, but find that to be a failure. You can not do that except in isolated instances where persons have a very nice house and are able to pay the bills. In our country the conditions are peculiarly adapted to the use of electricity for heating if it were feasible. We have cool mornings and evenings in the winter, and it is warmer during the day, so that the use of electricity for heating would be limited and the expense necessarily small in comparison with other sections of the country where they have more rigorous climates, but in our section of the country except in isolated cases, such as the residences of wealthy people, the use of electricity for heating space is a failure, and we discourage it rather than encourage it, because we have found in a dozen instances, possibly, that persons who would like to have the convenience of heating space by electricity have bought the apparatus without our knowledge and installed and then simply gone up into the air because of the amount of the bills. Instead of it doing us good it does us harm. It is possible, if you have a long purse you can indulge yourself in the luxury of electric heating, but if you can not afford to pay the bills do not heat with electricity.

We do find that electric irons, electric culinary apparatus, curling irons, and those small things which pay anywhere from twenty-five cents to fifty cents or a dollar a month to the central station company can be successfully introduced, but can only be pushed by personal solicitation. We engaged a woman who knew of the advantage of the apparatus, who said to us that she would go upon our system, and we are in a city where there are three competing companies, but that she would confine her work to our lines and would sell these irons for us upon a margin if we would let her have them at cost. We did that gladly and she introduced a great number of these irons for us. We let a lot of them out on a thirty-day trial, and out of the hundreds put out sixty-five per cent stuck, and we believe this year our revenue from this sort of service will be increased not less than $10,000 a year without any appreciable expense to us.

JAMES I. AYER.

In connection with laundry work I will say that there are upward of 300 laundries equipped with electric heaters throughout the country. The laundry installations are growing. The question of the use of air heaters is like the question of the use of cooking apparatus on lighting rates. It is not practicable at the average lighting rates to do general cooking and take over all of it. It is not practicable to do cooking at a much higher rate than three cents, where you are going to do all the cooking; but you can utilize in your kitchen a broiler, waffle iron, coffee pot for the dinner table, a chafing-dish, and similar things used from once a week to once a day, without any appreciable additional cost in the month's bill. I know of three cases, of which we have obtained data, where all the broiling in a family of from four to six persons and the coffee making, together with the incidental use of an occasional stove for toasting and doing little things in the evening, the use of the chafing-dish, the use of the family flat-iron, not for the laundry, but use about the house, the pressing a woman does in dressmaking and little things which do not come under the regular laundry work and in each of these three cases in no instance has the increase in the bill averaged more than $1.25 per month or about twenty per cent increase over the lighting bill where this free use of current was made. When you talk of a broiler you are talking of a device using ten or fifteen amperes, 110 volts, two hundred or three hundred watts, which has been in service about twenty minutes; a coffee machine taking two hundred or three hundred watts for twenty minutes. The incidental use of the chafing-dish is not large. The household flat-iron is used in many houses from five to ten or fifteen minutes at a time at the most, for pressing a seam, or some similar service, and it is not necessary to keep it in service more than ten minutes at a time. While the iron may use four hundred or five hundred watts, the total watt-hours in a day is small during which it is required, and the device is cheap and convenient.

In regard to radiators, there is a field for radiators in dwellings which is very large and becoming more so, and that is the use of radiators in the bathroom in the winter—there is a demand for something to take the chill off the bathroom. It takes a 2,000-watt heater to be effective, and fifteen or twenty minutes to accomplish the desired result. When I give that rating of heater, I am speaking of the average bathroom, and the time taken to heat the bathroom includes the average bathroom, and the amount of heat required to warm a room within the limit of time a man is willing to wait before the furnace in the house has got in its work. In practice we have found in the seashore summer homes and in the winter residences that the radiator is a great success. It may cost seven, eight or ten cents, or possibly twelve cents, depending on the rates for the heat required to take a morning bath. Take that in the case of a man who wants the convenience and the cost is low. It is a field which is growing larger every day, and a thoroughly practicable one. The experience of one of our members who installed an electric heater was unique. He was very much delighted with the heater, but he took a bath one morning just as he was about to go away on a two weeks' trip, and when he came back his bill was $96. He was the president of the company, which was an element in the case that made the situation a little easier to bear.

In all that I have said to-day I have tried to point out the idea of the members using the electric heating appliances of the smaller class to strengthen their hold upon their customers. The thing a person finds useful and valuable is the thing you want to put into his hands. If a person gets a water boiler or a little device of any sort, a flat-iron or any of the heating appliances in his home, you have not only increased the usefulness of your current supply, but you are doing missionary work in educating your customers to a further use of electric current. But to advocate that you will go home and make attempts to make a wholesale application of electric heating is not my intention. In the first place, when you come to installing kitchen outfits, when you go into the larger application of these things, you must be informed about the goods you are putting out; you must know the goods themselves and have had experience with them. This is not a thing which you will learn in a day. It is not difficult to learn about the simple things, but nevertheless it is the simple things you must master by closer acquaintance with them before you will be in a position to put them out to the general public who have no appreciа-

Digitized by Google

tion of the principles involved in heating methods. They do not appreciate the value of intimate contact with these appliances and the host of little lessons to be learned.

As to the cost of general cooking, you can safely figure that the cost for electricity has got to be down to three cents per kilowatt to be on a par with good $1 gas. The calorific value of gas varies some, the efficiency of the devices in which it is used varies, and all that, but the record from a large mass of data shows that to be an average condition you can count on. No two families use the same kind of gas stove; there is not the same character of living nor the same number of people, and there will be a variation in the bills. The factor of personal equation comes in, and the methods of handling the apparatus. But there is a law of averages and the statement it will take a kilowatt per day per meal per person for three meals to do all the cooking required for a family will be found to be a safe average for a family of three persons and up; it will not vary much with the increased size of the family; about 3.33 watts per meal per day per person. That involves a regular dinner cooked by a servant in the regular way, not in the hands of experts or people who are checking.

The question of heating air is impracticable from the point of view for cost for large quantities, not for small heating where people are doing electric cooking, as they are in many places where they shut off their range. Where people want hot water they can secure an ordinary type of kitchen boiler varying in capacity from thirty-five to forty gallons with a heater of maximum capacity not exceeding 2,500 watts, they can install the electric heater and use it with good success. What is required for the bath in a small way is not a very heavy expense. The boilers should be located and are frequently put in the water main right in series with the kitchen boiler. In other cases, where they are wanted for the bath alone, a five-gallon or ten-gallon boiler is put on the water main in the boiler. An hour's run, at about two kilowatts, will give a sufficient quantity of hot water for an ordinary bath; about thirty gallons. It is a question of rates, as to whether you want to encourage that practice or not. Where you sell current at five cents, people will be glad to pay ten cents for a bath. Where you attempt to heat water in the kitchen and utilize it as hot water is usually used, for dish-washing, etc., with the large incidental waste, it is impracticable, although some people do use these things in that way. We do not recommend it, but we supply the demand where people are interested enough to do it, and under such conditions we usually have good results. We have no complaints from central stations where they have bought articles of that sort, and there are a dozen stations which I have in mind which have installed hot-water boilers in their stations for cleaning lamp globes, the men's dinner pails, and that sort of thing, and where a careful check has been made it has been found that the average supply of current to the boiler is about 500 watts.

PURCHASED ELECTRIC POWER IN FACTORIES.

E. W. LLOYD.

The subject "Purchased Electric Power in Factories" has received considerable attention from engineers in the past few years, and I believe it is now the concensus of opinion that the use of motors for driving machinery in factories is the most economical, practical and flexible known to date. The question as to whether the current for driving these motors can best be furnished from an isolated plant in the factory or from the lines of the central station company furnishing power in the district, depends upon the rate per kilowatt-hour charged by the company when the installation conditions are the same. I believe the time is near at hand when the greater part of factory power loads will be furnished from central station service, as such great improvements have been made in central station generating apparatus in the past few years that the selling price of electric current for power purposes has been reduced to the point where we can successfully compete with private plants.

I do not think central station managers have much difficulty in obtaining power customers up to ten or fifteen horse-power, as the cost of running motors of this size is generally below the cost of running a steam engine or other prime mover now on the market, particularly when all of the items that go to make up the operating cost are taken in consideration. Even though the cost of furnishing current to small consumers were a trifle greater from the central station service, we should have very little difficulty in obtaining this class of business, as a factory owner would rather not be bothered with the power question and prefers to pay a little more if he is satisfied he will have no trouble. It is, therefore, with the large installations of motors in factories that run from central station service that this paper will treat.

The question as to whether a factory will run from central station service or whether it will generate current from its own plant is not always decided by the rate per kilowatt-hour which the central station company proposes to charge for the current. To any one who has had experience with installations of motors driving machinery, where one large motor was used, it is known that no economy can be obtained over engine drive with profitable rates for central station service. It may be possible with the use of a few motors in a large plant running fifteen to twenty-four hours a day with a low rate per kilowatt-hour, that central station power can compete with engine drive; but the average plant does not run more than ten hours a day, and, therefore, the rates of a central station company doing a profitable business can not compete successfully with these conditions. It is, therefore, necessary to consider other sides of the factory power subject than merely the question of price per kilowatt-hour.

The most important fact that has been developed to-day in connection with this subject is that the proper motor installation has everything to do with the economical furnishing of electric current from central station service. I think central station managers will agree that in a great many cases where factory power was lost to them the fault lay in the fact that the motor installation eliminated none of the wastes in the plant that were in evidence when it was driven from an engine. A great many cases of this kind have come to my notice, and I am fully convinced of the truth of these statements. While it is no doubt difficult to convince factory managers that the installation of a great many motors is the only economical method of driving, this is being accomplished by a number of companies, and it is becoming less difficult each day to demonstrate the efficiency of individual or good group-drive installations of motors. The elimination of all friction loads in a factory makes a wonderful difference in the kilowatt-hour consumption. I believe the time is coming when machinery of almost every description will be equipped with electric motors before it is put into service. It is a well-known fact that the efficiency, flexibility and output of a tool are materially increased with the use of individual motors. While it is true that the installation of individual motors increases the connected horse-power load in a given factory over and above what it would be should group-drive installation be made, it is also true that the current consumption is considerably

Digitized by Google

less on the individual motor installation. There are engineers throughout the country who advocate individual motor installation, but I believe the subject has not received the proper consideration from all central station companies, and the sooner it is brought forcibly to their attention that this type of installation will do more to increase their power load than any other one thing, the more universal the practice will become. The selling by some companies of electric current at very low rates, even to the extent of losing money on this current, is not necessary with proper motor installations. Extremely low prices for electric current in some localities are detrimental to the station business in others, and I do not think they are necessary if the proper attention is given to the engineering features in obtaining power business.

The agent sent out by the central station company to obtain large business must have some training before he is competent to get business. It is necessary to make a special study of factory conditions. Starting in the engine room he must understand the coal consumption of different types of boilers and the steam consumption of the different types of engines. While it is very likely he can obtain from most factory managers the coal consumption in the plant, it is very necessary that the agent know whether this coal consumption is correct or whether it is abnormal considering the engine and boiler installation. If the coal consumption per horsepower be high it is a point in favor of central station service. It must be taken into consideration that in a great many plants they do not always keep a correct record of the plant costs, and, in view of this fact, it is necessary to know what items go to make up these costs. The mere costs of fuel and labor are not by any means all of these costs.

One of the most difficult propositions an agent will meet is where a factory is equipped with fairly efficient engines and where there are a great number of machines in operation. The factory manager objects seriously to spending a great deal of money on small motors for the operation of his plant, and it is often necessary to guarantee results from such an installation for a short period in order to convince him that you are accurate in your estimate of the kilowatt-hours per month.

Factory managers are appreciating more and more every day the advantages of electric drive, and it is not nearly so hard a job to induce them to-day to change over to motor drive as it was a few years ago when there were comparatively few large plants in the country equipped in this way.

In connection with motor installations in new factories, it should be borne in mind that there will be a considerable saving in the first cost of the building and equipment by the removal of heavy line shafting. The cost of belts and pulleys and their maintenance is also eliminated to a large extent by the use of motors.

When endeavoring to convince a factory owner that he should accept central station service, his attention should be called to the fact that there are other reasons besides saving in cost of current that should convince him that this service is to his advantage—such as the elimination of smoking chimneys; inability to get coal should there be strikes; breakdown of the transmission shafting, stopping the entire plant; breakdowns of engines or boilers; the liability of accidents in the plant from explosions or other accidents; cleanliness; the absence of belts, vibration and heat; and, as before stated, the increased efficiency, flexibility and economical operating of the machines throughout the factory operated by motors. The output of a tool can be materially increased by such installations, and, therefore, the investment in tools decreased for a given output. Furthermore, there is the reliability of service from the central station at any time during the twenty-four hours. Should he have a particular contract where it is necessary to run a few machines in order to turn out goods, he can run this part of his factory very economically, it being only necessary to use such motors as are direct-connected to the machines that are required to do such work. There is also the fact that should his business increase it is only necessary to expend a small amount of money in order to increase the capacity of his power plant, instead of buying a new generating unit or of running a very large engine on an uneconomical load for a number of years.

In looking over the information sent by the different companies you will notice that there are some lines of business to which the central station furnished little or no power. As the selling of power from central station service is still in its infancy, this is not surprising; in fact, it is more surprising that the central station companies have obtained such large power loads in so few years. Experience in some lines would indicate that it will be necessary to give better rates on these classes of business than on others, in order to increase the central station loads in that direction. On machinery such as large blowers, refrigerating machinery, air-compressors, running ten hours or more, or any other machines that have a very high average load during their period of operation, the price per kilowatt-hour must necessarily be less than for machines such as punches, lathes or other tools, where, no matter how continuously they are operated, the average load is only a small part of the maximum load.

A. C. DUNHAM.

We have now installed and are operating a little over 5,000 horse-power in motors. Our lowest price for 1,700 kilowatt is $1.65 per kilowatt-hour. That is based on a large manufacturing concern, of which we have a great many. The price was made up after an examination of the books of a large drop-forging concern. The books were open to us and we went through them carefully and discovered the average cost for three years. Our largest user of power is Pratt & Whitney. We sell them 650 horse-power. They asked me to make this price and brought down a ream of papers and showed what it cost to make this power in three large establishments where they ran generators by steam and had motors scattered all over the factory. You must compete with that. You can not base your ideas on motors simply, because they pay for the motors and can put in steam engines direct-connected to the generator to make their own current as well as the central station. There is an element comes in there which will be overlooked unless you have put out a very large amount of power for a small place. We find on the switchboard of the 5,000 horse-power in motors installed we delivered from the switchboard about forty per cent; that is to say, the averages of the efficient power all through the town will run a good deal less than the total input of motors. I think that is where the profit comes in. You figure you are selling so much horsepower, and you are not delivering it. The price is based on nine hours' use, and we escape the peak, except for two months in the year. They stop at five o'clock all the year round. Perhaps for two months there is a small peak which we supply by storage battery.

L. W. EMERICK.

Information is desired of any cases where a proposition has been made involving power furnished a concern whose by-products were available in the way of fuel, such as sawdust shavings, buckwheat shucks, or anything of a similar nature. I had one case, that of a buckwheat mill, turning out large quantities of buckwheat shucks, ordinarily used for fuel and

Digitized by Google

possessing considerable value in that respect. This particular plant runs for about five months in the year, twenty-four hours a day, making enough shucks to furnish the fuel they require. In order to become acquainted with the facts of this and similar cases I spent a couple of days looking up their plants and find that contrary to my first belief the shucks have a decided fuel value. The proposition was a difficult one to handle, as the plant requires some steam for drying purposes as well as heating. After considerable time spent on the proposition we finally worked out a plan whereby if we allowed a rate that appeared to them quite low and, in fact, was low for power to be furnished during eighteen hours, and thereby relieving us from a load of this kind during the peak, and enabling us to control the demand in a way that would satisfy both the customer and the central station conditions.

JOHN F. GILCHRIST.

I will emphasize one sentence which Mr. Lloyd brings up, which I think is a point of great importance with all the companies and that is discountenancing the practice of attempting, without sufficient investigation, to get business by cutting rates, and Mr. Lloyd has shown quite conclusively that the average plant now running from steam engines is properly designed, and by good engineering a great economy can be obtained which can be laid to the credit of the electrical installation. It undoubtedly might be obtained by a redesigning of his steam plant.

I can cite one case, which will give an answer to the question raised by Mr. Emerick. We had the case of a concern which manufactured coffins. They used probably 150 to 175 horse-power. They had operated by steam and had a great deal of hardwood sawdust, shavings and chips, which is not as marketable as the soft-wood shavings, as refuse, which they used for generating steam. We worked on them a long time and the lowest rate we wanted to quote was 4.5 cents per kilowatt-hour. They showed us they could not afford to pay more than 2.5 to three cents per kilowatt-hour. We argued that their average load would be nothing like what they thought it would and that their bills instead of being $250 a month, at 2.75 to three would probably not be over $150 to $175 at 4.5 cents per kilowatt. I finally got them to put in a kiln for drying their lumber, which was done by using the refuse, and then by making them a maximum guarantee for a period of one year of $2 per horse-power installed, with the definite understanding that it was merely a test and that we would not consider such a proposition for more than one year, and that at the end of the year they must go on the meter rate. The results were favorable and they have never had a bill over $175.

REPORT OF COMMITTEE ON DISTRICT HEATING.

W. H. BLOOD, JR., CHAIRMAN, R. S. WALLACE, C. B. MAUNSELL.

As a general proposition, cities of 20,000 population or over have well defined and thickly settled business centres. This is also sometimes true of cities down to 10,000 population. It is evident that the farther away from the plant the customer is located, the poorer will be the service he receives; if steam is supplied the more moisture will it contain, and if hot water is used the lower will be its temperature when it reaches him.

The number of customers and the quantity of heat that they require, or, in other words, the density of the load, is an important factor which must be taken into consideration. As a general rule, the commercial business is the better in every way, since not only is the income derived from it greater per foot of main, but the amount of heat required per cubic foot of space so used is less proportionately, for the reasons that the buildings are not used at night, are less exposed, and usually have thick masonry walls. The service runs for commercial business are almost invariably shorter than those for residences, and in many cases one such service can be arranged to serve two or more customers.

Changes in the population of his city should receive the manager's closest scrutiny, for if the city is growing rapidly it is essential at least to keep pace with its growing demands. In a city not supplied with district heat, there comes a time when the undertaking of this branch of the business must be considered by the electric light company. If the opportunity is allowed to pass, it may be taken up by some new company as an entering wedge to serving the public, and perhaps greatly to the disadvantage of the older company.

A company just entering the heating field should be able, without much difficulty, to secure contracts for most of the buildings that are already piped. If exhaust (or live) steam is to be used, this does not entail any additional expense to the customer in changes to his installation; that is, if his building is piped for either hot water or for steam it can be handled from a district steam heating plant. If, however, hot water is to be distributed, an installation arranged for steam will require remodeling before it can be so served.

An element of extreme importance in this consideration is the relation of the cost of steam coal to that of domestic coal. In cities where steam coal costs from one dollar to two dollars and where domestic coal runs from four dollars to nine dollars, the company has much in its favor, and should be able to make rates that are at once attractive to the public and profitable to itself.

The length of the season is a factor to be considered, especially when heat is furnished on any flat rate system, *i. e.*, per square foot of radiating surface per season, per cubic foot contents per season, etc. When on a meter basis, however, the length of the season is of much less importance. It is well to avoid, in general, the making of contracts requiring heat during the summer months.

If water for condensing is not available, the argument for district heating is strengthened. Very many plants have short and sharp winter peak loads; and it would seem that under such conditions their managers might be warranted in installing some inexpensive, simple, non-condensing engines, the exhaust from which would be well utilized for heating purposes; or it might even prove to be best, under proper conditions of load and fuel costs, to install condensing apparatus which would run during the summer, but which in the heating season would be cut out, the exhaust steam being then utilized on the heating system.

The returns that we get from steam heating plants indicate that it is safe to figure for ordinary conditions about 0.20 pound of water per hour per square foot of radiation (varying from 0.05 to 0.50). As all the consumers are not using the steam at the same time, particularly if on a meter basis, the load-factor should be no more neglected than in the lighting business. Naturally, with the heating business this is higher; and if we use the figure of eighty-five per cent we shall probably be on the safe side.

Together with the above must be figured the interest charges on the total underground installation and that portion of the central station plant which is used for heating purposes; and lastly—depreciation—an item that is often neglected but which should nevertheless be estimated. From the best evidence at hand the last item seems to be about five per cent per annum on the total cost of the investment.

It is a well-recognized fact that a district heating system has often enabled a

Digitized by Google

company to secure contracts for light and power which it would not otherwise have obtained. These then produce an increase in load which in turn supplies more exhaust steam to sell for heat.

In many cases live steam has to be supplied at certain times in order to give good service. Where this condition exists and the demand on the live steam increases, it soon becomes necessary to set aside or to install a boiler solely for this purpose. The chances are that the plant is selling live steam on an exhaust steam basis, and it soon becomes evident, if the question is investigated, that there is no profit in the business.

So long as the demand does not exceed the supply of exhaust steam, but follows it closely, and the rates are kept up, the plant is in a fair way to make money, but any plant that undertakes to sell live steam on an exhaust steam basis is doomed to failure.

It is essential that rates be carefully fixed at the beginning of operations and that the cost of generating and distributing heat, plus proper investment, depreciation and dividend charges, be the basis of such rates. While it may be possible to compare with the daily and monthly load curves of the central station a hypothetical curve representing the amount of heat required by buildings of given dimensions, and thus estimate how much of the available exhaust steam can be utilized and how much live steam must be added, the result is at best an approximation. The only safe and reasonable rate is that based on the cost of supplying heat direct from the coal pile, or, in other words, on a live steam basis. Any exhaust available with rates thus fixed can, of course, be used to advantage.

If the heating business is to stand upon its own merits, it is unwise to go into it on any other basis than that indicated above. If, however, it is the intention to supply heat where so doing secures good consumers of electricity and for the express purpose of getting such consumers, it brings up entirely different considerations. It behooves the careful manager to direct the growth of business on the heating system in the direction that will bring the greatest number of good consumers of electricity, and to this end all extensions of mains should be carefully considered, remembering that the supply of heat is limited.

It is advisable to limit the service connections made in street mains to the fewest possible, making extensions, wherever practicable, from service pipes in adjacent buildings, with due regard, however, for the capacity of the service from which the extension is made. For this and other reasons, it is essential that all service pipes, extensions of same and service valves should be laid and owned by the central station.

Theoretically, a meter rate is the only equitable method of charging, but practically it may be found that a flat rate will answer the purpose fully as well.

Too much heat is not only possible but is nearly as bad as too little, and the consumer naturally takes pains to shut off the steam when the room begins to be uncomfortable. This would seem to form a strong argument in favor of a flat rate system.

If the flat rate is established, it is necessary to decide whether the rate shall be based on the square feet of radiation installed, or on the cubic feet of space, or on the equivalent cubic feet of space heated, which latter case takes into consideration windows, doors, masonry walls, etc.

A summary of the information collected shows that the steam consumption is greatest where the average temperature is lowest and that this is an important factor to be considered in arriving at the rate to charge; that the kind of service makes very little difference in the steam consumption, although residences seem to have a greater condensation per cubic foot of contents and a less per square foot of radiation than either stores or offices; that the results are near enough to justify the establishment of a flat rate, this being on the assumption that customers will use practically the same amount of steam whether on a flat or meter rate; and, finally, that if a meter rate is established a corresponding flat rate would vary according to the length of the season and average temperature.

C. R. MAUNSELL.

In my town we have had quite a little agitation on the point of the variation in rates, some customers being charged by meter and some by flat rate. They naturally ask, why do you take some customers on the meter rate, and some customers on the flat rate. The reason we place the majority of customers on the meter basis is because those installations would use an excessive amount of steam if left on the flat rate. We have one instance where there is a store on the first floor, a restaurant in the rear of the store, and the upper floors used for offices. The owner of the building is determined he will not use steam taken from our company, and he allows the attendants to get along the best way they can. It is not good policy, but it exists, and it brought about this very point. The occupant of the store insisted upon having a flat rate. It was necessary to supply steam through a long main line, together with the necessary branches before we could get steam into this store, and we refused to do it on the flat rate, and insisted on putting it in on a meter basis. The man carried the point to the city council that we were discriminating in rates and created an agitation. It seems to me the matter narrows down to a question of whether we are going to do the steam-heating business on a flat rate or a meter basis. Every man in the central station business will get up against the variation in rates, and if we do not meet it in the best way for our interests, which I believe to be the meter basis, we have to go out of the steam-heating business.

A great many companies throughout the country have gone into the heating business expecting that it was all velvet, and in figuring on the selling of exhaust steam calculated how much the investment would be and how much return they must secure to pay interest and depreciation. If they would figure absolutely on a live steam basis and sell it that way, there is no question but it would be a success, as every plant so operated is making a success of it.

The question of the control of installation is one of most vital importance, if you attempt to do any business on a flat rate. There is nothing that will bring home to a man so forcibly the extravagance of leaving the doors and windows open than a monthly reminder in the form of a bill. It is the same way in regard to lighting on a flat rate. The customer is careless in the use of the steam and allows the doors and windows to be open and gives you a considerable lower percentage of profit on his business than if he were paying on the meter basis.

JAMES E. PYLE.

I have found that steam-heating systems, as a rule, whether fed from the street mains or from boilers, are very unsatisfactory as a general thing to the customer and to those heating. I have found that the district steam company system of supplying steam heat to a building requires very much less radiation than is ordinarily used from an ordinary steam boiler, and that the chief trouble with the whole thing is that it is not under control, the same with the boilers in the cellar. We have introduced the system of control in our steam-heating main which is applicable to boilers just as well, and it is of interest to every man who has a home to heat or store to heat to buy steam whether by

Digitized by Google

boiler or from the mains in the street. We come in from the street and rise up to the highest point in the basement, and go through a reducing valve and reduce the pressure to five ounces and hold it there. We raise the pipe to the highest point and drain it by gravity to where we want the pipes to leave the building. Each radiator is equipped with a half-inch pipe with an indicating valve at the top of the radiator. We use a water radiator only, and figure on twenty per cent more radiation than the ordinary single pipe system by using the value at the top of the radiator with an index on it. That will show whether there is enough steam being admitted to heat one-quarter, one-half, or three-quarters of the radiator. We can admit enough steam to give the required amount of radiation for any kind of weather. In that way we heat the top of the radiator to the first notch only. The water is condensed and goes to the bottom of the radiator which is chilled and before it leaves the radiator all heat is used in the apartment being heated. The pipe from the radiator is connected to a small pipe in the basement which has no connection with the steam pipe whatever, except through a water-loop that may drain the steam pipe. From there it is conducted to coils for the purpose of cooling water condensed in the piping system only. From there it goes to the meter. This gives the customer the advantage of regulating the amount of steam in all the rooms independent of the fact as to whether the weather is very cold or moderate; he can have what steam he wants. The principal waste in steam heating is during mild weather, when large radiation is not required, which is overcome by this method; and we have found that our system operating on this plan is giving very much better satisfaction than the system operated on the single pipe plan and we are free to say that our customers' bills on this plan are at least thirty per cent lower on the single pipe system. Our system is almost entirely equipped with this kind of piping in every place. The only dissatisfied customers we have are those using the single pipe systems. The others like the service. They are heating on a basis of forty per cent cheaper than they could heat with coal at six dollars per ton. Some report a saving of thirty-three per cent on their coal bills. This system permits any company in this business to charge a rate proportionally higher and still give satisfaction which is an important point to all steam-heating plants.

CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

MANHATTAN BEACH, L. I., N. Y., JUNE 14, 15, 16.

The American Railway Master Mechanics' Association held its thirty-eighth annual convention at the Oriental Hotel, Manhattan Beach, L. I., from June 14 to June 16, inclusive. Two hundred and sixty-five members of the association registered and attended the business sessions, which were held in the ballroom of the Oriental Hotel.

The following papers were presented at the different sessions: "The Proper Loading of Locomotives." Discussion of report on "Locomotive Tests of the Pennsylvania Railroad Company at St. Louis Exposition." Topical discussions: 1. "The Best-Known Dimensions for Water Space Around Fire Box to Produce a Minimum Consumption of Fuel; and Replacement of Fire-Box Sheets and Reasons for Same." 2. "Locomotive Stokers." "The Value of Superheated Steam for Locomotive Work." "Locomotive Driving and Truck Axles and Locomotive Forgings." "Shrinkage Allowance for Tires." "Motive Power Terminals." "The Technical Education of Railroad Employés: the Men of the Future." Topical discussions on "High-Speed Steel" and "Staybolts." Discussion of reports on "Water Softening for Locomotive Use," "Time Service of Locomotives," and "Shop Layouts." "(A) Proper Lubrication of Valves when Drifting; (B) Relative Setting for Piston and Slide Valves." Topical discussions: "Relief and Bypass Valves for Locomotives," and "Are Engines with Self-Cleaning Front Ends Satisfactory?" All these papers were copiously discussed.

At the conclusion of the sessions the election of officers was held. It resulted as follows:

President, H. F. Ball, superintendent motive power, Lake Shore & Michigan Southern Railroad.

First vice-president, J. F. Deems, superintendent motive power, Vanderbilt lines.

Second vice-president, William McIntosh, superintendent motive power, Central Railroad of New Jersey.

Third vice-president, H. H. Vaughan, superintendent motive power, Canadian Pacific Railroad.

Treasurer, Angus Sinclair, editor *Locomotive Engineering*, New York city.

Executive committee—C. A. Seley, mechanical engineer, Chicago, Rock Island & Pacific Railroad; A. E. Mitchell, superintendent motive power, Lehigh Valley Railroad; G. W. Wildin, mechanical superintendent, Erie Railroad; A. E. Manchester, superintendent motive power, Chicago, Milwaukee & St. Paul Railroad; J. F. Walsh, superintendent motive power, Chesapeake & Ohio Railroad; F. H. Clark, superintendent motive power, Chicago, Burlington & Quincy Railroad.

In connection with the convention an exhibition of railway appliances was held. The exhibits were placed on the verandas of the Manhattan Beach and Oriental hotels, and in the space back of the Oriental Hotel and outside the enclosure. The exhibits were about 200 in number, and were well arranged. A great number of railroad appliances and auxiliary apparatus were shown. Among the firms exhibiting may be mentioned the following:

The Adams & Westlake Company, Chicago, which exhibited the Newbold electric car-lighting system, the Adlake acetylene gas car-lighting system, railway lanterns, signal lamps, oil, gas and electric chandeliers. Represented by E. L. Langworthy, A. S. Anderson, F. N. Grigg, R. M. Newbold, G. L. Waters and E. H. Stearns.

The American Brake Shoe and Foundry Company, Mahwah, N. J., modern steel back brake shoes and steel castings. Represented by Otis H. Cutler, J. D. Gallagher, J. B. Terbell, F. W. Sargent, J. S. Thompson, W. S. McGowan, Jr., F. L. Gordon, L. J. Hibbard, B. S. Hatch and G. K. Austin.

The American Carborundum Company, New York, had an exhibit of carborundum in various forms, namely, ores, grains and wheels. Represented by George F. Hardy.

The Anglo-American Varnish Company, Newark, N. J., exhibited a number of different varnishes. Represented by William Marshall and George M. Ballard.

The Baldwin Locomotive Works, Philadelphia, Pa., had an exhibit of a Baldwin four-cylinder balanced compound locomotive, built for the Oregon Railroad and Navigation Company, on the exhibition track. W. J. McCarroll, L. H. Fry and F. Woollven were in charge.

The Bridgeport Safety Emery Wheel Company, Incorporated, Bridgeport, Ct., exhibited a number of its motor-driven grinding machines. It also showed a number of different types of emery and corundum wheels. The president of the company, D. T. Homan, was in charge.

The Booth Water Softening Company, New York, had a railroad water softening machine with a capacity of 200 gallons

Digitized by Google

per hour. L. M. Booth, E. Richardson and H. H. Sutro were in charge.

The Bullard Automatic Wrench Company, Providence, R. I., exhibited adjustable pipe and nut wrenches. J. L. Blaisdell was in charge.

The Carborundum Company, Niagara Falls, N. Y., exhibited a number of its products, such as carborundum wheels, paper, cloth and other carborundum specialties, and carborundum fire sand for lining brass furnaces. The company was represented by F. H. Manly, E. J. Eames, Emil Ulrich and Eugene Ulrich.

The Chicago Car Heating Company, Chicago, showed a vapor system of car heating and a number of improvements in car-heating specialties. The company also had on exhibition a standard straight steam-heating system. It was represented by E. H. Schrieber, T. F. Downing and E. H. Gold.

The Cling-Surface Company, Buffalo, N. Y., showed a model equipped with a treated and an untreated belt. The treated belt was running slack, and the untreated one tight. The company was represented by Charles F. Chase and Joseph E. Sherry.

The Consolidated Railway Electric Lighting and Equipment Company was represented by Col. John T. Dickinson, T. L. Mount and P. Kennedy. The company had an exhibit on the veranda of the Manhattan Beach Hotel, showing an axle-driven dynamo and electric train lighting system

The Consolidated Car Heating Company, Albany, N. Y., exhibited steam-heating apparatus; also an automatic coupling apparatus and automatic traps. There was also shown in operation an automatic axle-lighting system. The company was represented by Francis C. Green, Cornell S. Hawley, James F. McElroy, W. S. Hammond, Jr., S. B. Keys and C. C. Nuckols.

The Dearborn Drug and Chemical Works, Chicago and New York, exhibited a number of chemicals used for water softening. William H. Edgar, W. B. McVicker, Robert F. Carr, Robert W. Francis were in charge.

The Joseph Dixon Crucible Company, Jersey City, N. J., exhibited Dixon's graphite lubricants and Dixon's silica graphite paint. H. A. Nealley, G. P. Hutchins and C. H. Spotts were in charge.

The Electric Controller and Supply Company, Cleveland, Ohio, showed the Deutsch electric train-lighting system in operation. It was represented by I. Deutsch, W. W. Adams and W. A. Ten Winkel.

The Electro-Dynamic Company, Bayonne, N. J., had a number of its "Interpole" variable-speed motors in operation at the Manhattan Beach Hotel. G. H. Condict, H. McL. Harding and T. B. Peck, Jr., represented the company.

The Foster Engineering Company, Newark, N. J., had on exhibition the different types of valves manufactured by it. These included reducing, stop and back-pressure valves, and valves for use in train-heating systems. The Foster pump governor was also shown. H. C. Foster and J. D. Owen were in charge.

The General Electric Company, Schenectady, N. Y., exhibited a mercury arc rectifier in operation and a system of straight and automatic air-brakes. The company also had on exhibition automatic block signal apparatus and a moving picture showing a race between the new electric locomotive built for the New York Central & Hudson River Railroad Company and a steam locomotive drawing one of the regular passenger trains. The company was represented by Gen. Eugene Griffin, J. R. Lovejoy, J. R. McKee, William J. Clark, L. R. Pomeroy, W. B. Potter, A. H. Armstrong, F. H. Gale, C. L. Pierce, H. D. Hawkes, W. M. Wright, E. M. Kinney and M. B. Jones.

The Gold Car Heating and Lighting Company, New York, exhibited car-heating apparatus, car-lighting apparatus and regulators for car heat. E. E. Gold, John E. Ward, W. E. Banks, B. H. Hawkins, A. E. Robbins, W. H. Stocks and Richard Voges were in charge.

The Goldschmidt Thermit Company, New York, made demonstrations every day of the welding of steel by the Goldschmidt process. W. M. Carr was in charge of the exhibit.

The Gould Coupler Company, New York, exhibited an electric car-lighting system and various forms of couplers, draft gears and brake apparatus. W. S. Gould, F. P. Huntley, T. L. McKeen, S. R. Fuller, George T. Milne, M. H. Sheed, W. R. Turbayne and W. F. Richards represented the company.

The International Correspondence Schools, Scranton, Pa., had an exhibit showing its method of instruction by correspondence. W. N. Mitchell, J. F. Cosgrove, Edward M. Sawyer and C. B. Congor were in charge.

The H. W. Johns-Manville Company, New York, had an exhibit showing various forms of coverings and non-heat-conducting materials. J. E. Meek, J. C. Younglove and L. B. Melville were in charge.

The Pedrick & Ayer Company, Plainfield, N. J., exhibited portable tools for railroad shops. The company was represented by R. O. Cumback and F. S. Healey.

The Pyle-National Electric Head Light Company, Chicago, exhibited a number of electric headlights for locomotives. Mark A. Ross and J. W. Johnson were the company's representatives.

The Robins Conveying Belt Company, New York, had a working model of a sixteen-inch convever on exhibition. The model showed discharge spouts, automatic reversible tripper, and different angles of working. A. B. Proal, Jr., E. S. Stadelman and Thomas Robins represented the company.

The Safety Car Heating and Lighting Company, New York, exhibited in the Oriental Hotel and in a Long Island Railroad car on the exhibition track its system of car lighting by the incandescent mantle system. The company also exhibited its steam-heating apparatus. R. M. Dixon, E. F. Slocum, William St. John, W. H. Hooper, F. A. Brastow, J. S. Henry, B. V. H. Johnson, G. E. Hulse and A. Sebold represented the company.

The Sprague Electric Company, New York, exhibited steel-armored steam and air hose and flexible armored conduit and cables. The company also had in operation a one-ton stationary electric hoist and a four-ton traveling electric hoist. A. C. Bakewell, E. H. Watlington and F. S. Douglass were in charge.

The Standard Coupler Company, New York, exhibited a standard steel platform with attachments, and also Session-Standard friction draft gear. George A. Post, A. P. Dennis, E. H. Walker, R. D. Gallagher and A. N. Cook represented the company.

The Standard Paint Company, New York, had an exhibition of Ruberoid roofing, and also insulated papers and preservative paints. It was represented by Ralph L. Shainwald, J. N. Richards, Paul M. Wade, Charles Earnshaw and J. H. Thomas.

The Star Asbestos Manufacturing Company, New York, exhibited a line of high-pressure asbestos packings. Edward D. Farmer, president; John R. Robinson, vice-president; J. D. Drew, treasurer, and G. E. Sutton, secretary.

The United States Lighting and Heating Company, New York, had in operation its system of car-lighting by means of a dynamo belted to the axle. It was represented by A. S. Adler, H. K. Brooks and Morris Moskowitz.

The Walworth Manufacturing Company, Boston, had an exhibition of injectors, valves and pipe tools. It was represented by George E. Pickering and George Elliott.

The Westinghouse Air Brake Company, Pittsburg, Pa., had an exhibition showing the Westinghouse friction draft gear and a number of air brake outfits. The company was represented by H. H. Westinghouse, E. M. Herr, E. L. Adreon, N. F. Niederlander, C. R. Ellicott, A. L. Humphreys, J. R. Ellicott, H. S. Kolseth, Frank Whitney, F. M. Nellis, George Baker, T. R. Burton, Walter V. Turner, Robert Burgess, James S. Siegrist, S. D. Hutchins, L. F. Purtill, R. H. Blackall, F. V. Green and S. J. Kidder.

The Westinghouse Air and Automatic Steam Coupler Company, St. Louis, Mo., showed the Westinghouse air and steam couplers. The company was represented by N. F. Niederlander, E. L. Adreon and R. E. Adreon.

The Wheel Truing Brake Shoe Company, Detroit, Mich., exhibited a number of abrasive brake shoes for truing flat wheels. J. M. Griffin was in charge.

The Yale & Towne Manufacturing Company, New York, showed a number of chain blocks, electric hoist and overhead trolleys, and also different types of Yale locks. The company was represented by C. W. Beaver and William Hazleton.

Digitized by Google

Reviews of Current Engineering and Scientific Literature.

Notes on the Compensated Single-Phase Shunt Motor.

In these two articles M. J. Bethenod discusses, at some length, the theory of the single-phase compensated shunt motor, a design due to Latour. The motor differs from the so-called single-phase commutating type in having the field circuit connected in parallel with the armature circuit, and in having, in addition, a pair of short-circuited brushes. There are thus three circuits, one through the shunt field, one through the series field, armature and a regulating resistance, and the third through the short-circuited brushes. This peculiar arrangement has the following characteristics: the speed is practically constant for a given condition, and in this respect the motor may be compared with the direct-current shunt motor, as it is a constant speed machine. The power-factor may be regulated, which is an advantage in point of view of the supply system. Although the starting effort is slight, this is not an inconvenience, since the motor may be started as a repulsion motor. When the speed of the motor exceeds that of synchronism, it may be used as a generator, and return power to the line. The motor commutates well at or near synchronism. It is the only design of a single-phase commutating motor which gives a constant speed, and it is thought that it will become an important type in the future.—*Translated and abstracted from L'Éclairage Électrique (Paris), March 4 and May 27.*

The Zirconium Lamp.

In a summary which is given here of the new types of lamp, M. Léon Versé describes the zirconium lamp, which is due to Wedding. The filament is made by mixing the oxides of zirconium with those of magnesium, and submitting them, at a high temperature, to the action of hydrogen. A compound is thus formed. This is then pulverized and mixed with cellulose, so as to form a plastic, homogeneous mass, which is squirted to form filaments. The filaments are subsequently carbonized in an atmosphere of oxygen, and then present a metallic appearance. One kilogramme of zirconium is sufficient to produce 100,000 filaments. The lamp may be sold at about fifty cents, and its specific energy consumption is about two watts per candle. Lamps are now made for thirty-seven or forty-four volts, and are used three in series on 110-volt circuits, or five in series on 220-volt circuits respectively. For luminous intensities of from 60 to 100 candles several filaments are connected in series and mounted within the one globe. Tests indicate that the lamp has a life of from 700 to 1,000 hours.—*Translated and abstracted from the bulletin of the Société Belge d'Électriciens (Brussels), May.*

The Single-Phase Railway System in Italy.

A description is here given by Mr. E. A. Kerbaker of the single-phase railway system as it has been applied to an electric road running from Rome to Civita Castellana. The traffic along this road is not dense, but the district is not served by any other road. The construction of the road has been commenced. The Westinghouse single-phase system will be used. The line is thirty-three and one-half miles long, and eventually will be forty-six miles long, as an extension will run to Viterbo. The district is mountainous, and some of the grades are steep, one being fourteen per cent. The power station will be at Ponte Milvio, two and one-half miles from Rome. It will be equipped with steam turbines rated at 300 horse-power, driving single-phase alternators. The supply will be at twenty-five cycles, 6,000 volts. The track has a gauge of one metre. The rails weigh seventy pounds per yard over that section of the road nearest Rome, and forty-two pounds beyond. The track is laid down on the old Via Flaminia. Only one side of the track is bonded, except between Rome and the power station. The pressure will be 550 volts on this section where there are two No. 00 trolley wires, while the other part of the road has but a single No. 0 trolley wire. This wire has a figure 8 section, attached to mechanical cars made of steel, and suspended so as to obtain double insulation. Two porcelain insulators are suspended by brackets by means of bolts. These are tested up to 20,000 volts. The second insulation consists of two insulators, to the ends of which are fixed, with a special cement, two hooks which hold the steel suspension wire. These insulators are tested at 40,000 volts. Chestnut poles from twenty-eight to thirty feet long are used. On these are mounted three insulators, two for the telephone service, and the third for the pilot wire. This pilot wire is to protect the system and persons in case the line should break. The trolley wire on the high-voltage section is continuous. Where turnouts are necessary it takes the form of an S, doubling back on itself so that there will, at no point, be two live wires connected in parallel. The pilot wire is attached to the far end of the trolley wire, while at the power-house it is attached to one terminal of the primary of a transformer. The other terminal is connected to the rail. The secondary of this transformer supplies a small current to an electromagnetic switch, holding it open as long as the trolley wire is unbroken. Should the trolley wire break, the current will be interrupted, the switch will drop and open an oil circuit-breaker. There is also an overload relay which trips the circuit-breaker when the main current exceeds a certain value. The cars are mounted on four-wheel trucks, each is equipped with two forty-horse-power, 250-volt, twenty-five-cycle, single-phase motors. There is one main transformer for primary pressures of 550 and 6,000 volts, and for a secondary pressure of approximately 250 volts.—*Abstracted from the Electrical Review (London), June 2.*

A Plea for Larger Units.

In this communication Mr. W. A. Vignoles, electrical engineer for the Grimsby Electricity Works (England), considers the saving in steam which would be effected if his plant were equipped with 1,000-kilowatt units instead of smaller units. At present there are installed two 220-kilowatt, four ninety-three-kilowatt, and two forty-four-kilowatt generating sets. The results of a test of this plant were given in the London *Electrician* for April 28. Mr. Vignoles estimates that the auxiliaries will require 5.7 pounds of steam per kilowatt-hour; that the 1,000-kilowatt units will require about 700 pounds of steam per hour at no load. The forty-four-kilowatt sets used at the present time take at no load only 130 pounds of steam. The auxiliaries will require about the same amount in either case. Against the saving at light loads due to the smaller units must be reckoned a saving in the reduced condensation, in the steam range, and in the leakage of drains which would be effected if the larger units

Digitized by Google

were installed. This is assumed to be about five per cent of the steam required at no load. From these data curves are plotted, according to Willans straight-line law, which show that the steam consumption per kilowatt-hour will be greater for the 1,000-kilowatt set than for the smaller at any load up to sixty-five kilowatts, but at any load above this the larger unit takes less steam. If the mean load on the plant during running hours be known, the saving in steam consumption by using the large unit can be determined. During the year ending March 31, 1905, the average load on the Grimsby plant was 160 kilowatts, and the saving in steam per hour by using a 100-kilowatt set would therefore have been about 700 pounds. The plant was in use about 7,209 hours, hence the total steam saved would have been over 5,000,000 pounds; and allowing six and one-quarter pounds of water evaporated per pound of coal, a saving of 360 pounds of coal, costing $472.50, would have been made. The author lays emphasis upon the desirability of having a standard size of unit. By the method outlined the largest size desirable can be determined, and the necessary power obtained by putting in as many of these sets as are needed.—*Abstracted from the Electrician (London), June 2.*

The Serius Accumulator.

A description is here given by M. Paul T. Pausert of a new French storage battery which is thought to have some decided advantages. The author first explains the necessity for a new type by pointing out the disadvantages of other types. Plates cast in the ordinary way can not be made to have large surface because, if the ribs are thin, the plates can not be taken out of the mould, and, besides, a cast plate is never perfect. The surface can be increased by machining the plate, but when an ordinary cutter is used, the blanks must be made of rolled lead, because the cast plate will not stand the work. The Serius plate belongs really to the latter type, but the machining is done in such a way as to make possible the use of a cast blank. The blanks are cast to the exact dimensions, and with all extensions necessary for suspension and electrical connection, except they are thinner than the finished plate. These blanks are then placed in a special machine furnished with rows of conically-shaped cutters arranged on each side of the plate. The machine is designed so that these cutters can be changed or can be brought closer together or moved further apart. The blank plate is placed in a frame which is oscillated rapidly back and forth between the cutters. The latter are gradually advanced. The action is rather that of rolling deep grooves into the plates than of cutting grooves. It not only raises the ribs on the surface so as to make the plate thicker, but the action of adjacent cutters is to compact the lead, making each rib solid and perfect. The thickness of these ribs may be not more than 0.2 of a millimetre. The cutters are spaced so as to divide the plate into sections of ribs, each section being separated from the next by a thicker portion of the lead. This process enables a cast plate to be used, produces a plate of uniform character, and is rapid. No data as to the performance of these plates are given.—*Translated and abstracted from La Revue Électrique (Paris), May 30.*

The Blake-Morscher Electrical Ore Separator.

A description of the Blake-Morscher electrical ore separator is given here by Mr. A. M. Plumb. As is well known, this device takes advantage of the different rates at which conducting and non-conducting particles become charged when passed over an electrically charged surface. The ore is ground fine and passed over a metallic roller charged by a static machine. The conducting particles are repelled, but the others are not affected, so that a separation is thus obtained. This separation is not perfect, however, but by properly dividing the stream of particles any desired degree of separation can be obtained. Results are given showing the performance of the machine when treating different kinds of ores. An ore which was useless before treatment became worth thirteen dollars per ton for the zinc, and two dollars for the silver which it contained after passing through a Blake machine. The machine may be used for separating zinc and iron, zinc and lead, for concentrating copper ores, and for concentrating gold ores containing iron. In an instance mentioned, seventy-four per cent of the gold was saved, the concentration being increased from 0.8 ounce to 2.42 ounces per ton. The charging current may be supplied by any improved type of static machine. The one used in the experiments mentioned was driven by a three-eighths-inch belt. Two men are sufficient to take care of a plant containing three machines during one shift.—*Abstracted from the Mining Magazine (New York), June.*

Purifying Drinking Water by Electricity.

United States Consul-General Guenther, Frankfort, Germany, communicates the following:

The Frankfort *News* states that it is probable that electric purification of drinking water will soon be introduced into the home. This method, already used by a number of municipal waterworks, is based upon the germ-killing effects of ozone, which is cheaply engendered by electricity. If an electric discharge takes place between two glass tubes, one inside the other, whose surfaces facing each other are coated with metal, ozone is developed in the space between the tubes.

Electricians have tried in recent years to simplify the means of electric ozone development for purifying water. The ideal apparatus would be one which every housekeeper could put in the kitchen, and by utilizing the electric current of the common electric light wires purify every glass of drinking water. According to the Frankfurter *Umschau,* such an apparatus seems to have been successfully made by a French engineer, Mr. Otto.

This apparatus is of very simple construction and takes up little space. It consists principally of a small, closed box, the metal cover of which is made conductory with the bottom. In the box is an ozone developer, an interrupter, and a tin tube. Through the latter the ozone, which first has to pass through a cotton stopper to free it from dust and germs contained in the air, is conducted into the water and mixed therewith. If much ozone has been absorbed, the water becomes phosphorescent in the dark. The most important part of the apparatus is the "mixer," action of which can be interrupted at will. The apparatus is capable of purifying about sixty gallons of water an hour, and the cost per hour is about the same as that of an ordinary electric incandescent light.

The Celebes-Guam Cable.

It is stated that the cable steamer Stephan, of the North German Cable Works, of Nordenham, has completed the laying of a cable between Menado-Yap and Guam, for the German-Holland Telegraph Company, of Cologne. The length of this cable is nearly 2,000 miles, its weight about 4,000 tons, and the greatest depth attained, 2,300 feet. By this cable the Dutch-India colonies and the German Carolines are placed in communication with the American Pacific cable. The Stephan is now proceeding to Shanghai to lay a cable 130 miles in length along the coast, which will form part of the Shanghai-Yap cable, of which the main line is now being constructed by the North German Cable Works, and which, it is expected, will be laid next winter.

Digitized by Google

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Method of Testing Lubricants.

United States Commercial Agent Harris, Eibenstock, Germany, communicates a new method of testing lubricants.

In some cases the thickness of the oil is the more important factor, in others the internal frictional resistance. In the few main bearings of large machinery less importance attaches to the internal frictional resistance than to the requisite viscosity of the lubricant at the highest temperature likely to occur, so that a sufficiently thick supporting layer between the rubbing surfaces will be maintained in spite of the high pressure on the bearings; for in this case the loss by friction is of little moment in comparison with the total output of power. In other cases, however, where the losses due to friction

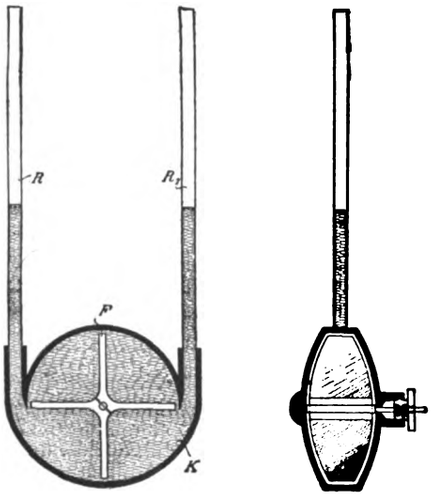


FIG. 1.—FRONT AND SIDE ELEVATION OF OIL-TESTING APPARATUS.

in the bearings constitute a large proportion of the entire power consumed, as, for example, where extensive shafts drive numerous small machines, any slight addition to the frictional resistance at each bearing surface has a marked influence upon the total consumption of power. This, of course, affects the economy of working, and in such cases an oil should be chosen which minimizes the frictional resistance.

For the purpose of determining these two characteristic physical properties the Gebrüder Körting Electrical Company (Limited), Berlin, has devised an important method of testing lubricants. The following description will serve to give a clear idea of the machinery used. In Fig. 1, K is a closed chamber which is filled with the lubricant to be tested. Within this chamber a fan F is made to rotate, the driving shaft projecting from the side of the chamber through a stuffing box. The fluid in chamber K has two communicating tubes, R and R_1, fitted to it, in

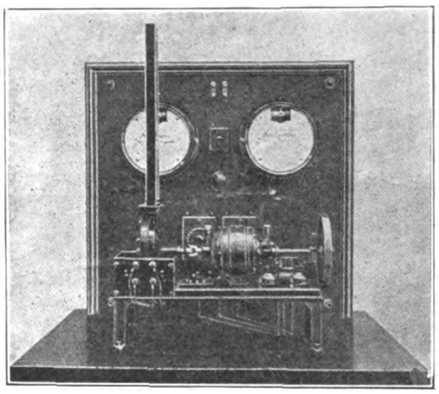


FIG. 2.—FRONT VIEW OF APPARATUS FOR TESTING LUBRICANTS.

which the lubricant rises about to the middle. When the fan is started the oil in the chamber is compelled to participate in the motion, and hence friction is established between the moving portion of the lubricant in the chamber and the stationary portion in the tubes. The frictional resistance thus produced causes the oil to rise in one tube and to fall in the other. The difference in the levels of the fluid columns, taken in conjunction with the specific gravity and temperature of the oil and the velocity of motion, affords a measure for the internal frictional resistance of the lubricant.

Figs. 2 and 3 show an apparatus by

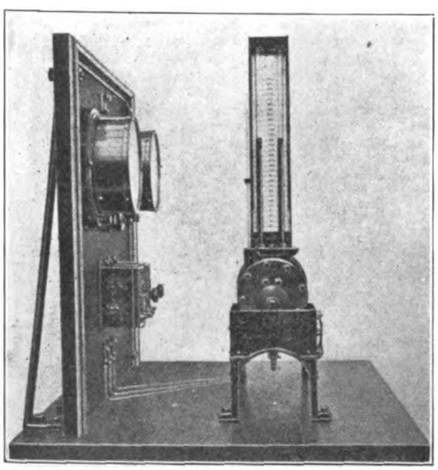


FIG. 3.—SIDE VIEW OF APPARATUS FOR TESTING LUBRICANTS.

means of which various lubricants may be tested by the method just described. In front will be seen the chamber with its two vertical tubes. The chamber rests in a large vessel serving as a heating bath. The shaft projecting through the side of the casing is coupled to a small electric motor, by which the fan is set in motion. The uniformity of the motion is increased by a small flywheel. The speed of the electric motor is variable within wide limits, so as to afford a convenient means of determining the connection between the frictional resistance and the velocity, and the bath surrounding the oil chamber, which may be heated electrically or in some other suitable manner, provides means of testing oils at different temperatures. The energy consumption of the motor also furnishes a measure for the viscosity of various lubricants used under similar conditions, that is, when temperature and speed is the same; or a particular oil may be tested at different temperatures with a constant speed.

The speed of the motor is regulated by finely graduated resistances, and the revolutions are counted by a speed counter, while the energy used is indicated by an ampere-meter and voltmeter, and the temperature by thermometers. The result of the test is readily ascertained after a few readings. This method enables factory managers to select lubricants best adapted for their plants and to test the value of lubricating oil offered to them.

The Ganz System of Three-Phase, Alternating-Current Electric Traction in the United States.

The Ganz system of three-phase, alternating-current electric traction, well known in Europe, is to be introduced in the United States. This system is to be exploited by the Railway Electric Power Company, in which several New York capitalists and railroad men are primarily interested. The company has acquired the electric traction patents and manufacturing rights of Ganz & Company, of Budapest. These rights, etc., cover the United States, Mexico, Cuba and all the West Indies other than those under British supremacy.

The board of directors of the company is composed of John E. Borne, president of the Colonial Trust Company; William L. Bull, of Edward Sweet & Company; Henry Seligman, of J. & W. Seligman & Company; Stephen Peabody; H. R. Duval, of the Atchison, Topeka & Santa Fé Railroad; Leopold Wallach, of Wallach & Cook; Henry L. Sprague, of Stetson, Jennings & Russel; Gustav Lindenthal, commissioner of bridges; and Gustave Leve. L. B. Stillwell, electrical director of the Interborough Rapid Transit Company, and Frank N. Waterman are the consulting electrical engineers.

Digitized by Google

TYPO-TELEGRAPH.

BY FREDERICK J. SWIFT.

This new principle of printing telegraphy was originated by Dr. George A. Cardwell, and is fully covered by patents in this and foreign countries. Three impulses only are required for each character printed, and all impulses for every character are of the same duration. The mechanism required at every station will not cover, for both sending and receiving apparatus, more than twelve by twenty inches on any table, and can be carried from place to place by any one. There is no tape sending or receiving. A copy of the message sent is printed in page form immediately before the operator's eyes. Any reasonable number of stations can be operated from the one place and the system can be duplexed or multiplexed. The fundamental principle is the selective permutation of local circuits, by means of combinations of plus and minus line impulses.

The selective scheme is based on the number of permutations of four things, taken three at a time. The transmission of a character, or the execution of a distant function, is performed by executing three of four possible functions in the proper order. Therefore the system may be worked over one wire with earth return, by means of plus and minus line impulses of two current strengths, or it may be worked over two wires with earth return, by means of plus and minus impulses on each wire of only one current strength.

The number of permutations of four things, taken three at a time, is twenty-four, when no permutation contains a repetition. Including repetitions there are sixty-four possible permutations. On account of the tailing of impulses in the line, the permutations having successive repetitions were discarded, leaving thirty-six useful permutations. Of this thirty-six only twenty-seven are needed for the characters and five for auxiliary functions —a total of thirty-two. The permutations in use for line signaling are shown below. That is, 1 and 2 may be respectively plus and minus line impulses of one current strength, and 3 and 4 plus and minus of a second current strength; or 1 and 2 may be impulses on one wire and 3 and 4 on a second wire.

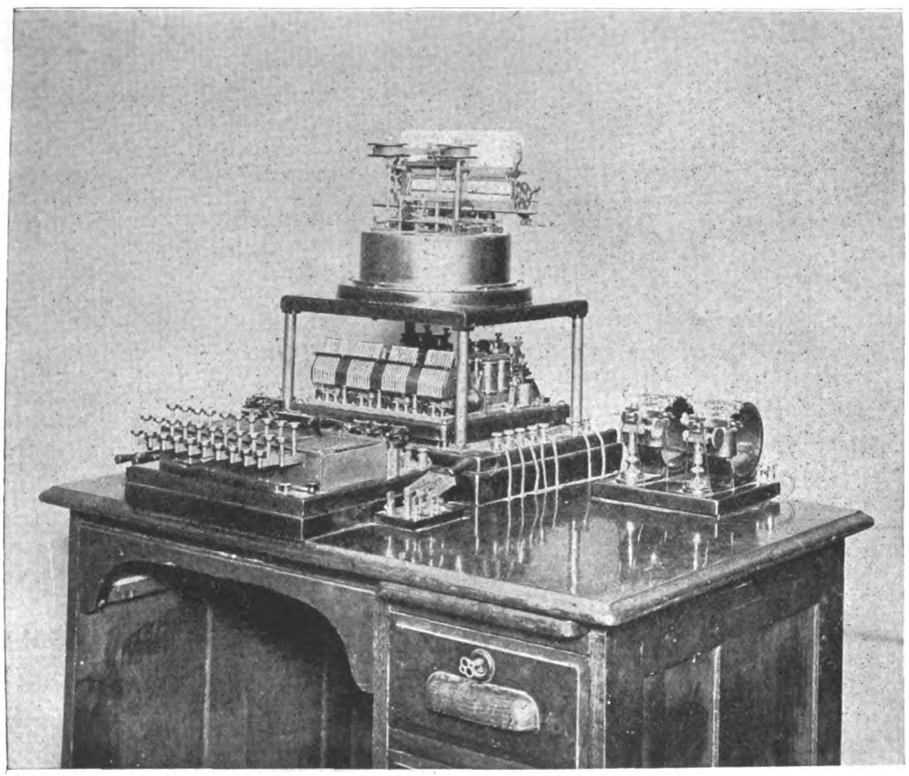


FIG. 1.—COMPLETE TYPO-TELEGRAPH STATION

SPACE	1-2-1
A	1-2-3
B	1-2-4
C	2-1-4
D	2-1-3
E	2-1-2
F	3-2-4
G	3-2-3
H	3-2-1
I	1-3-2
J	1-3-1
K	1-3-4
L	4-1-3
M	4-3-2
N	4-3-1
O	2-3-2
P	2-3-4
Q	2-3-1
R	1-4-1
PERIOD	1-4-2
S	1-4-3
T	2-4-1
U	2-4-3
V	2-4-2
W	4-1-4
X	4-2-3
Y	4-1-2
Z	3-1-4
FIGURES	3-4-3
CAR. RETURN	3-4-1
LINE SPACE	3-4-2
FIG. RELEASE	4-3-4

The keyboard from which these impulses are sent is of the universal type, and is arranged to close the local circuits of a series of magnets, which in turn transmit the line impulses. The impulses are of the same length, with equal intervals between the three impulses: the lengths of impulse and interval are controlled by interposing a series of local relays in the transmitting circuit, each of which energizes the next, etc., the last one closing the line circuit.

A general view of one complete station is shown in Fig. 1.

The three essential groups into which the mechanism may be divided are the keyboard transmitter, the distributor and the printer. The home record of transmission is obtained from the home line relays, which in turn operate the home distributor and the printer, and therefore it is possible to "break" the sending, from the distant receiving station, and the home record shows that the line is operating properly. Further than this, the combination of local locking relays in the transmitting circuit is unlocked only when the home printer is executing its record of the transmitted signal.

The principles and the circuits of the transmitter are illustrated in Fig. 2. The keyboard contains thirty-two keys, of which twenty-seven are for printed characters, the remaining five being the "spacing," "line space," "carriage return," "shift to figures" and "release." Each key lever is arranged to depress three of twelve bars, as shown in the figure; each bar closes a single contact. The six local relays are arranged to control the interval between the impulses, as well as the length of impulses; there may be more or less than six of these relays, according to the desired speed. The first impulse goes directly to line, when a key is depressed; the second follows when the distributor acts and local relay No. 2 is closed; the third takes place when local relay No. 6 acts, and the whole set of local relays is unlocked when the distributor unlocks and the circuit of local relay No. 1 is thereby opened.

Trace the transmission of the letter N. The combination is 4-3-1; this means a

Digitized by Google

negative impulse on L 2 followed by a positive impulse on L 2, and then a positive impulse on L 1. Depressing the key N on the keyboard will close the following contacts on the rear of the keyboard, as shown in Fig. 4: No. 1 in the group K, No. 2 in the group L and No. 3 in the group M. No impulses will pass to the line until K-1 is closed and then a negative impulse passes to the line L-2; the polar line relay in L-2 will close the distributor; and the circuit of local relay No. 1 will thereby be closed. Local relay No. 1 will close local relay No. 2, and No. 2 will throw the switch C-1 to its other position, opening the circuit through K-1 and closing the line L-2 through the contact 1-2, sending a positive impulse over L-2. Local relay No. 2 will close No. 3 and No. 3 will close No. 4, etc., until No. 6 is closed. Local relay No. 6 will switch the contacts C-2 to the other position, opening the circuit through 1-2 and closing the line L-1 through the contact M-3, sending a positive impulse over L-1.

On the third impulse the distributor completes its permutations and actuates the printer; at the same time the distributor currents are automatically unlocked, and the circuit of local relay No. 1 is thereby opened by the distributor. The whole bank of six local relays then unlocks, and all circuits and contacts are in readiness for the transmission of another character.

The distributor circuits are shown in Fig. 3; the locally permuted printing circuits are shown in full, although some of the auxiliary relay circuits and contacts have been omitted in order to show the principle more clearly. All of the functions, however, will be described. The polar line relays and their line connections are shown at the top of the figure. The process of selective permutation involves three consecutive steps, and upon the completion of the third step the permutation is completed and a selected circuit, containing battery, is closed, while the function corresponding to the combination of three-line impulses is duly executed. The two-line relays control four local circuits, each of which contains a self-locking relay; these relays are shown as 1, 2, 3 and 4 in the figure. Relay No. 1 controls the sets of contacts *a*, *a'* and *a''*; the contacts *a''* are operated by the relay 1' which is in series with relay No. 1, but does not lock; relay No. 1 is double-wound and the extra circuit is the locking circuit. That is, a + impulse on L-1 will close the contacts *a*, *a'* and *a''*, the contacts *a* and *a'* being locked and *a''* closed only momentarily.

Similarly, relay No. 2 controls *b*, *b'* and *b''*. The contacts *a*, *b*, *c*, and *d* are arranged on a shaft which is operated by the relay H, in the common return of the locking circuit; when the armature of one of the four relays is actuated, the relay H rotates the shaft slightly and the particular armature which is down will close its local circuit. The remaining three circuits will remain open until H is unlocked, because the contacts have been rotated into a position such that the relay armatures will not close them. That is, when any one of the four relays 1, 2, 3 and 4 operates, it closes and locks its contacts in the first and second groups and also locks open the three remaining contacts in the first group.

Trace the reception and printing of the character "N"; the line impulses are — on L-2 followed by + on L-2 and + on L-1. The first impulse will close relay No. 4, and will lock in a closed position the contacts *d* and *d'*, while *a*, *b* and *c* are locked open; the contacts *d''* will be closed momentarily. The second impulse will close and lock the relay No. 3, and its contacts *c'*; the contact *c* is locked open; the contacts *c''* will be closed momentarily. The last impulse will close relay No. 1; and when the contacts *a''* are closed the letter "N" will be printed, because a circuit has been established from the contact *d* to contact No. 4 in group *c'* and thence to the contact in series with the "N" magnet in the group *a''*. The other contacts in the group *a''* are closed simultaneously, but no other closed circuits are established. Likewise the contacts in the groups *a'*, *c'* and *d'* were closed, but again no closed circuits were established when *a''* closed, except through the "N" printing magnet. The distributor has selected and operated the "N" magnet, but the relays No. 1, No. 3 and No. 4 are still locked.

The magnet P, in the common return of the distributor, is double-wound, and the extra winding is arranged to make the magnet self-locking. This magnet P closes a circuit which actuates the printing hammer, by means of a local magnet

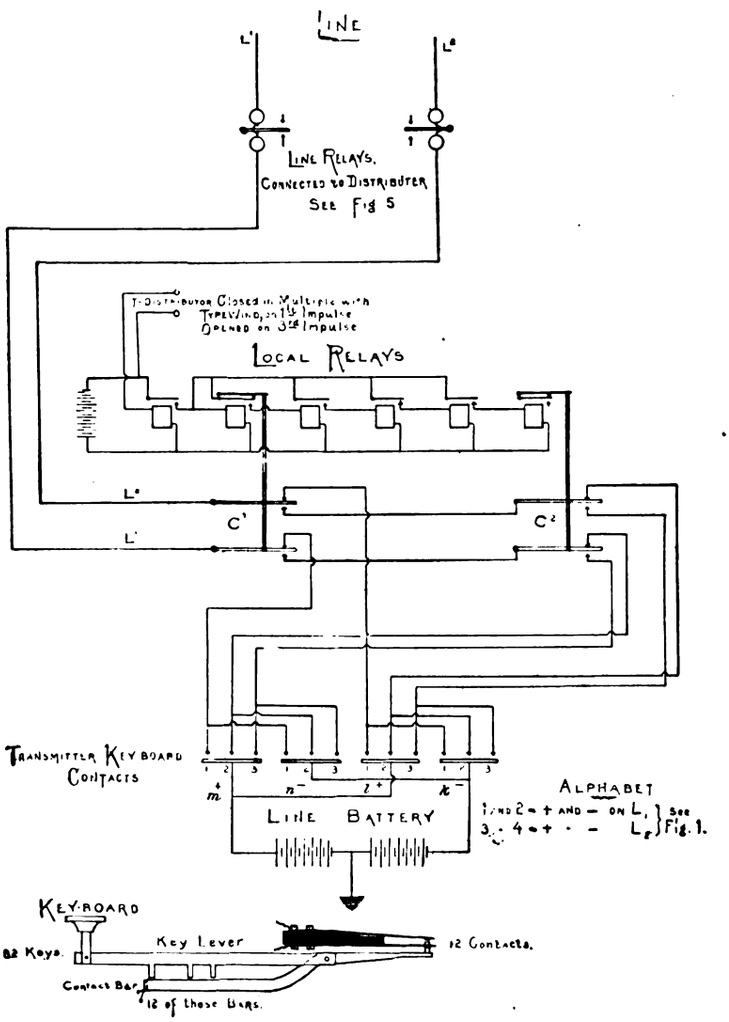
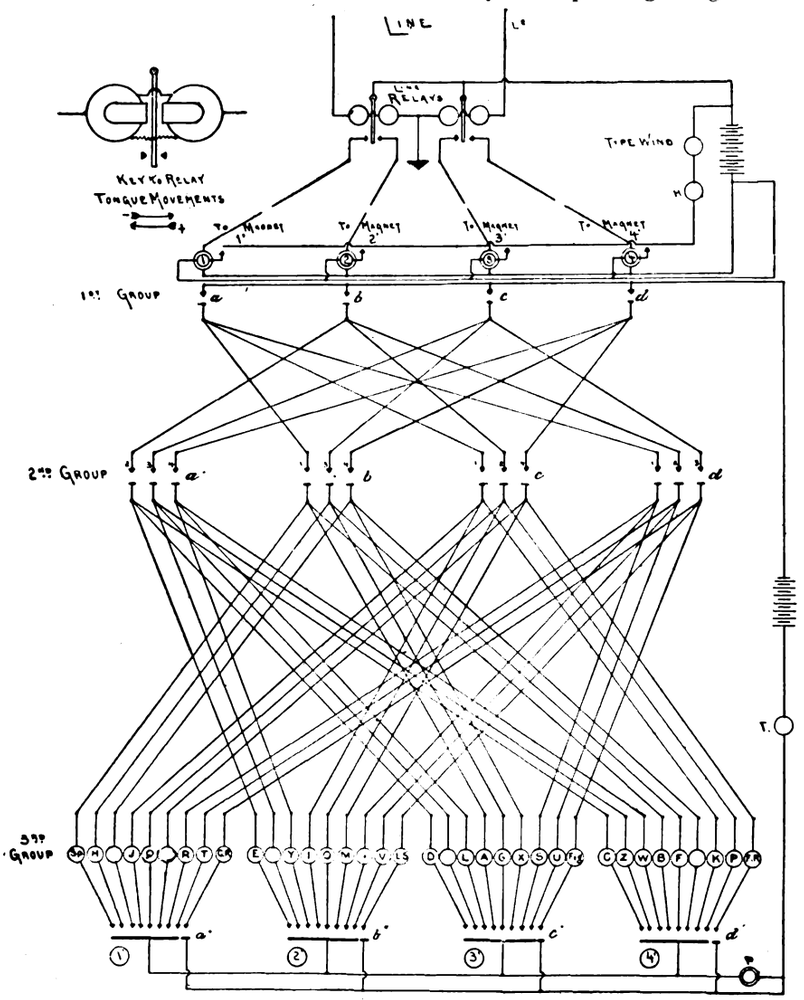


FIG. 2.—PRINCIPLES AND CIRCUITS OF TYPO-TELEGRAPH TRANSMITTER STATION.

Digitized by Google

on the printer. The locking winding of P is short-circuited by the local printing magnet which actuates the hammer. The magnet T breaks the locking circuit of the relays No. 1, No. 2, No. 3 and No. 4 and operates a trip magnet on the printer. The local circuits of P and T are so associated that their functions are executed in their proper order. The contacts for the "carriage return," "line space," "shift to figures" and "release" are completed through a separate return conductor, to avoid actuating the printing hammer.

It will be noticed, in Fig. 3, that the distribution of the circuits is such that



PRINTER, TYPO-TELEGRAPH STATION.

contacts in the first group close circuits to the other letters in the second group, and that contacts in the second group again close circuits to different letters in the third group; this arises from the omission of consecutive repetitions in the line signals and considerably simplifies the circuits and mechanism.

The printer contains twenty-nine local magnets, of which twenty-eight are shown in Fig. 3—the additional magnet being the trip magnet. The carriage spacing is effected by the magnet which actuates the printing hammer. There is one magnet for each of the functions, "line space," "carriage return," "shift to figures" and "release." The type-wheel spindle is actuated by a spring, which is wound by the type-wind magnet; this magnet is energized each time the distributor acts and is closed on the first impulse, as shown in Fig. 3. The type-wheel has two complete, circumferential rows of characters —one of letters and one of figures. The figures are brought into position by shifting the type-wheel along its axis. The type-wheel spindle is vertical, and carries a horizontal arm near its lower end. The twenty-nine printing magnets are arranged on a circular circumference, and each one, when energized, will raise its armature to a position in which it will engage the horizontal arm on the type-wheel spindle. The ends of these armatures which engage the arm on the spindle lie normally in radial slots in a horizontal disc. The armatures are normally horizontal, but when they are raised to engage the arm are clear of the disc, and are locked up by a slight rotary movement of the disc, which prevents their falling into normal position. The armature of the trip magnet will not, however, lock; and the function of the trip magnet is to release the armature last raised, just before the printing of another character. The trip magnet armature, when it is raised, moves the disc slightly in a rotary direction so as to release any other armature levers previously locked up. When a character is to be printed, the action of the trip magnet immediately precedes the raising of the armature which will stop the type-wheel in position for the characters to be printed. The action of the printing hammer actually prints the character; the printing hammer is actuated, as described, by the printing magnet.

The system as described works on the open-circuit plan. Intermediate stations may be employed. Sending from intermediate stations requires a line battery at the station. The system may also be operated on the closed-circuit plan, thus avoiding the necessity for separate line batteries at the intermediate offices. The voltages and currents employed are of the magnitude ordinarily used in commercial telegraphy; the normal strength of the line impulses is about thirty miliamperes—or 0.030 ampere.

The first commercial tests of the typo-telegraph were made on the Long Island Railroad Company's wires in 1901. A speed of fifty words per minute was readily maintained over circuits two hundred and forty miles in length, the longest obtainable on that road, of iron wire and in ordinary commercial condition.

Later tests were made over commercial telegraph circuits up to five hundred miles in length, with the most satisfactory results. The transmission is not interfered with by looping intermediate relays into line—which has been proven by actual trial. The various tests of the system have shown it to be commercial on ordinary telegraph circuits up to any distance commercially, operative without repeaters. As to the speed of working, no one has been able to operate the system at a speed so high that the mechanism was incapable of response. Speeds of fifty to sixty words per minute have been obtained by expert operators.

A series of very interesting tests has recently been conducted on the wires of the American Telephone and Telegraph Company. These tests were made over composited circuits from New York to Boston and return. The system was highly successful in this respect, and simultaneously telephony and printing telegraphy were practically demonstrated without interference with the telephone.

Digitized by Google

NEW YORK TELEPHONE COMPANY'S NEW DIRECTORY OUT.

EDITION FILLED TWENTY-ONE FREIGHT CARS AND WEIGHED 333 TONS—200,000 SUBSCRIBERS SHOWN.

Employés of the New York Telephone Company are now moving over 600 tons of paper, in blocks of two pounds, which means that the summer telephone directory has come from the press, and is being distributed, while the old telephone books are being collected. About one hundred and fifty men are at work on the task, which will take three or four weeks to complete.

The new directory is considered by the company to be the most satisfactory in every particular of any it has issued. Typographically it is a vast improvement over previous issues. Names of subscribers are run three columns to the page with the telephone number and exchange in heavy black-face type. The new book is much more compact than the old one, presents a neater appearance, and is much easier to handle.

It contains some 200,000 names, about one-half of which are subscribers in Manhattan and the Bronx. Twenty-one thousand names appear in this book which did not appear in the old one. Of this total gain about forty per cent was made in Manhattan.

The new directory represents twenty-five carloads of paper. After the books were printed, bound, and packed, it required twenty-one freight cars to carry them.

Although the directory is issued every four months, a dozen men are constantly at work on it. All changes, additions and removals are sent to the printer daily. They are at once issued as an addendum and forwarded each morning to the various exchanges, which are thus kept posted as to new subscribers, changes in address and number and removal of telephones.

When the new directories are delivered the old ones are taken away and are destroyed by the company. This is done for the protection and convenience of the subscriber, and to prevent the further use of the old books which would only result in errors. To do this work it really means that two complete editions shall be moved each time a new book is distributed.

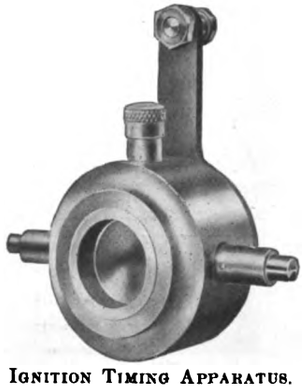
The very general use of the telephone directory as a general business and social register is one of the developments of the telephone business. Originally the telephone book was prepared as a guide for telephone users only, and no one dreamed that telephone service would ever reach such a stage of development that the directory of telephone subscribers would become the best general directory of New York and vicinity. Such is now the case, however. The telephone book is brought up to date and a new issue distributed every four months, which ensures a degree of accuracy almost absolute.

Nearly every firm or individual doing business in the city depends to a great extent on the telephone service, an important part of which is the listing in the telephone book. A very large proportion of residences in the city are likewise served by the company, and the result in listings in the book make the directory exceptionally valuable from its social side.

The accuracy, the convenience, and compactness of this book, together with its broad circulation, cause it to be used almost to the exclusion of all other directories in New York city.

A New Ignition Timing Apparatus.

The Atwater Kent Manufacturing Works, 112 North Sixth street, Philadelphia, Pa., has placed on the market a new form of timer embodying some new and original features. The aim of the manufacturer in producing this apparatus was to bring out a timer which would be mechanically perfect, simple to handle, and electrically durable. In the new form of timer the contacts have been given especial attention, and are guaranteed to have an extremely long life. The contacts are placed in the centre of the bearing, overcoming a large part of the ordinary strain and wear, and reducing to a minimum the possibility of the contacts getting

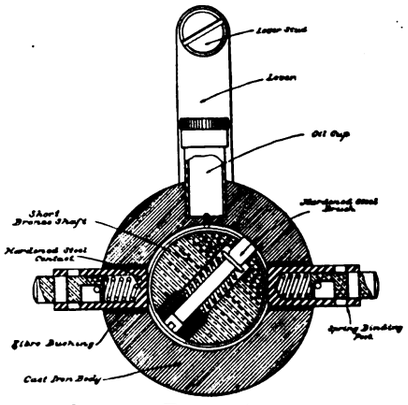


IGNITION TIMING APPARATUS.

out of alignment through wearing. The revolving part or shaft is made of phosphor-bronze, and the bearing in which this revolves is of cast iron. The stationary contacts are hardened steel, insulated from the casting by a hard fibre bushing. The brush is hardened steel, and rubs alternately against the cast-iron and steel contacts.

An oil cup located on the top provides oil for the two ends of the bearing. The manufacturer stated that it is impossible for dirt to get into the contact. There are no adjustments and no opportunity for any of the parts to get out of place.

The outside end of the contact forms the binding-post, which is of a special spring type. The end of the lever is provided with a stud for attaching the advancing rod. The hole for the shaft is made or-



IGNITION TIMING APPARATUS.

dinarily one-half inch in diameter. This, however, can be made of any desired size. The timers are made in one-cylinder, two-cylinder, three-cylinder and four-cylinder types.

Consolidation of Ingersoll-Sergeant Drill Company and Rand Drill Company.

The Ingersoll-Sergeant Drill Company and the Rand Drill Company, New York, have been united into a new company called the Ingersoll-Rand Company. The new corporation is formed under the laws of the state of New Jersey with a capital of $10,000,000, of which $5,000,000 is preferred and the balance common. The factories of the two companies are located at Phillipsburg, N. J.; Easton, Pa.; Tarrytown, N. Y.; Ossining, N. Y.; Painted Post, N. Y.; New York city, and Sherbrooke, Que.

The officers of the company are as follows:

President, W. L. Saunders, formerly president of the Ingersoll-Sergeant Drill Company; first vice-president, George Doubleday, formerly treasurer of the Ingersoll-Sergeant Drill Company; vice-presidents, Jaspar R. Rand, formerly president of the Rand Drill Company, John A. McCall, president of the New York Life Insurance Company, J. P. Grace, vice-president of W. R. Grace & Company, George R. Elder, general manager of the manufacturing department; treasurer, W. R. Grace, formerly secretary of the Ingersoll-Sergeant Drill Company; secretary, F. A. Brainerd, formerly treasurer of the Rand Drill Company. For the present the main offices of the new company will be located at 26 Cortlandt street, New York.

Digitized by Google

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW POWER PLANT IN GRAND COUNTY, COL.—Preliminary work is being done on the construction of a power plant in Grand County, Col. A system of storage dams will be built north of Grand Lake, and a plant with a capacity of 3,000 horse-power will be constructed. Three reservoirs and dams will be built, one dam being 150 feet in height. The system is expected to furnish power for the mines in the district, and also possibly for an electric extension of the Moffat road.

MERGER OF LIGHTING COMPANIES IN PENNSYLVANIA—The electric light and railroad companies of Sunbury, Northumberland County, Pa., have been merged. The new concern is known as the Northumberland County Railway and Light Company, and is capitalized at $1,000,000. The capital is divided into 10,000 shares of the par value of $100 each. Half of the stock is preferred, and will bear five per cent cumulative dividends. The other $500,000 is common. The companies consolidated are the Edison Electric Illuminating Company and the Sunbury & Northumberland Street Railway Company. The latter company also conducted a lighting plant.

POWER PLANT TO BE BUILT IN COLORADO—The South Platte Electrical Company has been formed to build a power plant on the south fork of the Platte river. Mr. James E. Rhodes, of Denver, has for some time been working on the formation of the company. He has property rights for the location of a plant on the river a short distance from Deansbury. The canon of the river at this point will be dammed, and a water-power plant installed. It is expected that 20,000 horse-power can be generated, which will be transmitted to Denver, a distance of about twenty miles. The company has secured a franchise from the city of Denver for the supply of electric current to power consumers in that city. It is expected that the plant will be in operation in about six months.

NEW POWER COMPANY CHARTERED IN CONNECTICUT—The Uncas Power Company, of Norwich, Ct., has received a charter from the general assembly of Connecticut. The company has an authorized capital of $1,000,000, and, under certain restrictions, may distribute electricity throughout New London County. It is specially empowered to deliver electricity to the Groton & Stonington Street Railway Company and to the Norwich, Mystic & Westerly Street Railway Company. It may issue bonds to the amount of three-quarters of its full-paid outstanding capital stock. Powers of merger with other enterprises and street railway companies are conferred on the corporation. Costello Lippitt and Edwin W. Higgins, of Norwich, and Charles W. Comstock, of Mottville, are among the incorporators.

REDUCTION OF ELECTRIC LIGHTING RATES IN NEW YORK AND BROOKLYN—A reduction in the rates for electrical service has been announced by the New York Edison Company and by the Brooklyn Edison Company, both reductions to take effect on July 1, 1905. The New York Edison Company has reduced its rate from fifteen cents to ten cents per kilowatt-hour. The rate in New York includes the supply of incandescent lamps and the trimming of arc lamps. The Brooklyn Edison Company announces that the new price will be twelve cents per kilowatt-hour for lighting purposes. This price is for all current consumed, regardless of the customer's connected installation or of the average daily time during which the current is used. The schedule for power purposes is ten cents per kilowatt-hour, subject to a schedule of reductions.

ELECTRICAL NOTES FROM MEXICO—A concession has been secured by William C. Green to utilize the waters of the Aros river in the state of Chihuahua for motive power. The concession authorizes the use of 10,000 litres of water per second from the river in the vicinity of the Guaynopa mine. The concession also authorizes the construction of a pole line or the use of underground wires. Surveys for the plant must be commenced within six months, and be presented to the secretary of works within one year. Construction must be commenced within two years, and must be finished within seven years. The concession also allows the building of telegraph and telephone lines throughout the works. The capital invested will be exempt from taxation. Arrangements are being made for the transfer of the concession for the construction of an electric railway from Guadalajara to Chamela, on the Pacific coast, which was granted to M. C. Miller, of Guadalajara, to the Jalisco Rapid Transit Company. Application for a charter for the latter company is to be made in the state of South Dakota. The capital will be $15,000,000.

ELECTRIC RAILWAYS.

GAS CITY, IND.—A franchise has been granted the Marion & Hartford Street Car Company for fifty years.

BLUFFTON, IND.—The Bluffton city council has granted a franchise to the Ft. Wayne, Bluffton & Marion Traction Company.

JONESBORO, ARK.—The Jonesboro city council has awarded to N. F. Lamb a franchise for the construction of a street railway line.

MAUCH CHUNK, PA.—The Tamaqua & Lansford Street Railway Company's line will be extended through to Lehighton this summer.

NEW YORK, N. Y.—The New York & Portchester Railroad has purchased terminal property valued at $85,000 at the point where it connects with the Interborough Rapid Transit.

PARIS, ILL.—Business men of Charleston, Ill., have subscribed $20,000 toward an interurban line to connect that city with Paris, as an extension of the present Mattoon-Charleston road.

CORRY, PA.—At a council meeting C. D. Northrup, of the Corry, Findley Lake & North East trolley, accepted the city franchise and filed a bond of $2,000. Work will start immediately.

CASPER, WYO.—A movement is on foot for the formation of a syndicate to construct an electric railroad from Casper to Alcova, the site of the government dam of the Pathfinder or North Platte project.

FAIRMONT, W. VA.—The contracts for the construction work of the line to Clarksburg, which will be built by the Fairmont & Clarksburg Traction Company, have been let, as have the contracts for the line from Fairmont to Barnstown, a suburb.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has asked the board of public works for a franchise to come into Indianapolis. The petition states that the line will be completed to Danville this fall. The intention is to build to Terre Haute.

MANSFIELD, OHIO—At the annual meeting of the stockholders of the Mansfield Electric Railway and Power Company the following directors were elected: Leopold and Rudolph Kleybolte, Cincinnati; H. M. Byllesby, Chicago; A. S. Huey, Chicago, and W. D. Breed, Cincinnati.

LEWISTON, WASH.—The Lewiston city council has passed the ordinance granting a franchise to Colonel Judson Spofford and associates for the operation of an electric street railway system to be operated in connection with the independent Lewiston-Grangeville electric railway line.

WHEELING, W. VA.—The Southeastern Ohio Railway, Light and Power Company, a local company, of which Colonel C. B. Hart is the chief promoter, has awarded the contract for the building of a trolley line between Zanesville and Crooksville, Ohio. The road will cost $600,000, and is to be fifteen miles in length.

TOLEDO, OHIO—Announcement is made that the Toledo & Chicago Interurban Electric Railway Company has increased its capital stock from $500,000 to $1,250,000, and the incorporators expect there will be no delay in beginning construction operations. The company was incorporated at Indianapolis about eighteen

Digitized by Google

months ago. The system is to connect Toledo and Chicago, traversing Northern Indiana counties. F. B. Perkins, of Toledo, is the electrical engineer.

HARTFORD, CT.—It is announced that the Hartford & Springfield Street Railway Company will take over the stock of the proposed new Rockville, Broad Brook & East Windsor Street Railway Company, and will issue $100,000 six per cent preferred stock to finance the transfer. The bill granting the latter company the right to make the extension has been passed by the legislature.

KANKAKEE, ILL.—The Kankakee city council has granted a twenty-year franchise to the Kankakee & Western Electric Railway Company to construct and operate a line on Station street west to the city limits from the Illinois Central tracks and on Fifth avenue from Station street north to Court street. The franchise contains the stipulation that the line must be in operation before the end of a year.

FORT WAYNE, IND.—The city council of Decatur has amended the franchise granted the Springfield, Decatur & Fort Wayne traction line so as to make the life of the franchise fifty years instead of thirty. The Fledderjohans, who are building the line, found it impossible to finance it, unless the time was lengthened. The council made it a condition that the company bind itself to maintain its power-house in Decatur.

BOSTON, MASS.—The New York, New Haven & Hartford Railroad Company is preparing to run trolley cars over its steam railroad between Rockville and East Hartford, Ct., connecting with the Hartford Street Railway Company's tracks at Hartford, so that electric cars can be run between Hartford and Rockville. It is estimated that the time between these points will be reduced from one hour and twenty-two minutes to forty minutes.

NEWARK, N. Y.—The board of railroad commissioners of the state has granted the Newark & Marion Electric Company authority to issue first mortgage bonds for $500,000, half of which may be issued at any time and the remainder on further application for consent. A large part of the construction work of this line has been completed and it is believed that it will be put in operation on the completion of the Rochester, Syracuse & Eastern.

KALAMAZOO, MICH.—The Kalamazoo common council has granted a franchise to the Kalamazoo & South Haven interurban line. This ensures the construction of an electric line between the cities named. Work will begin at once. S. J. Dunkley, of Kalamazoo; G. E. Barden, of Otsego; the Dewings and other capitalists are largely interested. It is hoped to have much of the road completed by fall. All of the right of way has been secured.

WHEELING, W. VA.—The announcement is made that the entire line of the Wheeling Traction Company, between the creek and Forty-eighth street, is to be rebuilt, costing in the close neighborhood of $200,000. The present comparatively light rails are to be replaced by ninety-pounds-to-the-yard rails. In addition a new car house and shop will be constructed, sites for which are being sought, and fifteen double-truck cars added to the rolling stock of the road.

LAFAYETTE, IND.—Work has been begun on the extension of the lines of the Fort Wayne & Wabash Valley Traction Company from the Soldiers' Home to Battle Ground, six miles. The extension is to be completed in time for the Battle Ground camp meeting on July 27. The board of county commissioners has ceded to the company a strip about a mile long between the battlefield and the Monon railroad. It is believed that by next year the interurban will connect with Logansport *via* Monticello and Delphi.

YOUNGSTOWN, OHIO—The Cleveland & Sharon Traction Company has been taken over by Philadelphia and New York capitalists and reorganized. The road, which was completed some time ago, will be completed as soon as possible, and when opened will connect Cleveland with Sharon and Youngstown, as at Sharon connections will be made with the Youngstown & Sharon and at Middlefield with a Cleveland line. The route of the new line will include Middlefield, Prespotamia, North Bloomfield, Kinsman, Orangeville and Sharon.

MEMPHIS, TENN.—Plans for building the Nashville and Huntsville railway, an electric line projected between Nashville, Tenn., and Huntsville, Ala., are assuming definite shape. The citizens of Huntsville and Madison County, Ala., have agreed to subscribe $60,000 to the capital stock of $3,000,000, and other towns will also help. President J. H. Connor, of Nashville, president of the company, believes construction will be begun this fall. The enterprise will be financed by the Municipal Bond and Surety Company, of New York.

VALLEJO, CAL.—Prospects are said to be excellent for an early start on the work of building an electric railroad between Vallejo, Benicia Suisun and Vacaville over the route of the franchises held by J. W. Hartzell. C. F. Archer, representative of the banking house of E. H. Rollins and Sons, has inspected the route and the resources of the country, and it is stated on good authority that upon his recommendation the banking house is now negotiating with a large eastern construction firm to take the contract for this line.

CHEYENNE, WYO.—Judge John Porter, owner of a street car line in Des Moines, Iowa, who went West to bid on the construction of the North Platte canal of the government, has offered to construct an electric street railway in Cheyenne at a cost of $100,000 if local business men will subscribe to 50,000 of the stock of a stock company to be formed. If suitable power can not be obtained from the Warren Electric Light Company at Cheyenne Mr. Porter will construct an independent power-house. The line will traverse the principal streets of the city and extend to Fort Russell.

LAPORTE, IND.—The South Bend Western Railway Company, which is the name under which the Indiana Railway Company will construct an interurban line from South Bend to Laporte, through New Carlisle and Rolling Prairie, has been formed. Articles of incorporation give the capital stock as $100,000. The officers are William L. Taylor, of Indianapolis, president; Mortimer H. Reed, of South Bend, second vice-president; W. W. Babcock, of South Bend, secretary, and Charles Lohman, of South Bend, formerly of Indianapolis, treasurer, with Fred W. Bueltzinslowen an additional director.

BALTIMORE, MD.—The Baltimore Terminal Company has asked permission of the Baltimore city council to construct and maintain what is intended to be the Baltimore end of the Washington, Baltimore & Annapolis Railway Company, which will link the three cities named. It is proposed to build a double-track road and to run cars at fifteen-minute intervals, making the trip between Baltimore and Washington in one hour. George T. Bishop, of Cleveland, Ohio, is president of the company, which is largely backed by western capital. Terminal rights have already been secured in Washington and Annapolis, it is said.

LEGAL NOTE.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY LITIGATION—In the United States Circuit Court of Appeals for the Third District, on an appeal by the Jefferson Electric Light, Heat and Power Company from the decision of the Circuit Court of the United States for the Western District of Pennsylvania, the court has overruled the plea of the appellant and affirmed the decree of the lower court, granting a preliminary injunction. The same court, under date of June 14, in the case of the Westinghouse Electric and Manufacturing Company, complainant-appellant, *vs.* the Stanley Instrument Company, defendant-appellee, denies the petition filed by the Stanley company on December 7, 1904, for leave to apply to the Circuit Court for leave to file a supplementary bill in the nature of a bill of review, or to amend the judgment on appeal.

NEW MANUFACTURING COMPANIES.

COLUMBUS, CHIO—The William Hall Electric Company has been incorporated by William Hall, Charles S. Hall, William Nichols, J. Edward Sallenberger and James A. Rickey. The capital is $18,000.

RICHMOND, VA.—Articles have been signed incorporating the Seaboard Electric Company. The incorporators are Arthur L. Bosley and Harry E. Karr, of Baltimore; Julien Binford, Jr., and William S. P. Mayo, of Richmond; J. W. Little, of Atlanta, and Thomas W. Dunk, of Jacksonville. The authorized capital stock of the new company is $50,000, and its purpose is to deal in electrical apparatus and supplies of every kind.

Digitized by Google

PERSONAL MENTION.

MR. JOHN MACK, who has been president of the Municipal Telephone and Stock Company, Albany, N. Y., has retired from that corporation.

MR. H. C. EDDY, electrical inspector in Washington, D. C., has tendered his resignation to the district commissioners. The resignation took effect June 15. Mr. Eddy has accepted a position with an engineering and contracting firm in New York.

MR. M. K. EYRE has been placed in charge of the factory of the Sawyer-Man Electric Company, New York city. Mr. Eyre has for a long time been connected with the incandescent lamp industry, and has taken a prominent part in the development of this apparatus. Mr. Eyre was graduated from Annapolis, resigning from the navy in 1894 to go into the electrical business. He became assistant to the manager of lamp sales of the General Electric Company, and in 1895 was appointed superintendent of the Edison lamp works at Harrison, N. J. In the latter part of 1895 he was made manager of works. He was a member of the manufacturing committee of the General Electric Company. In 1900 he became associated with the National Electric Lamp Company, having charge of the Fostoria plant, afterward becoming chairman of the manufacturing committee of the National Electric Lamp Company. He later became president of the Buckeye Electric Company. Mr. Eyre has been very successful in all of his connections with the above companies. His work has been particularly along the line of improving the product of the lamp factory and instituting shop economies which have resulted in a material reduction in the cost of lamp apparatus.

MR. M. K. EYRE.

MR. CHARLES E. SCHOLZ has taken charge of the filament department of the Sawyer-Man Electric Company, New York city. Mr. Scholz was graduated from the technological school at Stralsund, Germany, and spent about four years in commercial business before coming to the United States in 1879. In 1885 he engaged with the Schaeffor Company, Cambridge, Mass., in the manufacture of silk and bamboo filament. About that time Mr. Scholz and a Mr. Flock, a well-known lamp man of that time, began experimenting on cellulose, using different minerals to dissolve the raw material, achieving considerable success in producing a fine fibre. Owing to not having facilities for carbonizing this fibre, the product was given up for the time being. In 1892 the company located in Marlboro, Mass. Shortly after the Bryan-Marsh Company bought the factory to manufacture its own cellulose filaments. Mr. Scholz was placed in charge of the filament plant. This was successful from the start, the Marlboro plant not only supplying its own demand, but also the demand of other lamp factories for filaments.

MR. CHARLES E. SCHOLZ.

MR. FRANK C. RANDALL has joined the Allis-Chalmers Company as district manager for the district of New York, with headquarters in New York city, resigning as vice-president and general manager of the National Electric Company. Mr. Randall has been closely identified for years with the street railway supply interests. His business career began in Boston in the office of his father, who was an importer of special grades of iron and steel. After a few years' experience he took up railroading, becoming first "the performance of engines" clerk, and later chief clerk of the motive department for all divisions west of Willimantic of the New York & New England Railroad. He was afterward chief clerk of the motive department of the Boston & Lowell road, and held this position until the consolidation of the road with the Boston & Maine Railroad. After this he entered the shops of the Tripp Manufacturing Company, becoming expert in the manufacture of electric railway car trucks. He rose to the place of foreman, and later to that of superintendent of the works. He left this position to become eastern sales agent for the J. G. Brill Company, and later was transferred to the West, with headquarters in Chicago. Six years later he accepted the position of eastern sales agent for the Christensen Engineering Company, afterward becoming general sales agent for that company and its successor, the National Electric Company. He then became vice-president and general manager.

MR. FRANK C. RANDALL.

ELECTRICAL SECURITIES.

Although it was frequently predicted that the opening of peace negotiations, the settlement of the life insurance scandal, and the demand by many influential persons that an immediate return be made to old-fashioned, wholesome methods of financiering, would result in a prompt stimulation of stock market activities, the last week's session was probably as dull as has ever been witnessed in recent years. Following a very weak rally in the early part of the week, prices declined to what may be considered, for many securities, the low level of the year. While the present outlook shows little to be expected in the way of activity, the large operators having almost entirely abandoned speculation for the time being, the very fact that there is a condition of slumbering may lead to some rapid manipulation which will considerably change the face of things in a very short period of time. It is to be expected, however, that during the heated period there will not be any very great activity. Attention is now being turned more than ever to the prospects of crop returns, and there apparently is the assurance at hand that the conditions are such as to cause no anxiety, reports from all quarters indicating that all growing things are making the progress that can be expected at this time of the year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 17.

New York:	*Closing.*
Brooklyn Rapid Transit	63⅞
Consolidated Gas	186
General Electric	174
Interborough Rapid Transit	201
Kings County Electric	200
Manhattan Elevated	161¾
Metropolitan Street Railway	122½
New York & New Jersey Telephone	169
Westinghouse Manufacturing Company	180

The regular quarterly dividend of 1¼ per cent is payable July 15 to stockholders of record of the Western Union Telegraph Company as of June 20.

Boston:	*Closing.*
American Telephone and Telegraph	140¼
Edison Electric Illuminating	243
Massachusetts Electric	61¼
New England Telephone	139
Western Telephone and Telegraph preferred	98

American Telephone and Telegraph directors have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ of one per cent, payable July 15. Books close June 30 and reopen July 15.

Philadelphia:	*Closing.*
Electric Company of America	11⅜
Electric Storage Battery common	78
Electric Storage Battery preferred	78
Philadelphia Electric	8½
Philadelphia Rapid Transit	25¾
United Gas Improvement	92½

The directors of the United Gas Improvement Company have declared the regular quarterly dividend of 2 per cent, payable July 15 to stock of record June 30.

Chicago:	*Closing.*
Chicago Telephone	136
Chicago Edison Light	158½
Metropolitan Elevated preferred	64
National Carbon common	62
National Carbon preferred	116
Union Traction common	6
Union Traction preferred	32

At the annual meeting of the Chicago Edison Company officers and directors were reelected.

Digitized by Google

NEW INCORPORATIONS.

LANSING, MICH.—American Electric Company. $2,000.

MESSENA, IOWA—Messena Telephone Company. $10,000.

JEFFERSONVILLE, IND.—Independent Telephone Company. $500.

PEORIA, ILL.—Central Railway Company. Increased from $1,040,000 to $1,250,000.

MONTREAL, QUE.—Bell Telephone Company, of Canada. Increased from $8,000,000 to $9,000,000.

ALBANY, N. Y.—The Depew & Lancaster Light, Power and Conduit Company. Increased from $75,000 to $500,000.

DES MOINES, IOWA—Valley Junction Water and Light Company. $12,000. Incorporators: John Fisher and others.

AUSTIN, TEX.—Columbus Light Company, of Columbus. $10,000. Incorporators: J. W. Towell, Carey and Josiah Shaw.

BUFFALO, N. Y.—The Alden Lighting, Heat and Power Company. $200,000. Directors: Frederick G. Bagley, Alfred L. Becker and D. E. Klein.

OLEAN, N. Y.—Natural Gas, Electric Light, Heat and Power Company, Olean. $50,000. Directors: W. R. Page, F. R. Easton, J. L. Page, Olean.

SPRINGFIELD, ILL.—Home Electric Light and Power Company, Rock Island. $10,000. Incorporators: Robert W. Olmsted, R. S. Dart, E. H. Stafford.

NEW CASTLE, PA.—The Western Pennsylvania Motor Power Company. To build trolley lines in Mercer, Lawrence, Beaver and Butler counties. $10,000.

BUFFALO, N. Y.—The Southern Tier Power and Transmission Company. $200,000. Directors: H. Merton Merrihew, Harrison Williams and Herbert A. Taylor.

NASHVILLE, TENN.—Lenoir City Light and Power Company. $2,500. Incorporators: William Glass, R. M. Calloway, G. W. Strausberry, J. A. Nelson and J. E. Calloway.

JOHNSTOWN, N. Y.—Sacandaga Power Company. $6,000. Directors: William Harris, of Northville; George N. Ostrander, of Albany, and John A. Cole, of Northville.

ALBANY, N. Y.—The Empire State Gas and Electric Light Company, New Rochelle. $50,000. Directors: W. H. Cooper, N. R. Fox, New Rochelle; C. J. Van Slyke, New York.

SAN FRANCISCO, CAL.—The Oceanside Electric Light Company. $20,000. Incorporators: R. H. Fitzgerald, J. T. Boyd, Henry B. Young, J. H. Brenner and J. D. McGown.

LANSING, MICH.—Michigan, Indiana & Ohio Railroad Company, Monroe. To build an electric railway line from Petersburg to Monroe, a distance of five miles. $50,000.

GUTHRIE, OKLA.—Fairview Telephone Company, of Orlando. To operate in Payne and Noble counties. $540. Directors: Wm. D. Gish, Robert Grant and John L. Winkler, of Orlando.

DES MOINES, IOWA—The Valley Junction Water and Light Company. $12,000. Directors: John Fisher, A. H. Van Dyke, John and T. H. Ashworth, all residents of Valley Junction.

MINETTO, N. Y.—Minetto Light, Heat and Power Company. $20,000. Incorporators: Cadwell B. Benson, Minetto, Oswego County; Theodore A. Page, G. Leonard Johnson, Oswego, Oswego County.

MOUNT VERNON, N. Y.—Mount Vernon Telephone Company. To operate telephone lines. $5,000. President, C. W. Mansur; treasurer, R. W. Leighton; clerk, R. W. Leighton; all of Mount Vernon.

BATAVIA, N. Y.—The Genesee County Electric Light, Power and Gas Company, of Batavia. $100,000. Directors: Raymond M. Walker and C. C. Bradley, of Batavia, and Simond B. Storer, of Syracuse.

BINGHAMTON, N. Y.—Tracy Creek Telephone Company. To operate a line from Tracy Creek to Vestal Center, Willow Point, Vestal and back to Tracy Creek, *via* the river road, and also from Tracy Creek to Apalachin, Tioga County. $10,000. Directors: L. A. Mason, George Morton, Alex Webster, B. C. Plough, Fred Wood, F. D. Brummer, Orrin Knight, all of Tracy Creek.

GUTHRIE, OKLA.—Oklahoma Northern Mutual Telephone Company, of Grant County. $1,000. Incorporators: J. W. Thompson, president; C. E. Tibbits, secretary; A. C. Treat, treasurer, all of Hunnewell, Kan.

TOPEKA, KAN.—Jasper County Light and Fuel Company, Pittsburg, Pa.; $25,000. Western Rural Telephone Company, Harper; $600. Glenridge Mutual Telephone Company, St. John; $1,200. Lawrence Electric Light Company, Lawrence; $40,000.

JERSEY CITY, N. J.—Sioux City Service Company. To manufacture, generate and supply electricity and other mechanical power for light, heat, etc. $250,000. Incorporators: Louis B. Dailey, Thomas F. Barrett, B. Stafford Mantz, all of Jersey City.

ALBANY, N. Y.—Upper Hudson Electric and Railroad Company, Newburgh. To operate an electric road twenty-five miles long, from Albany to the village of Catskill. $500,000. Directors: Luke F. Gillespie, Newburgh; Eugene Wolfe, Athens; F. J. Curnick, New York.

PEORIA, ILL.—Central Illinois Interurban Railroad Company. To build a line from Peoria, through Pekin, Havana, Mason City, Springfield, to Lincoln and intermediate points. $5,000. Incorporators: John B. Abbott, Fritz Hendahl, Cande Stone, Paul Enlows, Athos King.

PEKIN, ILL.—Peoria, Pekin & Bloomington Interurban Railway, of Illinois. $100,000. Incorporators: F. E. Seagrave, Toledo, Ohio; Deloss S. Brown, Peoria; Levi Johnson, Danvers, Ill.; Judge Jesse Black, Wm. A. Potts, Walter E. Lautz, Pekin, and E. H. Roberts, of Washington.

RALEIGH, N. C.—The South Atlantic Terminal Company. To construct a railroad from Wilmington to Southport, twenty-seven miles. $1,000,000. Incorporators: D. M. Dougherty, New York; D. W. Bullock, W. J. Bellamy, George L. Morton, C. T. Bennett and J. H. Winston, Wilmington.

AUGUSTA, ME.—Central Railroad of Oregon. Organized at Augusta for the purpose of acquiring, constructing, maintaining and operating a line of railway and telegraph and telephone lines in connection therewith, etc. $2,000,000. Officers: president, J. Berry, of Augusta; treasurer, I. L. Fairbanks, of Augusta.

CARLINSVILLE, ILL.—St. Louis, Litchfield & Eastern Railroad Company. $5,000. Incorporators: J. H. Belt, Jr., president, Bunker Hill; J. E. Kelsey, vice-president, Bethalto; H. R. Budd, secretary, Bunker Hill; C. E. Drew, treasurer, Bunker Hill; W. P. Dickie, Bunker Hill; George A. Klein, Bethalto; A. R. Stansifer, Litchfield.

INDIANAPOLIS, IND.—South Bend Western Railroad Company. To build an electric line to Laporte and absorb the Chicago & South Shore line now operating between Laporte and Michigan City. $100,000. Officers: W. L. Taylor, president; M. P. Reed, vice-president; W. W. Babcock, secretary, and C. G. Lohman, treasurer.

OKLAHOMA CITY, OKLA.—Oklahoma Traction Company. To construct an electric railway line from Oklahoma City to Lexington, Cleveland County, a distance of forty miles. $300,000. Incorporators: C. E. V. Eggleston and S. G. Glasgrow, of Oklahoma City; C. R. Eggleston, of Ft. Smith, Ark.; L. E. Patterson, of Ada, I. T., and L. D. S. Woodson, of Alva.

JEFFERSON CITY, MO.—Oran Electric Railway Company, of Oran. To build an electric road ten miles in length, running from Oran to Rockview, the entire line to be within Scott County. $50,000. Incorporators: M. G. Gresham, George Albert, F. D. Cookey, P. P. Marshall, M. Q. Tanner, J. T. Gittens, W. H. Stubblefield, Jr., W. H. Westcott, Caleb Matthews and M. Helmbacher.

ALBANY, N. Y.—The Jefferson County Gas and Electric Company, of Watertown; $100,000; directors: J. B. Taylor, F. B. Pitcher, B. J. McCarthy, of Watertown. The Otsego Transmission Company, of Oneonta; $40,000; directors: John D. Capron, of Menands; William W. Capron and William H. Smith, of Oneonta. Castleton Light, Heat and Power Company, Castleton; to operate in Schodack, Castleton, East Greenbush and Rensselaer; $25,000; directors: J. D. Smith, T. F. Clifford, F. H. McKnight, of Castleton.

Digitized by Google

TELEPHONE AND TELEGRAPH.

BEVERLY, OHIO—The Farmers' Telephone Company has established a new exchange at Waterford.

ROYALTON, N. Y.—The Bell Telephone Company is making preparations to extend its line from Terry's to Royalton Centre.

TROY, N. Y.—The Hudson River Telephone Company has purchased the business of the Fort Miller Telephone Company, and is extending its lines to Fort Miller.

FLUSHING, N. Y.—A farmers' telephone line will be erected from Palm to Clayton, and in Douglass township a large number of farmers will build a local line.

SHERMAN, TEX.—All indications now point to the early completion of a long-distance telephone connection between Sherman and Gainesville by the independent company.

ST. JOHNSVILLE, N. Y.—The Interstate Telephone Company is about to begin the construction of a rural line from Indian Castle to Fort Plain, *via* the Dutchtown or Fort Willett road.

LENA, WIS.—The Bell Telephone Company has sold its line from Pound to Coleman to the Farmers and Merchants' Telephone Company, of Lena. This gives Lena and Coleman direct communication with Pound.

KANSAS CITY, MO.—The Missouri & Kansas (Bell) Telephone Company has taken out a permit in Kansas City, Kan., for a $3,000 addition to its West office at Sixth street and Armstrong avenue, in that city. The switchboard will be extended the entire length of the new building.

BALDWINSVILLE, N. Y.—The local telephone line extending from Jordan to Baldwinsville is nearly completed, the poles being set to the corporation line. This line will establish connection with the farmers residing at Cross Lake and Plainville. At Baldwinsville connection will be made with the Bell Telephone Company and also the Syracuse & Baldwinsville line.

SIOUX CITY, IOWA—Work has been begun on the construction of the first of the New State Telephone Company's copper toll lines in Sioux City, this being the line connecting Sioux City with LeMars. At LeMars the line will open up a field of several hundred towns in northwestern Iowa, and several thousand telephones to be given connection with Sioux City under the new independent system.

SAN DIEGO, CAL.—Officials of the Home Telephone Company state that construction of lines at Coronado and National City, where applications for franchises have already been made, will commence as soon as material arrives from the east. Long-distance communication with the north by extension from Santa Ana is also to be established, the poles for the lines having already been ordered.

LOS ANGELES, CAL.—The Home Telephone Company, of Los Angeles, which, according to report, is to extend its operations to San Francisco and Oakland, has issued its annual report, in which it is set forth that the surplus after paying operating expenses, interest on bonds and dividends for 1904 is $50,603.27. During this time dividends amounting to over $75,000 were paid on the stock of the corporation.

CANANDAIGUA, N. Y.—The People's Telephone Company, of Ontario County, held its annual meeting recently, and these officers were elected: president, H. W. Blake, Naples; vice-president and general manager, John Litzendorf, Honeoye; secretary, George B. Hemenway, Naples; treasurer, G. R. Granby, Naples; directors, D. O. Pierpont, of Richmond; E. Chapin Church, of Canandaigua and R. B. Abbey, of Richmond.

OLATHE, KAN.—Oscar O. Ayers has sold to F. R. Ogg, an attorney of Olathe, and M. G. Miller, owner of the Bank of Olathe, the Citizens' Telephone Company for $35,000. The Citizens' Telephone Company was organized about five years ago, with Harry B. Walker, of Kansas City, Mo., as its president. Walker sold to Ayers about one year ago for $20,000. Ayers has extended the line and now has 800 telephones in service.

ALBANY, N. Y.—During the current year the Hudson River Telephone Company shows a net gain in stations of nearly 4,000, and the figures at present indicate that the net gain in Albany will be fully a thousand stations before the end of the year, while for the company's entire territory the increase will be more than 8,000. New buildings are being pushed to completion by the company at Saratoga, Newburgh, Rensselaer, Plattsburg, Sandy Hill and Peekskill. It is expected that all will be finished by the early fall.

NASHVILLE, TENN.—As a result of several conferences between the auditors of the Cumberland Telephone and Telegraph Company and the city council committee a reduction of telephone rates is announced. The present monthly rate on business telephones is $7 within a radius of one mile, with $1 for each additional mile; two on party line, $5, and $1 added. The $1 additional will be abrogated under the new schedule and limited call service telephone at $4 per month straight will be added. The present rate on residence telephones is $4, with $1 added for each mile over one. This rate is reduced to $3 flat, and $2.25 for two-party lines, and $2 for four-party lines. The rates apply to all of Greater Nashville. The city is to secure a rate thirty per cent less than the rate charged private parties.

ELECTRIC LIGHTING.

NASHVILLE, TENN.—The Nashville Railway and Light Company has secured a permit to erect a $25,000 power-house addition.

AUBURN, ME.—The Lewiston & Auburn Electric Light Company has been awarded the contract for street lighting in Auburn.

WINSLOW, ARIZ.—Winslow has voted a franchise for an electric light and power plant, and the machinery will be installed at once.

GALION, OHIO—The Crawford Gas and Electric Company has purchased the electric light plant at Crestline, from the Crestline Illuminating Company.

FLORENCE, N. J.—At a recent town meeting an appropriation of $1,925 for lighting the streets was passed. Commissioners were elected to arrange plans.

RUSHFORD, MINN.—A company has been formed to utilize the water power of Root river. It proposes to furnish electric light and power for the manufacturing plants of Rushford.

PITTSTON, PA.—Thomas Dunn, of Wilkesbarre, is forming a new electric light company in Pittston, to supply the city and near-by towns. The company is to be capitalized at $100,000, of which $35,000 has already been subscribed.

KALAMAZOO, MICH.—The Creston Mutual Electric Light, Heat and Power Company has organized with the following officers: president, J. C. Sullivan; vice-president, C. S. Rice; secretary, J. W. Reynolds; treasurer, John Hackett.

VERGENNES, VT.—The Bristol Electric Company has been absorbed by the Lake Dunmore Power and Traction Company. The latter company plans to put two dams in the New Haven river. It also plans to install an auxiliary steam plant. The village of Bristol has authorized the trustees to make a five-year contract with the company for street lights.

CONCORD, N. H.—The contract for enlarging the canal and making the excavation for the addition to the power station of the Concord Electric Company, at Sewalls Falls, has been awarded to Holbrook, Cabot & Rollins, of Boston. The contract for the power-house and equipment is yet to be awarded. The cost of the improvements to be made will aggregate $125,000.

NIAGARA FALLS, N. Y.—The stockholders of the Canadian Niagara Power Company have elected the following directors: W. H. Beatty, W. B. Rankine, A. Monro Grier, K. C., W. H. Brouse and Wallace Nesbit. Officers were elected as follows: president, W. H. Beatty; first vice-president and treasurer, W. B. Rankine; second vice-president and secretary, A. Monro Grier; assistant secretary and treasurer, W. Paxton Little.

CHARLESTON, S. C.—The Charleston Light and Water Company has elected as directors for the ensuing year: P. H. Gadsden, W. C. Miller, W. E. Huger, A. H. S. Post, of Baltimore; G. W. Williams, Morris Israel, and J. S. Keen, Jr., of Philadelphia. At the meeting of the directors, held afterward, the following officers were elected: president, A. H. S. Post; vice-president, P. H. Gadsden; secretary, J. M. Divens; treasurer, Zimmerman Davis.

Digitized by Google

INDUSTRIAL ITEMS.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., will be pleased to send bulletin No. 92, descriptive of the two-plate type chloride accumulator.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., reports a continuance of brisk trade in its "Sunbeam" lamps, the sale of these lamps for this season of the year being unusually large.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is distributing an attractive series of literature calling attention to its National Code fuseless cleat rosettes, porcelain fixture sockets and sign receptacles.

THE NATIONAL BATTERY COMPANY, Buffalo, N. Y., is distributing bulletin No. 1 describing the installation of unit accumulators in the central exchange of the Frontier Telephone Company, of Buffalo, N. Y.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., is distributing bulletins No. 145 and No. 146, describing respectively the S. K. C. type B. O. lighting transformers and a new line of polyphase induction motors.

THE W. E. CALDWELL COMPANY, INCORPORATED, Louisville, Ky., manufactures all kinds of tanks, towers and tubs. The company is calling attention to its products in a thirty-six-page catalogue, which contains a large amount of valuable information.

G. M. GEST, the expert subway contractor, New York and Cincinnati, has been awarded the contract for the construction of a complete underground conduit system for the Montreal Light, Heat and Power Company, Montreal, Canada. Over 1,000,000 feet of conduit will be used.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has issued a catalogue, describing the various types of lifting magnets manufactured by it. A number of different magnets are illustrated, and the various uses to which they may be put are shown.

THE MOLONEY ELECTRIC COMPANY, St. Louis, Mo., has issued two attractive catalogues descriptive of the Moloney high-grade transformers. The construction and performance of these transformers are fully described in these catalogues, which the company will be pleased to send upon request.

THE ELECTRIC COMPANY, Continental Building, Baltimore, Md., has published an attractive booklet entitled "Notes on Electric Service." This comprises a number of verses under the heading "The Tale of the Merry Zephyrs," which introduces to the reader the utility of various forms of electric fan apparatus.

THE F. BISSELL COMPANY, Toledo, Ohio, has shipped to the Van Wert-Fort Wayne extension of the Fort Wayne, Van Wert & Lima Traction Company an order of 2,000 forty-foot seven-inch poles. The company has also filled large orders for Idaho poles at Fort Wayne and Middletown, Ind., and Hamilton and Findlay, Ohio.

THE WHITE SEWING MACHINE COMPANY, Cleveland, Ohio, has issued the *White Bulletin* No. 9, describing the White steam carriage. The bulletin contains a number of interesting articles, among which may be mentioned one entitled "Touring from Savannah to Buffalo," and one entitled "An Impromptu Trip from New York to Chicago."

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., in bulletin No. 44, describes and illustrates representative applications of its back-geared motor to industrial plant service. This is a compact, self-contained device which accomplishes slow speed without the necessity of employing motors designed for slow armature speeds.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Mt. Branch, Pa.; Berwick, Pa.; Fulton, Kan.; Fenton, Iowa; Bowbells, N. D.; Folsondale, Ky.; East Smithfield, Pa.; Elizabeth, N. C.; Washington, N. C.; Oranville, N. D.; Pontiac, Ill.; Macon, Ill.; Chicago, Ill.; Fulton, Iowa.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., in circular No. 13 and circular No. 14, describes, respectively, individual motor-driven machines and the "Interpole" variable-speed motor. The company is rapidly increasing the scope of application of "Interpole" variable-speed motors, and these bulletins present some very interesting matter concerning the characteristics and performance of this apparatus.

THE NEWTON MACHINE TOOL WORKS, INCORPORATED, Philadelphia, Pa., has issued catalogue No. 41, describing the rotary planing machine built by it. The catalogue takes up a number of machines varying in size from twenty-six inches to ninety-six inches, and also a number of special machines, including vertical spindle rotary planing machines, roll-cutting machines, slabbing machines and cold saw cutting-off machines.

THE PRATT & WHITNEY COMPANY, Hartford, Ct., is calling attention to its new twelve by forty-eight thread-milling machine. This is being done by means of a unique mailing card, which is made in the form of a shallow box. The cover of this box may be lifted, exposing a folder upon which is delineated some of the work done by this machine. The company claims that the machine will mill spiral gears, worm threads, screw threads, etc., quicker and more cheaply than they can be made on a lathe.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., announces that it is enjoying large sales of its single-phase, self-starting motors. During the month of May, 1905, the sales exceeded the total sales for the year 1904. The motors are built in sizes of one-half to five horse-power, sixty cycles, but are also wound for any other commercial frequency. The company also reports a heavy increase in the demand for its alternating-current ceiling fans, the factory being at present taxed to supply the demand.

THE CINCINNATI MILLING MACHINE COMPANY, Cincinnati, Ohio, has issued a book entitled "A Treatise on Tool Room Grinding and Grinding Machines." The book consists of two parts, treating, respectively, of the No. 1 "Cincinnati" universal cutter and tool grinder, and the No. 2 "Cincinnati" universal cutter and tool grinder. The book contains descriptions and illustrations of the various machines built, together with illustrations of the work done by them, and directions for their operation.

THE ELECTRICAL TESTING LABORATORIES, Eightieth street and East End avenue, New York city, is distributing a booklet descriptive of standard lamps used as secondary standards of candle-power. The Electrical Testing Laboratories has issued about 1,000 lamps for use as secondary standards of luminous intensity. These lamps are in the hands of colleges, consulting electrical engineers, lighting companies, lamp manufacturers and photometrists in general. They include standards ranging from miniature lamps to 150-candle-power lamps, and have given universal satisfaction.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., has issued a treatise on the use of sulphate of iron and copper in water purification. This is a subject which has recently attracted a great deal of attention, the remarkable success which has been attained by the use of sulphate of iron and copper in water purification and in reducing the liability of typhoid epidemics having occasioned a great many tests by eminent scientists and physiologists. The treatise contains the reports of the United States government experts on experiments conducted at Anderson, Ind., in February, 1905.

THE CANADIAN WESTINGHOUSE COMPANY, LIMITED, Hamilton, Ontario, will equip the Windsor & Tecumseh Electric Railway with 300-kilowatt, 3,300-volt Westinghouse single-phase, engine-type generators direct-connected to Robb-Armstrong engines. The car equipments will consist of two fifty-horse-power Westinghouse single-phase motors each. This will be the first single-phase road in Canada, and its development will be watched with considerable interest. The Chatham, Wallaceburg & Lake Erie Railroad Company is building a new line from Chatham to Wallaceburg a distance of about twenty miles. The Canadian Westinghouse Company, Limited, will also furnish the material for this road, having received an order for four double equipments and one quadruple equipment of No. 101 railway motors. Another contract received by the Westinghouse company is that for furnishing two 6,400-kilowatt, three-phase, 2,400-volt generators with motor-driven exciters and switchboard apparatus, and four 3,200-kilowatt, oil-insulated, water-cooled, step-up transformers for the Hamilton Cataract Power, Light and Traction Company, for additions to its power plant at De Cew Falls.

Digitized by Google

Digitized by Google

Digitized by Google

YH 01850

356156

Electrical.
TK1
E48

Engineering
Library

UNIVERSITY OF CALIFORNIA LIBRARY

Digitized by Google

Digitized by Google